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The Differentiation and Integration of Information Technologies: Three Empirical Studies on `Bring Your Own Devices'

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Abstract

This dissertation examines how the management and configuration of organizational IT portfolios enhance organizations and their employees. Specifically, the theory of the differentiation and integration of information technologies is developed with in-depth examinations of "Bring-Your-Own-Device" (BYOD) policies. Four data collections are utilized: survey vignettes, case studies, agent-based simulations, and a questionnaire survey. Each essay uses a mixed-method approach providing insights into the selection, development, and management of ITs across individual and organizational levels.

Essay 1 explores the impact of BYOD on employees' performance, job satisfaction, and work-life conflicts. The results indicate that IT integration improves performance and job satisfaction, and reduces work-life conflicts. Alternatively, IT differentiation increases work-life conflicts while having no direct impact on performance or job satisfaction. However, the impact of IT differentiation is enhanced when increased IT integration is present in the organization's IT portfolio which in combination provides variety for individuals while ensuring reduced compatibility issues across employee tasks.

Essay 2 examines how organizations can configure their IT portfolios over time to meet the demands of varying task portfolios. The results provide insights into optimal levels of IT differentiation and IT integration for varying environments. Increased IT differentiation allows employees to utilize more efficient and effective technologies to meet their specific tasks. However, an increased level of IT integration is needed to meet the additional compatibility concerns arising from this IT differentiation.

Essay 3 examines how individual decision-making behaviors and organizational IT policies impact the configuration of IT differentiation and IT integration. A combination of online survey vignettes, agent-based simulations, and a questionnaire survey provides insights into how individuals and organizations can impact the IT portfolio over time. The results indicate that the claimed benefits of BYOD may not materialize unless the employees are choosing their provided technologies based on rational decisions.

This dissertation finds that BYOD polices may increase productivity and satisfaction for employees and organizations. However, organizations must ensure they examine their task portfolio, employee technology needs and knowledge, and IT policy attributes to ensure BYOD is the right solution. The results provide organizations increased knowledge to ensure increased performance from their IT decisions.

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Chapter 1: Introduction

Which information technologies (ITs) should be used within an organization to achieve the maximum level of performance? This is a seemingly simple question, yet one with a plethora of potential answers from many differing perspectives. Determining the most effective and productive technology investments for employees to utilize within the organization has been a question posed for decades. Debates have focused primarily on who should be making the decision to select, adopt, and use various ITs within the organization, such as a centralized IT department or those closest to the problems and requirements, i.e., the users (Brown and Grant 2005). Despite the utilization of various IT governance structures, organizations struggle with developing IT portfolios that allow their employees to increase their productivity and satisfaction. Despite the extensive research on ***who*** should be making the IT purchasing decisions within the organization, there is a lack of in-depth research on ***what*** an organization should be implementing, what ***configuration*** of ITs an organization should implement, and ***how*** these implementations affect performance over time.

"Bring-Your-Own-Device" Phenomenon

Organizations have traditionally had significant control over the type and number of ITs that are introduced within the organizational IT portfolio, and thus influenced the distribution and adoption of organizational technologies. More recently, with the advent and accelerated adoption of mobile phones and tablet computers, organizations are increasingly allowing employees to use their own personal devices on the job for a variety of tasks. This concept of allowing individuals to use their ***own*** devices and technologies to access, use, and complete tasks within their organization is typically referred to as Bring-Your-Own-Device initiatives (BYOD; Willis 2012).

BYOD initiatives have recently seen a surge of activity within public, private, and even government organizations (CIO Council 2012a, 2012b). This has led to firms increasingly developing policies for managing BYOD. Whereas five years ago most organizations had no BYOD policy, the proportion of organizations with formal support of BYOD policies rose to 60 percent in 2011 and to 76 percent in 2012 (Good 2012, 2013)[a]. Many organizations implementing BYOD policies now allow individual employees to select, purchase, and maintain their own technologies within the organization with the expectation of reduction in costs, increased satisfaction, and higher productivity of employees (Unisys 2012; Willis 2012). This recent emergence of the BYOD phenomenon is driven largely by the consumerization of IT, which has led to the speed, adoption, and evolution of consumer technologies matching or exceeding those of organizational IT. Additionally, the ITs that are utilized by consumers are now much closer to those deployed by organizations in today's IT environment (Willis 2012). Many individuals even believe they possess better IT at home than the organization provides (Forrester 2012) which is a sweeping shift from prior generations.

Even if a formal BYOD policy does not exist within the organization, many employees still utilize their personal mobile phones to reach out to work contacts or install their own applications on corporate computers to aide in their tasks without the knowledge of IT departments (Unisys 2012). The current focus of BYOD is on physical devices, although the ability to bring your own applications, collaboration systems, and support is increasing as well (Delacour 2012). In a recent survey, 75 percent of firms prohibit employee-installed applications and list them as grounds for termination despite the fact that 38 percent of employees admit using them (Forrester 2012). As a shift from prior organization-driven initiatives, BYOD is typically an employee-driven process and as such employees are likely to purchase technology

[a] Sample organizations range from 500 to 20,000 employees across 13 industries (Good 2013).

with their own money, use their personal computer, and convince their boss or company to purchase technology to help in their own organizational tasks (Unisys 2012).

> *"People will solve problems executives cannot see. Allowing people to bring their own devices to work will unlock their potential. - David Johnson" (Saran 2012)*

A series of potential benefits of BYOD policies have been identified such as reduced maintenance costs, higher employee productivity, and increased employee satisfaction (Unisys 2012; Willis 2012). In addition to these benefits some potentially significant problems have been as observed as well such as data security, lack of support for novel technologies, control over the employee-owned devices, and compatibility with existing architectures (Casey 2012; Kaneshige 2012). Employees are now able to select which technologies to utilize to improve their own performance within their organizational tasks, yet the interdependent nature of an organization requires that employees' tasks also be integrated together to complete larger organizational tasks. Therefore, while employees may focus their selection of technologies on their own benefits, organizations need to monitor and manage this adoption to ensure the ability to integrate information and ITs together between individuals working on organizational tasks. This management through various BYOD initiatives and policies is needed to ensure increased productivity for both individual and organizational tasks as well.

While most of the common concerns with BYOD policies involve increased security risks and the lack of organizational control of IT (Casey 2012) a significant cost has been potentially overlooked. The fact is that while BYOD policies allow employees to utilize their own devices which they are most proficient at, eliminating the need for training costs and increasing their individual productivity, the outputs generated by individual employees typically need to be shared with others across the organization. This need for sharing and integration between individuals indicates the necessity for ITs to be able to interact seamlessly to complete *interdependent* tasks. A lack of communication between individuals and ITs can lead to complete task failure despite individual productivity.

Consider a hypothetical example, an organization built primarily on Microsoft products decide to introduce a BYOD policy, which allows their employees to adopt Apple products for their work. Individuals using Apple products are able to open and utilize many of the file formats present in the Microsoft environment due to built-in file conversions. Alternatively, items generated in the Apple environment may be less likely to transfer back to the Microsoft environment as easily, creating integration and communication problems. While the employee utilizing the Apple product is more productive and efficient in his or her *own* tasks, when completing *interdependent* tasks the integration with additional technologies of their co-workers is a critical stepping stone to achieve successful outputs of larger, organizational tasks.

As BYOD policies potentially provide an increase in employee productivity they may also limit the growth of organizational knowledge about specific ITs across the organization. The identification and dissemination of the technologies and applications that are being utilized successfully by employees throughout the organization is critical in providing increased productivity support not only to the focal individual but others throughout the organization as well (Kendrick 2012). If the organization is unaware of a technology that is successful in a task, it cannot be recommended and provided to others throughout the organization who may share similar tasks. Therefore, although BYOD can have significant benefits, they need to be paired with a combination of policies, software, infrastructure monitoring, and controls to see organization-wide success (Willis 2012). In the face of surveys and studies examining the extent of BYOD within industry, organizations are still struggling with BYOD due to a lack of clear policies and procedures for success (Hamblen 2012).

With the ability for individuals to select their own technologies, the sheer number of alternative technologies and corresponding level of variety of ITs within the organizational IT portfolio expands immensely. The use of policies such as BYOD allows individuals to select the most beneficial technology for *their* own unique tasks based upon the requirements of their relevant task environment. However, when each individual within the organization is utilizing a different technology the potential emerges for both coordination and communication problems due to technologies that may lack appropriate integration capabilities. Thus, a paradox exists such that allowing IT variety may increase individual performance and success while simultaneously increasing the potential for problems at the group and organizational level when attempting to integrate interdependent tasks. This leaves us to question as to ***how should organizational IT portfolios be configured to provide the best performance to individuals and organizations through variety while simultaneously addressing the potential for integration problems?*** This dissertation, organized as three essays, attempts to address these gaps in this issue by expanding upon the prior literature, which has examined this paradoxical nature of variety and integration in a variety of fields and phenomenon, and to provide insights into the potential recommendations for IT portfolio configurations.

The Four Data Collection Efforts

The dissertation is based on four data collection efforts: online survey vignettes, organizational case studies through employee interviews, agent-based simulations, and a survey questionnaire. A focal part of the dissertation is the development of the theory of the differentiation and integration of information technologies (T-DINIT) through mixed-method designs consisting of *qualitative and quantitative* data collections. To obtain insights within a real world context, a series of online survey vignettes and organizational case studies are conducted. First, 159 online survey vignette responses are gathered to capture individual decision making processes used when making technology decisions as the basis for the agent-based simulations. Next, 22 employee interviews are conducted across three organizational case studies to provide rich insights into the management of IT within the organization, specifically in regards to BYOD policies.

Third, a series of contingency factors are investigated by empirically modeling the environment with agent-based simulations and examining how various IT portfolio configurations, organizational task characteristics, organizational IT policies, and individual decision making models affect optimal outcomes within the organization. The individual interviews are conducted both before and after the start of the simulation development to both inform and validate the agent-based simulation. Lastly, the insights from the case studies and simulations are further explored and validated through a quantitative analysis of 497 individual-level surveys of employees within various organizations.

The Three Research Essays

While each essay introduces a unique data collection, all three essays are based on a mixed-method approach with two or three of the above four data collections efforts used to address the proposed research questions.

Essay 1 benefits from the use of organizational case studies and individual-level surveys to focus on the following research question depicted in Figure 1.1:

> *(RQ1) How does the configuration (IT differentiation and IT integration) of organizational ITs affect outcomes associated with individual employees?*

[See Figure 1.1.]

While Essay 1 focuses on identifying the impacts of IT integration and IT differentiation, on a series of employee outcomes at ***one point in time***, the impact of the organization's IT portfolio on performance and effects on each other over time and in varying organizational environments are specifically examined within Essay 2. Essay 2 incorporates the effects of various organizational task characteristics and time on the performance within the organization. This essay benefits from the use of a single case study in conjunction with agent-based simulations to examine changes in IT integration, IT differentiation, and performance ***over time*** and address the following two research questions depicted in Figure 1.2:

(RQ1) How does the organizational IT portfolio affect performance over time?
(RQ2) How does the organizational IT portfolio moderate the effects of the organizational task portfolio on performance?

[See Figure 1.2.]

Finally, Essay 3 further extends the examination of IT differentiation and IT integration by exploring two antecedents: individual decision making models and organizational IT policy attributes. The studies further explore the effect of the organizational IT portfolio on performance while simultaneously taking into account the role that (a) individual decision making models and organizational IT policies have on influencing the configuration of the IT portfolio, and (b) examining the moderating effect of the organizational IT policy on the relationship between the organization's IT portfolio and performance. Essay 3 benefits from the use of online survey vignettes, agent-based simulations, and a quantitative survey questionnaire to address the following four research questions depicted in Figure 1.3:

(RQ1) How does the organization's IT portfolio influence organizational performance?
(RQ2) How do individuals' IT decision-making behaviors influence the organization's IT portfolio?
(RQ3) How do organizational IT management policies influence the organization's IT portfolio?
(RQ4) How do organizational IT management policies moderate the influence of the organization's IT portfolio on organizational performance?

[See Figure 1.3.]

Thus, Essay 1 focuses on the effects of IT differentiation and IT integration on individual-level outcomes, and examines how these effects vary across different outcome measures. By contrast, both Essays 2 and 3 focus on organizational performance. However, Essays 2 and 3 differ in their foci and research questions. Whereas Essay 2 focuses on how the portfolios of ITs and tasks affect organizational performance, Essay 3 examines the effects of individual decision-making models and organizational policies on IT differentiation, IT integration, and organizational performance.

Each of the three essays use two or three of the data collections for a mixed method approach. Table 1.1 summarizes the aspects that are used for each essay to address the relevant research questions. While there is some overlap in the use of each data collection, each essay utilizes different aspects of each data collection due to the differences in the research questions and units of analyses.

[See Table 1.1.]

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Chapter 1. Tables and Figures

Figure 1.1. Essay 1 Research Model

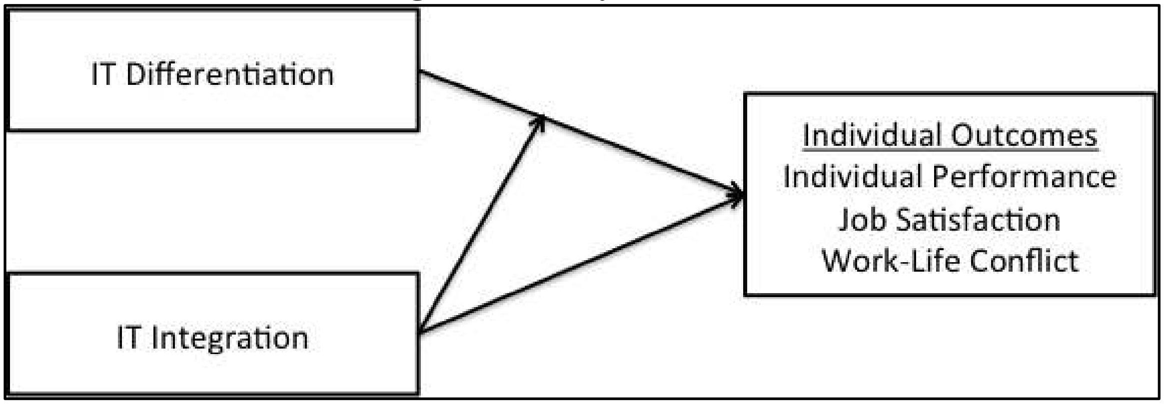

Figure 1.2. Essay 2 Research Model

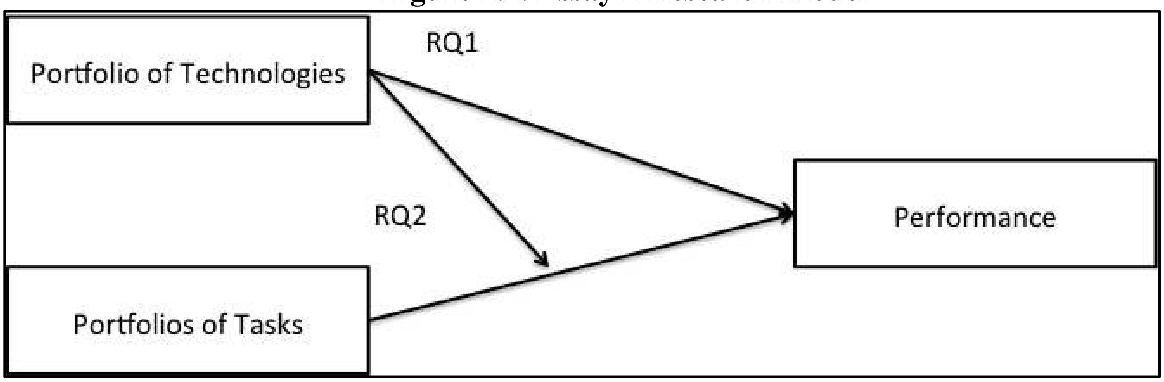

Figure 1.3. Essay 3 Research Model

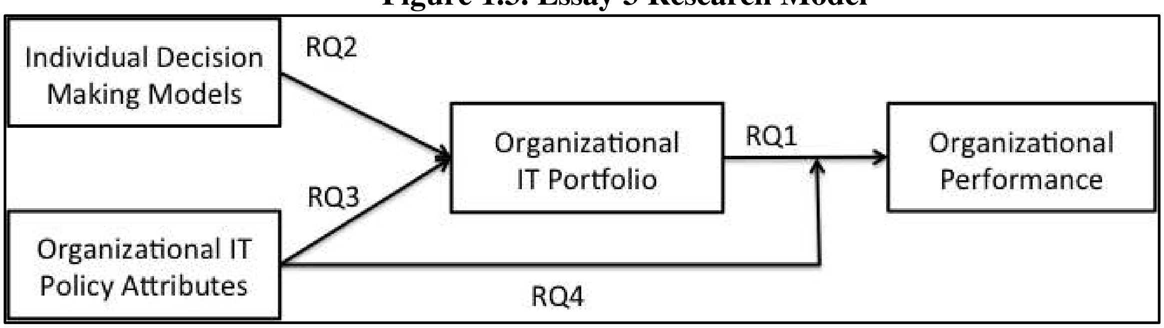

Table 1.1. Dissertation Data Collection Overview

	Essay 1				Essay 2				Essay 3			
Constructs	Case Studies and Interviews	Agent-based Simulation	Survey Questionnaire	Online Survey Vignettes	Case Studies and Interviews	Agent-based Simulation	Survey Questionnaire	Online Survey Vignettes	Case Studies and Interviews	Agent-based Simulation	Survey Questionnaire	Online Survey Vignettes
IT Differentiation	X		X		X	X				X	X	
IT Integration	X		X		X	X				X	X	
Organizational Performance					X	X				X	X	
Individual Performance	X		X		X	X						
Job Satisfaction	X		X									
Work Life Conflict	X		X									
Task Variety					X	X						
Task Complexity					X	X						
Task Interdependency					X	X						
Individual Decision Making Models - Selecting Behavior										X	X	X
Individual Decision Making Models - Switching Behavior										X	X	X
Organizational IT Policy Attributes										X	X	

Chapter 2. The Differentiation and Integration of Information Technologies: The Impact of "Bring Your Own Device" Policies on Employees

Introduction

Recent literature has emphasized understanding ways in which information technology (IT) can provide performance benefits (Melville et al. 2004; Kohli et al. 2012). This literature provides important insights into the significant beneficial impacts that IT investments can have on both employees and organizations, such as increased productivity, satisfaction, and performance. In addition, organizations have been provided directives regarding the strategies and policies for managing the organizational IT portfolio (Wade and Hulland 2004; Chen et al. 2010). Academic debate on IT strategies has focused on ***who*** in the organization should be making the decisions to select, adopt, or use various technologies, such as a centralized IT department, which has the most IT expertise, or the users, who are closest to the problems and requirements (Brown and Grant 2005). Despite the discussion of such IT governance structures, organizations struggle to identify the IT portfolios that would increase productivity and satisfaction (Sykes et al. 2014).

Prior research has examined aspects such as: (a) who should make the strategic IT decisions (Brown and Grant 2005); (b) how and when should those strategic decisions be made (Sabherwal and King 1995); and (c) how the IT strategy should relate to the rest of the organization (Bharadwaj et al. 2013). However, in the face of extensive research on ***who*** should be making the IT decisions in the organization, there is a lack of in-depth research on ***what*** an organization should be implementing, and ***how*** these ITs can and should relate to each other.

Thus, despite a strong consensus that IT can provide a competitive advantage to the organization, the selection of ***what combination of technologies*** to implement has proved problematic. The most effective and productive technology investments for employees to utilize within the organization has been a question posed for decades by organizations (Hitt and Brynjolfsson 1996; Black and Lynch 2001). "Which set of ITs should be an organization use to achieve the best performance?" is a seemingly simple question, but with conflicting answers from numerous perspectives.

With the exponential growth of IT capabilities, organizations implement new ITs at a rapid pace seeking to increase their ability to respond to the current information-intensive and rapidly changing environment (Gartner 2014). They focus on implementing flexible IT infrastructures to develop the ability to meet these ever-changing requirements (Byrd and Turner 2000, 2001; Bush et al. 2010). IT flexibility is "the ability to easily and readily diffuse or support a wide variety of hardware, software, communications technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of existing IT infrastructure (Byrd and Turner 2000, p.172)." An approach that organizations can take to increase the flexibility of their IT infrastructure is by increasing the variety, or ***differentiation***, of ITs to handle various tasks, along with the subsequent ***integration*** of those ITs within the organizational IT portfolio (Tallon and Pinsonneault 2011).

Despite the initial evidence supporting the benefits of IT investments and IT flexibility, we lack insights into the configurations of IT portfolio needed to achieve a flexible IT infrastructure. For example, does a $1 million investment in a single IT provide the same level of benefits as a $1 million investment in three different ITs? Additionally, are there instances where these different ITs can work in isolation or do they need to be integrated or coupled (Orton and Weick, 1990) to provide the intended benefits? Under what environmental conditions would each approach be better than the other? Although prior research has examined the attributes of the IT infrastructure (i.e., IT flexibility) organizations should strive for (Byrd and Turner 2000), IT decisions have been viewed as individual decisions with little insights into how organizations can determine the need for differentiating their IT infrastructure or achieve its subsequent integration.

Thus, despite the insights research has provided into the organizational and governance structures for the management of IT architectures, less attention has been given to the selection of the ***configuration*** of ITs to be implemented in the organization, and ***how*** ITs are ***integrated*** with each other. Building on the theory of differentiation and integration within the management literature (Lawrence and Lorsch, 1967a), this essay provides insights into the literature on the management of IT. While prior theories of differentiation and integration in information systems (IS) research focus on IT governance, IT management structures, and organizational structure, the proposed theory departs from this traditional approach to conceptualize the relationships among ***actual*** ITs within an organization's IT portfolio. Through the development of the theory of the differentiation and integration of information technologies (T-DINIT), this essay provides insights into the selection, development, and management of ITs in the organization. This essay focuses on the following research question to develop and test the T-DINIT theory:

> *How does the configuration (IT differentiation and integration) of organizational ITs affect outcomes associated with individual employees?*

This essay adopts a multi-study approach to address this research question by developing T-DINIT through a combination of qualitative and quantitative data that provides insights into the intricacies of IT portfolio management and configuration in the organization. Study 1 uses in-depth qualitative interviews with 22 employees to obtain insights within a real world context. Study 2 elicits responses from 497 organizational employees through a survey questionnaire to validate and refine the T-DINIT theory. This mixed-method approach (Venkatesh et al. 2013) enables the development (using case studies) and testing (using surveys) of T-DINIT, and provides insights into the management and impacts of organizational IT portfolios.

The rest of this essay is organized as follows. In the following section, the theoretical basis for this essay, the theory of differentiation and integration (Lawrence and Lorsch, 1967a), is adapted to an organizational IT environment to begin the development of the T-DINIT theory. The methods for the qualitative data collection and analysis using employee interviews in Study 1 are then described, followed by the resulting insights into the theoretical research model. The subsequent section describes how the resulting research model is empirically tested in Study 2 through survey data from employees across multiple organizations. The results and findings of Study 2 are then discussed. The essay concludes with a discussion of the implications of its results for research and practice, limitations, and directions for future research.

Theoretical Foundations

Considerable prior research has investigated the configuration, design, and implementation of organizational structures to enhance performance of organizations, teams, and individuals (Ancona and Caldwell 1992; Jansen et al. 2009). A prominent perspective in this arena is the theory of differentiation and integration (Lawrence and Lorsch 1967a, 1967b). Over the past 47 years, this theory has seen continued use across multiple research disciplines, with a significant recent increase[b]. Lawrence and Lorsch's (1967a) original book has been cited 10,568 times with the corresponding journal article (1967b) being cited 2,160 times[c]. Their conceptualization focuses on two complementary states of organizational assets – differentiation and integration – which, when matched to the environment, produce superior organizational performance.

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[b] Verified through citation analysis within Web of Science.
[c] Google Scholar results as of 3/5/2014.

Lawrence and Lorsch (1967a) proposed an alternative approach from prior organizational theories by starting at a higher level, the organization, as the primary unit of analysis instead of the individual actors, with *organization* being defined as "a system of interrelated behaviors of people who are performing a task that has been differentiated into several distinct subsystems, each subsystem performing a portion of the task, and the efforts of each being integrated to achieve effective performance of the system. (Lawrence and Lorsch 1967b, p. 3)." The construction of the organization in this perspective is through a set of subsystems (e.g., sales, manufacturing, shipping) that perform individual tasks to pursue larger organizational goals. This division of labor is the focal concept of *differentiation* within the organization. As depicted in Figure 2.1, the organizational processes are distributed across multiple sub-units, which perform their own tasks to pursue a higher, unit-level organizational task.

[See Figure 2.1.]

Differentiation has been defined as "the state of segmentation of the organizational system into subsystems, each of which tends to develop particular attributes in relation to the requirements posed by its relevant external environment" (Lawrence and Lorsch 1967b, pp. 3-4), and as "the process of dividing the organization into groups that deal with different components of the organization's external environment (Blanton et al. 1992, p. 533)." This recognizes the need for complex organizational to be "departmentalized" to enable individuals or departments to know their specific roles and not expect to perform "anything at any time" (Dougherty 2001).

Differentiation enables organizational sub-units to focus on and respond to specific aspects of the external environment, but the accomplishment of organizational goals; especially those with interrelated tasks also require an increased level of integration between the sub-units. This concept of *integration* has been defined as "the process of achieving unity of effort among the various subsystems in the accomplishment of the organization's task p. 4)," and as "the process of coordinating the interrelated activities of these groups in order to obtain unity of effort (Blanton et al. 1992, p. 533)."

Successful organizations achieve high levels of differentiation to respond to a variety of external environmental conditions while simultaneously ensuring high levels of integration between the subsystems to achieve coordination of effort. However, an inverse relationship exists between the level of differentiation and the ***effectiveness*** of the integration within the organization (Lawrence and Lorsch 1967a). More specifically, as the number of differentiated subsystems increases, the ability to integrate across them decreases due to the differences in procedures, goals, and interpretations. Therefore, to enhance organizational performance, differentiating subsystems within the organization while integrating them is crucial.

Integration is achieved through various *integrating mechanisms* that "serve in resolving conflict and achieving integration under various external environmental conditions (Lawrence and Lorsch 1967b, p. 12)". More specifically, the selection of a set of integrating mechanisms is critical for effective integration within the organization (Blanton et al. 1992; McCann and Ferry 1979). Thus, successful organizations are those that achieve increased levels of differentiation to meet environmental demands, with a corresponding level of integration to ensure the unity of efforts, through the use of a set of integrative mechanisms.

Lawrence and Lorsch's (1967a, 1967b) theory of differentiation and integration has also been recognized and used within the IS literature on concepts such as IT governance (DeSanctis and Jackson 1994), data integration (Gattiker and Goodhue 2005; Goodhue et al. 1992), and the impact of IT organizational structure on IT support effectiveness (Blanton et al. 1992). This study builds on the original foundation of differentiation and integration, adapting it to provide insights into the management of IT portfolios across the organization, and also on the prior IS literature that has used the differentiation-integration perspective. Whereas this literature has focused primarily on the structuring of the organization, team, or individual to achieve varying levels of differentiation and integration, the specific ITs have not been considered. Instead, this research utilizes a bottom-up approach of IT use (Nan 2011) by focusing on the actual differentiation and integration of ITs within the organization.

This theoretical development utilizes both a social and technical view of integration to provide a more holistic view towards how IT is selected, managed, and appropriated within the organization (Waring and Wainwright 2000). For example, while individuals may be divided across the organization into various sub-units (e.g., departments, groups, teams) they may still share a single IT (e.g., ERP) that is consistent across the entire organization. Therefore, from an IT perspective, this scenario presents a low level of differentiation with increased levels of integration between the few technologies. Alternatively, some sub-units, such as R&D departments, may utilize their own technologies in a highly decentralized IT management structure with limited integration across the organization.

To focus differentiation and integration within the organization on both the actual ITs utilized in the organization and the corresponding organizational structures, this essay adopts the following approach. Building upon the prior definitions of differentiation, **IT differentiation** is defined as the *organization's* level of IT variety between the *individuals'* or *sub-units'* IT portfolios. The adoption and utilization of ITs by each individual or sub-unit are typically selected in relation to the requirements posed by their relevant tasks and external environments. Similarly building on prior theory, **IT integration** is defined as the level of coordination of effort among the *individuals'* or *sub-units'* IT portfolios within an *organization's* IT portfolio.

The achievement of IT integration within the *organization's* IT portfolio is through the use of **integrative IT** and **integrative mechanisms** (e.g., procedures, processes, and policies) that facilitate the collaboration, coordination, and communication between the various ITs in an *organization's* IT portfolio. For example, joint selection committees and IT purchasing policies to determine which ITs should be utilized for a specific task within the organization are integrative mechanisms. Also, integrative ITs are specific technologies that are used to enable the conversion, coordination, and communication between two or more specific ITs. For example, software plug-ins that helps open and save alternative file formats is an integrative IT.

The need for differentiation within the organization is based on the notions of uncertainty and variety within the environment. Consider, for example, two individuals within the organization who are completing the same task, yet utilizing different ITs to do so. Each IT has its own costs and benefits but is selected by the individual due to their experience and satisfaction with the technology. Figure 2.2 depicts a set of potential scenarios that may occur based upon the possible variations in the inputs (external ITs), throughputs (individual ITs), and outputs of the focal task.

In scenario A, the two individuals are given a single file format from the external IT to use for the task. The first individual utilizes Microsoft Office as their individual IT for the task and can successfully produce a quality file. However, the second individual utilizes OpenOffice.org as individual IT. The functionality needed to open the specific file format from the external IT is therefore unavailable to the second individual, leading to a sub-optimal output. Thus, despite the same input from the external IT, the variation in individual ITs creates a variation in task output.

Scenario B provides a situation where both individuals are utilizing the same individual IT, or equivalently, only one individual is performing the task. In this scenario, the individual receives two *different* file formats from the external IT to use in the task. Utilizing Microsoft

Office as their individual IT, the individual is able to complete the task and generate an adequate output for File 1, similar to scenario A. However, the format of File 2 is not a native Microsoft Office file and the details of the file are lost during conversion, leading to an inadequate output. In this scenario, the individual is unable to deal with the variation in the inputs from the external IT due to the use of a single individual IT, which causes a variation in outputs.

Finally, scenario C is potentially optimal. Here, both individuals utilize differing ITs and the task receives differing inputs from the external IT. Both individuals may attempt to process the external IT inputs of both File 1 and File 2 utilizing their respective individual ITs and generate some output for both. However, in this scenario, the first individual is able to create an adequate output for File 1 while the second individual creates an adequate output for File 2. Despite the inadequate files that may be created, the individuals would hopefully select the “best” individual IT and subsequent output for the completion of the task. Therefore, in this scenario, the variation in inputs from the external IT was met with adequate variation in the individual ITs to regulate the variations in outputs. This is the essence of the law of requisite variety which states that the only way to reduce variation in outputs is to address the variation of inputs with a similar level of variation in throughputs such that “only variety can destroy variety” (Ashby 1958, p. 207).

[See Figure 2.2.]

In this example, each individual is working on his or her own, independent sub-tasks within the organization. In instances where both individuals must work together, their choices of IT used to complete their individual tasks become critical in predicting the performance in larger, organizational tasks. If both individuals utilize the same technology, the ability to share their outputs between each other is high, however, if each utilize a different technology there is the potential for significant collaboration issues due to a lack of integration. Therefore, while a level of IT differentiation may benefit the individual, IT integration must be configured and monitored to ensure organizational performance as well.

Study Context

Organizations have traditionally had significant control over the number and type of ITs that are introduced within the organization's IT portfolio, and thus influenced the distribution and adoption of ITs across employees. More recently, with the advent and accelerated adoption of mobile phones and tablet computers, organizations have increasingly allowed employees to utilize their own personal devices at work for a variety of tasks. This concept of allowing individuals to utilize their ***own*** devices and technologies to access, use, and complete tasks within their organization is called Bring-Your-Own-Device initiatives (BYOD; Willis 2012).

Study 1

The introduction of policies such as BYOD is a stark contrast to the prior strategies to utilize a unified IT or purchasing policy throughout the firm to ensure communication and consistency. With the evolution of BYOD policies in organizations, the way that organizations select, adopt, and continue to use ITs has changed. This limits the relevance of insights from prior literature, and necessitates an in-depth exploration of the phenomenon through exploratory approaches such as case studies or interviews (Seidel et al. 2013; Dubé and Paré 2003). Accordingly, we conducted interviews explore an in-depth exploration of multiple organizations that use different approaches to manage IT differentiation and IT integration through BYOD policies.

Methods.

Study 1 explores the various organizational policies and strategies used to manage organizational IT portfolio, specifically in the context of BYOD, and their impacts on employees. Utilizing a multiple case study approach (Eisenhardt 1989), with within- and cross-case analyses (Miles and Huberman 1994), this study attempts to provide insights into this emergent context that has seen little prior research.

The sample for this study includes three organizations located in the Midwest United States. Organizations were approached based on their interest and use of BYOD policies in various stages to provide some variety in IT management contexts across the cases. Organization REC is a multi-national online and brick-and-mortar retailer supporting a large employee workforce. Organization TEC is a large IT infrastructure provider that supports REC and many other Fortune 500 companies in their technology needs. Organization GOV is a state-level IS department providing services to state, county, and city agencies for their day-to-day tasks.

Data collection.

Data for the case studies was collected primarily through 22 interviews with employees at the three organizations. Table 2.1 provides background information about the informants. Prior to the interviews, the research design and interview protocol were validated, and organizational support for the study was obtained through three pilot interviews with organizational IT users, two research presentations to a board of IT executives from multiple organizations, and a collaboration meeting with two of the organizations in this study.

[See Table 2.1.]

Each interview was conducted on-site, except three via video conferencing due to employee availability, to explore the IT management policies and procedures, specifically in regards to BYOD, utilized within each organization, the level of differentiation and integration of ITs across individuals in the organization, and the expected impacts on employees. In-depth interviews were conducted with both senior executives (e.g., COO, CFO, CSO) and front-line employees (e.g., call center employees, account managers) to obtain a breadth of perspectives. Interviews ranged from 28 to 100 minutes for a total of 884 minutes. Interviews were conducted at each organization for about a week. A semi-structured interview protocol (given in Appendix A) was used to ensure that specific aspects were explored while leaving room for additional information and attributes to emerge during the interviews (Wengraf 2001). During each interview, an attempt was made to capture both organizational and individual perspectives on the issues, opportunities, and outcomes related to the organization's BYOD initiatives.

In addition to interviews, a set of objective data was collected from internal organizational resources (e.g., software install listings, technology usage reports, formal policies, implementation presentations). The use of both objective organizational reports and employee perceptions allow for the cross-validation of the data sources to develop a more accurate view of the organizational reality (Eisenhardt 1989; Mason et al. 1997).

Analysis.

A variety of techniques were utilized to categorize, visualize, and analyze the qualitative data. They included approaches recommended by Miles and Huberman (1994), along with the validity checks suggested in the IS literature (Myers 1997; Dubé and Paré 2003; Lee and Hubona 2009). A multi-phase analysis, show in Figure 2.3, was used to explore the cases at macro- and micro-levels.

[See Figure 2.3.]

Initial analysis began with the immersion (Marshall and Rossman 2010) into the raw transcripts, based on a thorough reading of the 314 single-spaced pages of interview dialog. This provided a rich understanding of the organizations, and was followed with a second reading of each interview to identify directed comments about key aspects. Within-case analysis helped develop a macro-level view of each organization's environment, BYOD policies, and impacts (Miles and Huberman 1994), and produced insights, captured through executive summaries, that could be compared across organizations to develop theoretical insights (Eisenhardt 1989).

Following the macro-level analysis of each organization, the raw transcripts were transferred to a qualitative database for a more detailed cross-case analysis (Miles and Huberman 1994). A structured analysis was conducted by coding each transcript and specific comment in each interview to link it the focal constructs in the research model (Sabherwal et al. 2001). This was done through a qualitative database in Excel, including 2,817 rows (one for each comment), with columns for: (a) the individual interview identifiers; (b) the comments being coded; and (c) the constructs derived from the theoretical foundations. This helped compare and sort the comments from the transcripts to search for specific patterns and attributes within and across interviews.

Based on the above, the number of comments related to each construct was identified[d]. Following the identification of each construct, the comments were sorted and coded a second time to identify the relationships *between* the constructs. The number of times a specific relationship was identified within the interviews was utilized as further empirical support for the justification for the propositions in the theoretical research model (Sabherwal et al. 2001).

Following the macro- and micro-level analyses, the organizational case studies were compared and contrasted in relation to the focal constructs through a variety of visual representations and tables to allow for a clearer view of organizational relationships (Miles and Huberman 1984; Eisenhardt 1989). The results of these analyses are described below.

Results

As mentioned, each organization had recently made changes to its organizational IT management policies, either introducing a new BYOD policy or updating an existing BYOD policy. GOV, which was just beginning to explore this area, allowed individuals to utilize their own personal mobile devices to access their corporate email. Before implementing this policy, employees were required to carry with them multiple corporate devices throughout the day and use them to complete their organizational obligations both at and away from the office.

> “We're going to put this solution in place anyway because we want to protect our government-issued devices. It's just a side benefit to other people that will be able to BYOD.” – GOV7

RET was implementing a similar change by rolling out a large-scale BYOD policy, focusing on the introduction of personal mobile phones and tablets into the organization.

> “Whether we like it or not, people are using their personal cell phones to conduct business…what I think we're trying to do is basically say hey, if you use your personal device in this manner, we can help protect you.” – RET6

Due to security concerns, RET had earlier allowed only select individuals (e.g., executives) to utilize their own devices. However, a recent initiative to implement a BYOD policy, led primarily by employee demands, allows individuals to purchase and utilize their own devices at work while receiving significant monetary incentives to do so.

> “I think one of the things that we've changed that made it better was the incentive around the carrier offerings that we made.” – RET2
> “Two of our four primary carriers were able to offer us a significantly better discount… we actually save them [employees] money.” – RET1

TEC has been experimenting with BYOD policies for about eight years and was again adjusting policies based on employee feedback. TEC allows its employees to utilize not only mobile phones and tablets, but also software applications, to meet their personal needs.

> “This is the kind of bigger challenge with not just BYOD. It’s BYO of all of it…the CEO said, ‘You guys are ridiculous. We don’t need to be saying no, we need to be saying how.’ and that's why we call it any device program.” – TECH1

By implementing new network tracking software within the organization, TEC can now monitor the ITs that individuals are using for their tasks and track the emergence of ITs in the

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[d] Some comments related to more than one construct, and were coded as such.

organization. As the use of specific ITs reaches a certain tipping point, the organization may begin to take over significant IT support and implementation roles to aid the rest of the organization, which may find these ITs beneficial in increasing their performance.

> "You can pour this data out into the data warehouse and … what this shows is the volume … going to different Cloud services… These are people who are already doing it … because … they needed to... Our [employee] just went around us and said, "Screw you. If you're not going to solve my problem I'm going to solve it for you." – TECH1

The interviews at each organization focused primarily on the employees' perceptions of the existing BYOD policy, changes they would like to see, and the impacts that the freedom in IT adoption has had on their work lives. During these interviews a series of key outcomes were consistently brought up around the impacts on employee performance, satisfaction, and work-life conflicts. These outcomes are similar to those identified by the practitioner press regarding the impacts of BYOD policies on the organization and its employees (Willis 2012; Unisys 2012).

In the following section, these focal outcomes are discussed to explore the relationship that the flexibility in the organizational IT portfolio, through IT differentiation and IT integration, has on employees. Illustrative quotes indicating the key impacts of IT differentiation, IT integration, and their interaction on individual performance, job satisfaction, and work-life conflicts are provided in Table 2.2 with a deeper discussion provided below.

[See Table 2.2.]

The effects of the IT portfolio on individual performance.

When speaking to individuals across the organizations, a common theme emerged regarding their beliefs about how these BYOD policies impacted their individual performance. Due to the increased freedom of technology use (i.e., IT differentiation), they were no longer hindered by using potentially inefficient ITs for their tasks. While some technologies were beneficial for some tasks within the organization, they simply did not handle the needs of many others.

"… the corporation is doing its best to balance the cost of letting everybody do it their own way versus the value from everybody doing it the same way. I'll call it freedom within the framework is the approach that we typically use." – RET1

IT differentiation is crucial for increased performance, especially in those functions that are performing uniquely different tasks within the organization. For example, RET is composed of two general functions, their online store and their brick-and-mortar stores. Each of these functions serve different customers, utilizes different business processes, and need different types of technologies to meet their demands.

"the most different group that I'm aware of is our [online store] … the traditional way that you build infrastructures … don't work for teams who are developing internet-based e-commerce applications… They need more open access to the internet." – RET1

Many individuals indicated the need for the online store to have specialized technologies and infrastructure to meet the speed of their environment. However, those that were within the brick-and-motor environment noted that their tasks were all very similar and that they strived for similarity within their environment.

"the benefit…in [online store] is them being able to do things more quickly. They need to be able to deliver things more quickly. People in the online world are expecting features quickly…" – RET2

Employees noted the benefits to having freedom in their IT selections, but they also indicated many issues that arose due to employees utilizing different technologies. For example, when sharing information between other employees, clients, or vendors, collaboration technologies were typically used. In RET, the employees ran into issues collaborating in even basic tasks such as PowerPoint presentations due to between locations (e.g., online store headquarters and home office headquarters) due to the implementation of incompatible technologies.

"… we have a lot of challenges because our technologies are incompatible; our video conferencing was different, how they connect to us was always a challenge. They [online store] use different tools than we do…they tried to share a presentation with us … and it was in a format that we don't have access to…" – RET2

On the other hand, to address this potential issue, TEC utilized an integrated set of technologies, which allowed anyone to connect to their own collaboration software via mobile phones, tablets, or laptops with limited constraints. This software allowed the employees to work more efficiently together with their colleagues, clients, and vendors by reducing the time-wasting tasks of setting up meetings. This was even more effective for those employees who work off-site and must virtually connect to their colleagues during their workday.

> "…we developed a set of tools that would integrate with Microsoft Outlook to allow the ease of scheduling a video conference into your Outlook meeting. I look at your calendar, I see your availability... Now let me hit a button and it's going to schedule the bridge, the resources for the bridge, and then populate the bridge information into the body of my invite and then send it out to everybody in one motion." – TECH3

GOV ran into integration issues as well when implementing a new database system with their incumbent technologies within their state-wide call-center. Employees at the call-center service many different types of agencies and need access to knowledge about a variety of technologies implemented across the state to perform their tasks successfully. During this transition to the new database, much of the data within the incumbent system was lost due to incompatibility. Even simple tasks such as searching for emails, addresses, and prior support issues were interrupted during this transition, causing significant workflow problems when tracking prior solutions.

When the organizations were able to allow for freedom in their technologies (i.e., IT differentiation) and still ensure an adequate level of IT integration the employees were able to utilize their time more efficiently and effectively for their work. Even mundane tasks such as checking emails, filing expense reports, and monitoring server tasks became more productive. While employees were previously tied down to a corporate laptop the benefits of a mobile devices allow employees to utilize some of their down time such as in elevators, eating breakfast, and waiting in line at stores to complete their basic tasks more efficiently and effectively. This left much more value-added time to be used when in the office.

> "I spend the first hour of the morning lying in bed going through my email on my phone. Where, before, that wasn't an activity that I did. I would always wait until I got to the office to boot." – TECH3
>
> "I wouldn't say that I work any more or less. I just work more flexibly, and I can work when I want to" – TECH4

From these insights, it appears evident that employees welcome the ability to use alternative technologies when it makes their individual tasks more efficient and effective. However, with this increased level of IT differentiation, a sufficient level of IT integration is required to ensure that their work within the organization can be conducted without interruption. Without adequate IT integration to meet the demands of an increase in IT differentiation, the organization may have significant workflow problems occur and fail to see the intended benefits of IT flexibility.

The effects of the IT portfolio on job satisfaction.

Many organizations are implementing BYOD policies in an attempt to increase not only employee performance but job satisfaction as well (Rains 2012; Donston-Miller 2012). The initiation of BYOD policies is typically driven by the employees' demand for the freedom and ability to utilize specific technologies (CIO Council 2012a; Willis 2012). This was found in all three organizations as one of the initial drivers of BYOD policies.

> "…the main presenters … were the people group. They were hearing people saying we want to use our own devices and it allows for flexibility… we're listening to a new generation of workers that want this…" – RET4
>
> "I believe it comes from the outcry of the user…" GOV10

All the organizations provide their employees a corporate-issued computer for day-to-day tasks. These devices, which are primarily PCs, are typically selected and provided with limited employee input. While a decade ago both consumer and organizational IT environments were dominated by the PC, in today's environment a large portion of individuals beginning to use Apple products for their personal usage. Employees have pushed forward claiming their desire to utilize alternative technologies, such as a Mac, for their corporate obligations in both TEC and

RET. TEC initially attempted to hinder the growth of Mac adoption within the organization to ensure consistency and supportability within the organization.

> “They [employees] started buying Mac because it just worked better for them, absolutely. We tried to use our Mac product to block all the Macs and we were not successful in doing this, thankfully.” – TECH1

However, a change in the corporate leadership shifted this directive and made Macs an official corporate option to the standard PC. Over the past five years TEC’s IT portfolio has evolved into one that is approximately evenly split between PC and Mac. Users of Macs at TEC are adamant that they are highly satisfied with their choices, which leads to less support issues, more stability, and enjoyable usage.

> “When the Mac platform became available I became a Mac user. Had no baptism into that platform … Had no knowledge of it. We jumped in both feet, about 15% of the company did … the Mac user base has pushed up to 40/45% of our 76,000 people” – TECH3
>
> “They had told me, … “Don't get frustrated. Wait until the 31st day to say I'm going back,” They were about right. It was about 30 days when I felt comfortable… I think that now, once I know how to use it, I'm much faster…. No way. Absolutely no way would I go back.” – TECH5

RET and GOV took an alternative approach and only allowed individuals within the organization who *need* specific aspects of a Mac to make a switch in their personal technology usage, such as employees in the Marketing department.

> “We do have a few hundred Mac users here … and those are like people over in the advertising and marketing, creative type departments.” – RET5

However, executives at RET agree that limiting this technology to a subset of individuals is potentially limiting the creativity, satisfaction, and potential performance of individuals by forcing employees to utilize technologies that they are less skilled and satisfied with.

While the individuals indicated an increase in their job satisfaction due to utilizing technologies that they *preferred* instead of those chosen for them, stories also emerged of benefits driven from the increased IT integration itself. For example, RET requires its 10,000+

employees to be able to collaborate with their colleagues, customers, and vendors across the globe on a day-to-day basis. The approaches taken by RET and TEC to satisfy this need was through the use of online collaboration suites consisting of video conferencing, email, and instant messaging. During the visit on-site, RET was in the process of implementing a new collaboration suite due to issues with the current options within the environment.

RET had to manage the technologies of their internal employees as well as the interaction with the thousands of vendors. The existing technologies at RET lead to significant issues in even simple tasks such as sharing a PowerPoint slide with those in the meetings and caused dissatisfaction with having to attend meetings virtually. Utilizing the guidance from, and technologies provided by, TEC, RET started implementing a new platform that supported both the need for a fully integrated collaboration suite and the increased variety of technologies due to the BYOD policies. The software suite (TechX[e]) allows individuals to attend videoconferences, receive instant messages, emails, and even voice calls directly to any device connected to the corporate network. Individuals now had the ability to attend these meetings via a tablet, phone, laptop, or desktop phone without loss of ability to fully participate. This fully integrated suite was heralded within both RET and TEC where it had been in place for approximately 3 years.

> "…we're real excited about their [TechX] roll out. That's been a big, big win for us." – TECH5

A *lack* of adequate IT integration was also a driver of reduced job satisfaction, especially in the cases of those individuals who were specifically utilizing alternative technologies than they had previously been allowed to use due to the BYOD initiatives. For example, many TEC employees who were using a Mac indicated many frustrating issues in their workflow due to

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[e] Official technology name blinded as per request of organization.

their technology choices. While their technology has now changed, their tasks have not and the new technology must still allow for a seamless integration with their prior workflow.

> "… all of our calendars ran across exchange… all using a Microsoft client. The day after … everyone was trying to figure out what client to use and things didn't look and feel the same on Apple Mail … We wanted to have the same feel and flexibility as we had in Outlook from a calendaring standpoint, from a flagging of emails or categorizing of them, and you couldn't do that functionally. We were living in a world that was based in Windows." – TECH3

The majority of the in-house developed applications at TEC were designed for a PC environment and had caused significant issues when employees attempted to complete various portions of their tasks such as document and presentation creation, diagram development, and even simple meeting requests within email clients.

> "…there were some tools that just did never have anything that was going to be, frankly, as good as it was on Windows because of the years of development and perfection." – TECH3

The employees were satisfied with their freedom in technology choices but were initially dissatisfied with the integration problems that arose within their basic workflow. To address these problems the organizations provided their employees with a PC operating system installed through a virtual machine within the Mac. Through the use of these integrative ITs, employees were able to still utilize their preferred technology while ensure their workflow across the organization remains compatible.

Therefore, from these initial insights it appears that the level of IT differentiation and IT integration each have a significant positive impact on an individual's job satisfaction. By allowing individuals to utilize a technology they prefer, over one that they are simply assigned, there may be an increase in their total satisfaction towards their job. This increase in freedom provides a sense of autonomy for the employee, which has been shown to increase both job satisfaction and performance (Morgeson et al. 2005; Spector 1986). However, without an adequate level of IT integration to meet the requirements of the differentiated technologies, there may be a significant drop in satisfaction due to handling communication issues and workflow interruptions between individuals across the organization. Therefore, organizations must ensure that they are providing adequate levels of IT integration between the technologies in their organizational IT portfolio or risk frustration and chaos due to individual technology adoption.

The effects of IT portfolio on work-life conflict.

Another large concern that has been indicated both within the press (e.g., Ballenstedt 2012; CIO Council 2012b) as well as the interviews relates to work-life conflicts due to increased accessibility and obligations after implementing BYOD policies. Individuals have recently become highly attached to their personal mobile devices (Bianchi and Phillips 2005), and struggle to disconnect from their corporate obligations once they begin to utilize their personal devices for their organizational tasks. The benefits of increasing IT differentiation through BYOD policies have the potential to become a double-edged sword by simultaneously increasing accessibility and perceived work obligations.

One of the greatest benefits that individuals noted during this study was ability to alleviate some of their obligations to be tied down to a corporate device such as a laptop throughout the day. Many individuals only have access to their corporate email through a company laptop that only works while connected to Wi-Fi. This restriction on mobility can severely interfere in an employee's personal time such as attending sporting events, dinner, and movies. The ability to now access this information through their personal mobile phone has provided an increase in freedom for these employees and reduced the hold their laptop had on them.

> "I think the biggest change is some flexibility to be able to move about without having to carry a laptop which is cumbersome…" – RET3

> "We went around and said, "This is what I need to do my job. I don't necessarily want to do it. I don't necessarily want to check my email, but because professionally that's part of how I respond in my business by being always available, by doing my job regardless

> what time of day it is, I wanted to be able to get in and see my email come if I did sneak out on a Friday afternoon for a round of golf, if I had ten minutes on Saturday afternoon before mowing the lawn." Right?" – TECH3

This increase in technology freedom provided even further benefits for those individuals who previously had very limited technologies choices. For example, store managers at RET typically spend 100+ hours in the store during the week due to their inability to access the corporate network from home or their personal devices. With the recent BYOD implementation at RET these managers were now able to still remain in contact with their organization to complete their obligations but from the satisfaction of their own home.

> "…if you are a store manager, before you had BYOD, you had to be in the store 100 hours, 110 hours a week. That's not life man. That's not life at all." RET6

However, with this increase in freedom and accessibility through their mobile devices, individuals are now much more likely to feel additional obligations to answer emails, respond to instant messages, and attempt different work tasks during their personal time. With other employees in the organization now knowing that they have a direct line to their colleagues at all times, the potential to abuse this connectivity can lead to significant work-life conflicts. This is an often seen instance of couples sitting at dinner on their phones, fathers typing out emails during a son's baseball game, or checking system statuses throughout the evening.

> "For some people it's very difficult to draw the line in the sand of the e-mails there. They felt compelled that they have to answer at the moment … how do I turn it off, how do I take a vacation and truly get a vacation. Is the expectation of my company going to be because I have this device that I'm available 24/7, 365." – RET3

These changes in accessibility have led to individuals adjusting their personal time to handle the corporate responsibilities. Many individuals indicated that they check their email first thing in the morning, in the middle of the night, or opening their laptop up next to them while attempting to relax while watching TV.

> “When I wake up at 5:15 in the morning, the first thing I do is I wake up and grab my phone and I look to see did I get any pages last night…” – TECH3
> “Before I do to bed at night, I check my calendar… When I wake up first thing in the morning, I check my inbox…” – TECH4

RET, TEC, and GOV are each attempting to reduce this strain on their employees’ personal lives by developing more efficient and effective applications for their mobile devices. While they cannot completely stop an employee from attempting to work during off hours, they each feel that they can make those mundane tasks take less time away from their personal lives and be more productive for the employee. These initial applications were pushed primarily through the use of mobile e-stores that host mobile versions of basic organizational tasks.

The development of additional `applications via mobile web-stores themselves does not necessarily reduce the level of work-life conflict that an employee faces as it may begin to create even further work. However, by providing some of the most common, simple tasks that employees conduct in their day-to-day tasks such as time cards, travel receipts, and approvals through a fully integrated web-store accessible through multiple personal devices can reduce the monotonous time employees spend.

> “We have an application store that we published to all of our mobile devices…. What my store has is corporate approved but personally acquired applications… This list has grown this year. It will continue to grow apps are a driving force behind it.” – RET1
> “All the way out to using it for HR related activities as I'm a people manager as well. If you're one of my direct resources and you want to request a PTO day off, a vacation day, you submit it. I can access it from my phone.” – TECH3

Therefore, based on these insights it appears that IT differentiation has the potential to both increase and decrease the level of work-life conflict an employee experiences dependent upon the level of IT integration the technologies have. By simply providing more technologies, the perceived obligations and conflicts may arise; however, making the simple tasks more efficient and effective by integrating the existing technologies and processes into mobile technologies can reduce the time wasted and controlled by corporate obligations.

Study 1 Summary Insights

The insights from the 22 interviews conducted across these organizations provide a rich set of expectations for different users within the organization. More specifically, individuals indicated that the freedom in their technology choices allowed for more productivity and performance in their individual tasks due to efficiency and effectiveness of their technologies. Additionally, these individuals felt much more satisfied with their job as the use of BYOD policies, which allow the flexibility in the individual's IT usage, provided a level of freedom in *how* an individual works. Previous policies requiring individuals to utilize corporate equipment to complete their obligations when away from home caused frustration with old technology and the "tethered" feeling that many employees had. While this freedom did allow for more efficient and effective work by employees, it also had the potential to increase their work-life conflicts. With more access to emails, contacts, and work information, individuals noted having a harder time disconnecting from their work obligations. Many employees even adjusted their personal routines to fit in the organizational needs such as checking email and monitoring various tasks.

Although many individuals indicated a clear positive relationship of IT differentiation and IT integration on both individual performance and job satisfaction, individuals were less clear on their beliefs of the impact on their work-life conflicts. Therefore, based on these insights, the following research model in Figure 2.4 will be further examined and validated in Study 2 utilizing a survey questionnaire from a larger set of organizational employees.

[See Figure 2.4.]

Study 2

The proposed research model in Figure 2.4 was developed and outlined through a combination of prior theory and qualitative interviews in Study 1 (Eisenhardt 1989). To further test this model, quantitative survey data was collected from a larger sample of organizations.

Utilizing a mixed-method approach through a combination of qualitative, real world insights and quantitative, empirical data from a larger set of respondents provides further support for the validity, reliability, and generalizability of this theory (Venkatesh et al. 2013).

Method.

The sample for this study includes 497 U.S. employees across a variety of organizations and job roles, recruited through an online crowdsourcing market (Steelman et al. 2014). Each individual participating in the online survey questionnaire responded to items regarding their individual perceptions of organizational policies and procedures, the IT infrastructure, and a variety of individual outcomes. The respondents have an average of 4.94 years at their organization, are 23.21 years old, with 54 percent being males, and 48.51 percent having a bachelor's degree or higher. The respondents are employed in different industries, job roles, and environments across the U.S. The use of this broad sample of employed individuals is fitting for the analysis of this research context as BYOD policies are typically implemented for a variety of organizational functions (Willis 2012).

In the light of the novel conceptualization of IT differentiation and IT integration in this essay, a rigorous multi-step procedure was used to develop and validate the associated measures (MacKenzie et al. 2011). However, existing scales and instruments were used where possible to ensure consistency and comparability with prior research. Due to space constraints, this process, which consisted of seven pilot studies with 1,127 respondents, is described in Appendix B.

As described in Study 1, the organizational benefits that emerged from the implementation of BYOD policies differed across each organizational context. These BYOD policies have direct impacts on the level of both IT differentiation and IT integration within the organization as individuals adopt and remove technologies from the organizational IT portfolio. In an attempt to further explore and capture the individual outcomes of IT differentiation and IT integration within the organization this survey captured a series of dependent variables: overall individual performance, job satisfaction, and work/life conflict. These individual outcomes, derived from the practitioner claims of the BYOD literature and the stories described during the interviews provide a broad view of the potential impacts that the IT portfolio may have on the employees.

The survey instruments for the focal constructs within the T-DINIT theory, IT differentiation and IT integration, were developed within this study in an attempt to capture the definitions and conceptualization discussed previously. To begin, each individual responded to the focal construct scales in regards to the technologies *they specifically use* within the organization and comparing them to the other individuals within the organization. Next, individuals answered a set of questions regarding their perception of the impact that the organizational IT portfolio has on the their performance, job satisfaction, and work-life conflicts. Lastly, a series of demographics and individual attributes (i.e., tenure, age, education, and gender) were collected for controls during the subsequent analysis. For an overview of each construct, the source of the survey instruments, and the specific instrument items, please refer to Appendix B.

Analysis.

Structural equation modeling, specifically partial least squares (PLS), which is well suited for theory development and exploratory studies such as this (Chin 1998), was used to analyze the proposed research model in Figure 2.4. PLS has seen recent advances in the post-hoc robustness analyses techniques to ensure validity of the empirical findings such as common method bias (Liang et al. 2007; Bagozzi 2011), multi-group analyses (Sarstedt et al. 2001; Chin 2000), and unobserved heterogeneity (Becker et al. 2013). Furthermore, a two-step procedure (Goodhue et al. 2007; Henseler and Fassott 2010) was utilized to analyze the full research model due to issues related to the moderating effect estimations within SmartPLS 2.0 (Ringle et al. 2005). The details of this procedure are described below during the estimation procedure and results discussion.

Table 2.3 presents summary statistics that consists of the composite reliability, average variance extracted (AVE), means, standard deviations, and correlations for each of the focal constructs in the model. All of the constructs have reliability estimates >0.90, AVEs > 0.50, and square root of the AVEs exceeding any of those of the off-diagonal correlations indicating evidence of reliability, convergent validity, and divergent validity (Hair et al. 2006). Additionally, the loadings and cross-loadings for each measurement item, presented in Table 2.4, provide further evidence of convergent and divergent validity as each item loads on its focal construct and less so on each of the other constructs (Gefen and Straub 2005). Therefore, the evidence suggests that the instruments utilized in this essay have adequate reliability and validity that provides increased confidence in the subsequent results.

[See Tables 2.3 and 2.4.]

When examining the correlations between the focal constructs within this research model an attempt was made to ensure the relationships were consistent with prior research to further ensure validity and reliability of the measurement. First, the negative correlation between IT differentiation and IT integration (r = -0.22) is consistent with prior research and expectations such that was the level of differentiation increases, the ability to integrate technologies together becomes more difficult (Lawrence and Lorsch 1967a). Second, the negative correlation between work-life conflict and individual performance (r = -0.09), as well as job satisfaction (r = -0.34), is consistent with prior literature (Ahuja et al. 2007; Thomas and Ganster 1995) such that more conflict for an individual reduces their satisfaction with the work environment and hinders their performance. Lastly, the positive correlation between individual performance and job satisfaction (r = 0.25) indicates that more satisfied individuals tend to perform better within their organizations (Judge et al. 2001). Based on these initial findings and the reliability and validity tests above, it appears that the instruments utilized in this survey behaved as expected.

Before presenting the final model estimations, three tests were conducted to address the potential for common method bias within the results (Bagozzi 2011). First, a Harmon's one-factor analysis (Podsakoff and Organ 1986) was conducted to test if a common latent factor was influencing the results within the model. Results from this test produced five factors with the first factor only accounting for 37% of the variance, indicating that common method bias did not provide a significant threat in the study (Sanchez et al. 1995). Second, the correlations were reexamined within the model where excessively large correlations ($R^2 > .90$) may indicate further common method bias (Pavlou et al. 2007). As shown in Table 2.3, this is not present within our analysis with the highest correlation being 0.34 between job satisfaction and IT integration. Finally, the Liang et al. (2007) method was utilized to test for common method bias within a PLS estimation. This approach has seen increased utilization in the past few years due to its simplicity and ability to test common method bias in relation to the structural equation model and not the constructs in isolation (Chin et al. 2012). During the estimation of the research model including a method factor, (a) only 3 out of 23 of the method factor loadings were significant, (b) the loadings of the substantive indicator items were all highly significant and in magnitudes larger than the method factor, and (c) the original results of the research model did not change significance or direction. The results from this analysis further indicated that the average variance explained by the substantive factors explain 76.16 percent of the variance and the average method-based only captures 0.20 percent of the variance. Thus, based on these tests, there is evidence common method bias does not seem to be a significant concern in this study.

Following the examination of the measurement model validity, the estimation of the research model was conducted through a variety of methods and robustness analyses. Testing of the research model was conducted through a two-step procedure (Goodhue et al. 2007; Henseler and Fassott 2010) utilizing a combination of PLS to test the measurement model and traditional ordinary least squares (OLS) for the structural model analyses. While the estimation of the structural model entirely with SmartPLS 2.0 would be ideal, it generates its moderating effects utilizing a product indicator technique of generating interaction terms within the model by conducting pairwise multiplication of each item indicator between each interacting construct (Chin 1998). Unfortunately only a single dependent variable may be estimated with this software-developed moderating effect, generating significant multicollinearity issues when attempting to measure multiple interaction effects such as in this research model.

To address this concern of multicollinearity, along with the sufficient validity and reliability estimations of the measurement model, the primary analysis utilizes mean-value scores of the latent variables in multiple OLS analyses within STATA 12 (Statacorp 2011)[f]. The standardized variable scores were used to generate the required interactions (Cohen et al. 2003). The results for the analyses of each dependent variable are provided in Table 2.5.

[See Table 2.5.]

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[f] A series of additional methods were utilized to ensure the robustness of this analysis technique. The research model was estimated utilizing PLS-generated latent variable scores in place of mean-variable scores with a consistent pattern of results (See Appendix C). Additionally, the three OLS models were estimated utilizing seemingly unrelated regressions (SUR) with both sets of variable scores with a consistent pattern of results. For the sake of brevity the SUR results are available upon request.

Results

The research model was tested in a hierarchical progression to estimate the impacts of the controls, direct effects, and interaction effects for individual performance, work-life conflict, and job satisfaction in Table 2.5. The examination and discussion of the impacts on each dependent variable are conducted through the most complete model, the interaction model.

The effects of the IT portfolio on individual performance.

When examining the impact of IT differentiation, IT integration, and their interaction on individual performance a series of significant effects emerge. First, from an individual perspective it appears that IT differentiation itself does not provide a significant benefit to individual performance ($\beta = 0.017$, n.s.). IT integration on the other hand has a significant positive impact ($\beta = 0.180$, $p < 0.001$) indicating its importance to individual employees in aiding in their job performance. Individuals require that their technologies work together as they complete complex tasks within the organization and interact with other individuals throughout their workday. The significant interaction between IT differentiation and IT integration ($\beta = -0.085$, $p < 0.01$) depicted in Figure 2.5 provides a deeper understanding of this relationship.

[See Figure 2.5.]

This interaction plot, generated by plotting one standard deviation above and below the means for IT differentiation and IT integration (Cohen et al. 2003), depicts the significant positive impact of IT integration on individual performance. The best individual performance results when IT integration is high but IT differentiation is low. This relationship seems to go against some of the initial expectations from the theoretical model, based on Lawrence and Lorch's (1967a) work, when noting that the high IT integration and high IT differentiation scenario has a slightly lower level of individual performance. However, by returning to the individual stories and insights provided from the interviews an alternative explanation emerged.

When there is a low level of IT differentiation, the number of technologies an organization needs to help support for their employees is lower. A typical IT help desk can reasonably handle the needs of the organization's employees as they complete their day-to-day tasks. However, once the level of IT differentiation begins to increases, especially in cases of BYOD adoption such that only a few employees may utilize a specific technology, organizations may be unable to designate resources to help those individuals. In these cases, individuals must self-support their technologies and may run into issues that hinder their performance if gone unsolved.

> "I said, "I'm fairly dumb here." They're like, "No, we've got the Wikis and the blogs. We do our own internal help desk support with that. Almost like crowd sourcing, if you will." – TECH2
>
> "I'll say this. Frankly, we did a better job when we were supporting ourselves because we were all learning and we were all understanding if this breaks, how can I go around and who's had this problem? We talked better." – TECH3
>
> "I can tell you it was just a year and a half ago when we moved apple under IT support. Prior to that, we were supported off a Wiki page." - TECH5

Therefore, while a high level of IT differentiation and IT integration is not the best performing scenario from these results, it may be a function of the organizational support and potential IT options available with the organization that drives these decisions. Providing adequate support and training on a large number of differentiated technologies is much harder to achieve than supporting a few, key organizational technologies.

The effects of the IT portfolio on work-life conflicts.

The examination of work-life conflict sees additional significant impacts of IT differentiation ($\beta = 0.085$, $p < 0.05$), IT integration ($\beta = -0.215$, $p < 0.001$), and their interaction ($\beta = 0.072$, $p < 0.05$). The positive impact of IT differentiation on work-life conflict indicates the potential for an increase in technologies, and the subsequent accessibility by employees, to further increase the potential for work-life conflicts. By allowing individuals to utilize their personal devices at work an individual can increase their work performance; however, individuals have problems disconnecting from their work responsibilities at home when their corporate access is easily within reach (Turel and Serenko 2010). IT integration on the other hand can help to reduce the level of work-life conflict by making the interactions between the differentiated technologies more seamless, require less support and troubleshooting, and allow for quick task completion during off-work hours when required. The interaction of these two relationships, depicted in Figure 2.6, provides additional insights into potential organizational scenarios.

[See Figure 2.6.]

In this depiction, it appears that whether there are many or few technologies utilized across the organization, without adequate IT integration, there are significant work-life conflicts due to issues that lead to inefficient work. In scenarios of high IT integration, there are lower levels of work-life conflict, however the level of IT differentiation has a positive influence on the level of conflict perceived. While in the work environment, increased access to technologies can lead to increased performance by meeting varied task demands; however, when these technologies become mobile and travel into an employee's personal life the potential for significant work-life conflict is amplified. Having access to more technologies to connect to work obligations at home typically leads to increased levels of work expectations during off-hours. This has been a significant problem for many years with individuals seeming to become addicted to their blackberries due to the ease of access to work information (Kakabadse et al. 2007).

> "…we have a split between hourly associates and salaried associates that for employees with somebody it's hard to tell when someone is on the clock or off the clock especially if the personal device went it can go home with you and you can work those hours so that strict adherence at certain times and trying to keep an eye on overtime and being fair with pay and work conditions, that's a massive issue that I don't think anybody has fixed for those issues." – RET4

These impacts are similar to the stories described by employees who noted that they had changed their off-hours routines to meet their new accessibility developed by BYOD initiatives.

However, the use of personal devices can lead to not only work obligations at home, but increased personal obligations at work as well. A few individuals noted their ease of access to personal issues and obligations while at work which were easier to access due to having their personal device to complete their organizational work.

> "Now, I can Facebook, and read the newspaper, and do these things while I'm waiting for processes. I determined that there could be a significant time sink involved with allowing the employees to do their work off their personal devices, because there are no controls on what you do with that personal device…" – GOV10
>
> "…like I said, if I do want to text my wife on this, I don't want that to be on the front page of the [newspaper] the next day. So that's what I do now. This is my personal BYOD device." – GOV2
>
> "If I'm going to be checking my email all night long and responding to emails at midnight if I happen to be awake, then there's some level of trade-off in that. That may be I have five minutes, let me go check what the weather forecast is for tomorrow. Let me go make a tee time for my golf match next week. Right?" – TECH3

The effects of the IT portfolio on job satisfaction.

The examination of job satisfaction provided similar results to those for individual performance, as expected. These results indicate a positive impact of IT integration ($\beta = 0.302$, $p < 0.001$), a positive but non-significant impact of IT differentiation ($\beta = 0.058$, n.s.), and a negative relationship for their interaction ($\beta = -0.099$, $p < 0.01$). The increased integration of the technologies in the organization enhances an employee's job satisfaction as (s)he spends less time dealing with issues and troubleshooting technologies with organizational and self-service support. Additionally, the results of Study 1 indicate that individuals prefer to utilize varied technologies such as their personal phone, tablet, or laptop for their work tasks. Individuals who are allowed to select technologies to meet their own needs and not forced to utilize a standardized technology that may hinder their creativity seem to be more satisfied with their job, however the empirical results remain more unclear. The interaction of IT differentiation and IT integration, depicted in Figure 2.7, provides deeper insights into this relationship.

[See Figure 2.7.]

In this scenario, when there is a high level of IT integration, employees do not necessarily prefer a high or low level of IT differentiation as long as their technologies work well together and complete their tasks. However, when there is a low level of IT integration and potential issues may arise across technologies when working together, individuals would prefer a high level of IT differentiation consisting of technologies they personally enjoy. If an individual were going to run into issues integrating technologies within their organization due to a lower level of IT integration, many would prefer to utilize their own personal devices that they may have more experience with to increase their own levels of satisfaction.

Based on these results, it appears that the level of IT integration, IT differentiation, and their interaction affect an individual's perceptions of performance, job satisfaction, and work-life conflict. The emergent results are provided in Figure 2.8 below. These results generally follow the insights derived from the qualitative interviews in Study 1. The implications and contribution of these findings are discussed below.

[See Figure 2.8.]

Discussion

This essay explored the relationship between the organizational IT portfolio attributes, specifically IT differentiation and IT integration, on individual performance, job satisfaction, and work-life conflicts. These outcomes have been heralded in the public press during the recent evolution of BYOD policies within the organization despite the lack of academic research exploring their relationship (Willis 2012; Unisys 2012). Through the development of the T-DINIT theory utilizing a mixed-method theory development approach (Venkatesh et al. 2013; Tashakkori and Teddlie 2003) the results indicate general support for the T-DINIT theory.

In Study 1, the insights from 22 employees within 3 different organizations indicated the potential benefits and issues that arise due to the implementation of BYOD policies at an individual level. The respondents indicated that they preferred to utilize their own technologies in many instances due to their preferences, experience, and satisfaction with their personal devices. The respondents also indicated that the increased level of IT differentiation generally increased their performance due to freedom in the way to complete their work, however, there were also significant issues that began to arise due to increases in work-life conflicts. As individuals had more access to their work obligations from their personal devices, there was an increased expectation for responses and a reduced ability to simply disconnect from the work environment during off-work hours. In Study 2, utilizing a larger sample of 497 respondents, the positive impact of IT differentiation was supported for job satisfaction, non-significant for individual performance, and supported for the increased development of work-life conflicts.

As for the IT integration, respondents in Study 1 and Study 2 both indicate the significant benefit towards both individual performance and job satisfaction. When the integration of the technologies are increased, there is a reduction in problems and issues that arise for employees completing their organizational tasks, making their work more effective and efficient. The results also indicate that an increase in the IT integration can reduce the level of work-life conflicts for employees as their obligations to their organization can be performed more efficiently during their personal time. For example, many individuals indicated that not having to carry their work devices (e.g., phone, laptop, etc.) and their personal devices simultaneously, which made their flexibility and mobility in their personal life more satisfactory.

While the direct effects of IT differentiation and IT integration on performance, job satisfaction, and work-life conflict provide important insights to validate the expected outcomes of BYOD policies within the organization, these attributes are not managed independently. When adjusting and configuring the organizational IT portfolio both IT differentiation and IT integration are affected simultaneously through the removal and influx of the technologies. The interaction effects of these IT portfolio attributes provide interesting scenarios of organizational IT portfolio configurations within the organization. While prior theory indicates that a high level of differentiation and integration of assets are beneficial (Lawrence and Lorsch 1967a) this scenario was not always the case in Study 2. The results indicate that IT integration is significant across the board in helping increase performance, satisfaction, and reduce work-life conflicts. However, an increase in IT differentiation, while allowing individuals to have specialized technologies to meet their needs, can also lead to an employee's increased need to self-support and troubleshoot their own issues which may reduce their performance and satisfaction if the employee is inexperienced.

In summary, this research makes a few contributions to the information systems literature. Prior research has investigated the impacts of IT on the organization and individuals utilizing aggregate measures of IT investments such as IT budget (Bharadwaj 2000; Bharadwaj et al. 1999). However, this lack of examination into *specific* IT investments and the configuration of these investments have been indicated as a potential driver for the conflicting results within the IT paradox literature (Mithas et al. 2012; Aral and Weill 2007). This essay examines the *specific configuration* of the organizational IT portfolio and its impacts on employees to provide insights into how organizations can configure their IT assets to meet the needs of their employees.

The examination of the emergent BYOD phenomenon has seen significant discussion within the practitioner literature (e.g., Kaneshige 2012; Saran 2012), however the academic exploration of this IT management problem has been lacking. This essay is an early exploration of the BYOD phenomenon that is growing throughout the organizational IT environment. The insights contribute to this literature stream by providing a more rigorous exploration of the impacts of BYOD above and beyond that of prior explorations.

Lastly, this research contributes to the IT management literature through the development of the T-DINIT theory, which provides insights into how organizations can configure their organizational IT portfolio to meet the needs of the organizational environment. This theory, while developed in the context of BYOD, is abstract in nature such that the insights may generalize to not only individual IT adoption decisions but organizational IT adoption decisions as well. Future research should explore these insights in additional IT adoption scenarios within the organization to determine their generalizability to further environments.

Although these insights provide a new perspective to the impacts that the organizational IT portfolio can have within the organization, they are not without their limitations. First, the interviews during the theory development phase of this research were conducted at organizations implementing BYOD policies. While this approach of utilizing an emerging phenomenon within the organization has the potential to provide results that are more directed towards BYOD insights only, the validation of the research model was conducted with 497 employees across different organizations. The survey questionnaire did not specifically ask about any BYOD policies within the organization but the IT management policies and IT portfolio in general. Future research should explore the T-DINIT theory with specific organizations to identify any additional organizational attributes that may further influence these results such as the number of technologies available, the level of IT support, and the variety of tasks within the organization.

Conclusion.

In summary, this essay has provided the initial development of the theory of the differentiation and integration of information technologies (T-DINIT) through a mixed-method analysis of qualitative interviews and survey questionnaires. Through the exploration of an emergent organizational IT management phenomenon, “Bring-Your-Own-Device” initiatives, this theory provides insights into how allowing variation in the organizational IT portfolio can lead to increased performance, satisfaction, as well as work-life conflicts for the employees. Additionally, the impact of the integration of organizational IT is explored to determine how organizations can attempt to foster the beneficial outcomes and reduce the potential negative outcomes related to BYOD policies in the organization.

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Appendix A. Interview Protocol

The following information provides an outline of the interview protocol utilized during each of the interviews throughout the data collection. The survey was designed to allow for a directed interview yet still provide freedom in the conversation as topics evolved during the conversations.

Section 0: Introduction

Thank you [insert name here] for taking the time to speak with me today. We are investigating recent changes in organizational IT policies, specifically “Bring-Your-Own-Device” policies. In this interview, I am attempting to get a deeper view of the role that allowing individuals to select their own technologies to use has on those individuals’ as well as the organization’s performance.

But, before we get started I want to share with you the consent form for this interview and describe to you the general procedure we will follow.

First, I hope that you will allow me to record these interviews so we can transcribe them for analysis at a later date. The responses will be kept in the strictest confidence and the detailed transcripts will only be shared between the researchers. If at any time you feel that you need to me to stop the recording for a specific portion of the interview, please let me know.

Please take a few minutes to read through the consent form and if you feel comfortable with this process sign the bottom and we can begin.

[Share Consent Form]

As I mentioned, this interview is going to focus on how the technologies that you use within the organization are selected, managed, and impact performance at [organization name]. I will get to more detailed questions shortly but I want to start off by getting some background information about yourself and your role in the organization.

Section 1: Job Position

Can you please describe to me your position within [organization name]?

Section 2: BYOD Context

Now I would like to obtain your insights into a more recent initiative that many organizations are taking.

What do you understand by the term “Bring-your-own-device” or BYOD?

Are you aware of any BYOD initiatives at [organization name] that you could tell me about?

What aspects of “BYOD Policy” do you consider important?

Have your daily tasks changed since [organization name] began to initiate a BYOD policy?

What types of technologies does [organization name] allow you to select with this policy for your tasks? For example, laptops, tablets, mobile phones, software, etc.

Can you tell me about any specific restrictions or constraints that [organization name] places on the technologies that you can choose from? Please indicate this for technologies such as laptops, tablets, mobile phones, software, etc.

Section 3: BYOD Impact

Now I want to ask you about how you think these BYOD policies have impacted [organization name] and your own tasks.

How successful do you think BYOD initiatives have been accepted across [organization name]?

What changes do you think would make this more accepted?

Do you think that these BYOD policies are beneficial to the organization?

What specific impacts do you think BYOD has had on [organization name]?

Now how beneficial do you see BYOD for *yourself* and *your own tasks*?

If you could make any changes to the current BYOD policies at [organization name] what would they be?

Section 4: Job Position and Tasks

Next, I would like to learn a little more about your *specific* tasks in the organization.

Can you please tell me a little bit about the different tasks that you complete each week in more detail?

Do you consider these tasks to be significant different from each other or generally related?

Now, for these tasks that you have described I am a little curious about the level of complexity between each of them.

Ok, now for these tasks, can you tell me in a little more detail about the different technologies and skills that are needed to complete these tasks?

Now, for these tasks that you complete each week, how often are you required to work closely with people from other business functions/departments in the organization?

Can you describe some of these interactions with other individuals and how they impact your own tasks?

Section 5: Switching and Selection Behaviors

Now with BYOD allowing employees to select their own technologies, we are curious about the thought process that employees take to pick a specific technology.

When you are trying to determine which technology to adopt for *your own* use within the organization, what factors influence your decision of which to use?

Can you describe to me a time when you decided to stop using one technology and switch to an alternative?

Now, when you are selecting between which technology to use, how many options are there out there?

Now, thinking about the technologies that you have to select from how similar are the abilities to complete each task between these technologies?

Thinking about your own technology, is there a time that you can recall that you had to select between two or more technologies that did very similar tasks? For example, in my field of work I typically can use 3 to 4 different applications to do the same statistical analysis but have to take into account who I am working and sharing the information with beforehand.

Section 6: IT Portfolio Information

We are also interested in understanding the effect BYOD policy can have on the *variety* in technologies in the organization.

When thinking about the technologies that you specifically use, how different are they from the technologies that other individuals in the organization use?

What about those individuals that are in a similar position as you?

Can you describe what some of the biggest differences between your own and other employees' technologies that you see?

What are some of the reasons that you think that other employees would need to use different technologies than you for their tasks?

Can you think of a time when the differences in technologies either positively or negatively impacted the performance of a task?

Now that we have talked about the differences lets focus more on the similarities.

How integrated would you say the different technologies used across the organization are?

Does your organization do anything specific to ensure that the technologies that employees select are able to work together seamlessly?

In your opinion, what impact does having many different technologies in the organization that employees use have on the organizational performance?

What about the impact it has on your own performance when interacting with other individuals?

Are there any specific things that you think could be done to improve the set of technologies available within the organization?

Section 7: Closing

Before we wrap up, I want to share with you a short survey that focuses on different aspects related to BYOD. If you can take a look at these aspects and rate them based on how important you feel they are to you from "unimportant" to "very important". This will be used to gather a broad view of what aspects that employees see as key to a BYOD implementation within the organization.

[Share 1 page survey]

Thank you for taking the time to speak with me today, before we end is there anything that we forgot, or is there anything else that you would like to talk about?

Could I get back in touch with you if I have some clarification or follow-up questions after our analysis of these interviews?

Section 8: Recap Survey

The following questions will provide a recap of our discussion and be used as a reference point for comparisons between individuals. Please circle your answer each questions on the five point scales below.

1. BYOD has been accepted successfully across the organization.

Strongly Disagree				Strongly Agree
1	2	3	4	5

2. The BYOD policies allowing individuals to select their own technology is very beneficial to the organization.

Strongly Disagree				Strongly Agree
1	2	3	4	5

3. My job has a lot of variety which requires me to do many different things.

Strongly Disagree Strongly Agree

1 2 3 4 5

4. My position requires me to use many different areas of knowledge and skills to complete my tasks.

Strongly Disagree Strongly Agree

1 2 3 4 5

5. How often do your tasks require you to work with people from other business functions in the organization?

Never Always

1 2 3 4 5

6. There are many different technologies to select from when deciding which technology to use for my tasks..

Strongly Disagree Strongly Agree

1 2 3 4 5

7. The technologies that I use in the organization are different from those used by other individuals in the company.

Strongly Disagree Strongly Agree

1 2 3 4 5

8. The technologies utilized across the organization are highly integrated.

Strongly Disagree Strongly Agree

1 2 3 4 5

Appendix B. Survey Instrument and Development

To develop the questionnaire utilized for this research a rigorous development and validation process was conducted (MacKenzie et al. 2011). Through recent arguments regarding the lack of rigorous development and validation of survey instruments within Information Systems literature, MacKenzie et al. (2011) have developed a series of guidelines and procedures to aid in the development of strong and reliable instruments. These procedures, consisting of conceptualization, development of measures, model specification, scale evaluation and refinement, validation, and norm development, were used to develop the survey instruments for the focal constructs in this research. Below are the details of the methods and data collections used for each step in this procedure.

Step 1 – Conceptualization

To begin, a clear conceptualization of the focal constructs of **IT differentiation** and **IT integration** were described to provide a foundation for the subsequent steps. This initial step required developing clear, simple, and concise definitions of each focal construct. These definitions were derived from the prior literature, theoretical foundations, and similarities and dissimilarities from prior research. In addition to the definition a series of attributes regarding the construct were defined such as the focal entity, the general properties, dimensionality, stability, and required aspects for each construct.

Based upon the foundational differentiation and integration theory (Lawrence and Lorsch, 1967) **IT differentiation** is defined as the *organization's* level of IT variety between the *individuals'* IT portfolios. The focal entity of this construct is an organization with the focus being on a general property, an organizational attribute. Additionally, the construct is unidimensional in nature as it focuses purely on the number and variety of technologies used within the organization. As the number of technologies an organization uses over time may vary, the level of IT differentiation can change over time and across organizations. A necessary component of the measurement of IT differentiation is the presence of technologies utilized within the organization. An attribute of a high level of IT differentiation is a large variety of technologies within the organization.

As for IT integration, defined as the level of coordination of effort among the *individuals'* IT portfolios within an *organization's* IT portfolio, its focal entity is an organization as well with the focus being on a general property, an organizational attribute. Similar to IT differentiation, this construct is unidimensional as it focuses only on a measure of the integration of technologies. As the number and variety of technologies change within the organization the level of IT integration can vary over time and across organizations as well. An attribute of a high level of IT integration is the presence of high levels of conversion rates between the technologies within the organization.

Step 2 – Generate Items to Represent these Constructs

The second step was to acquire a set of representative items that capture the nature of the construct to be utilized in the subsequent analyses. The following items were generated based upon the focal definitions and dimensionality to capture the attributes of the construct. Ten items per construct were selected to provide the potential for removal in following cleansing steps.

IT Differentiation Items.

1. *I use many different technologies for my organizational tasks.*
2. *The number of technologies I use is different than those of other employees*
3. *The technologies we use within my organizational are all the same*
4. *Employees within the organization all tend to use different technologies.*
5. *The employees within my organization all tend to use the same technology.*
6. *I use unique technologies for my tasks compared to others within my organization.*
7. *Other individuals within the organization use unique technologies for their tasks.*
8. *The technologies used within the organization are very different between individuals.*
9. *Employees tend to select different types of technologies for their tasks.*
10. *There is a large differentiation in technologies between employees.*

IT Integration Items.

1. The technologies within my organization work together seamlessly
2. It is easy to share information and tasks from my technology to others within the organization.
3. The technologies I use within the organization are integrated with the others in the organization.
4. Files are not transferred easily between the different technologies in the organization.
5. It is for me to share task outputs from my technology with other individuals.
6. The technologies within the organization all interact with easy other easily.
7. There is little to no loss in quality sharing my task outputs to others will different technologies.
8. The technologies I use for my tasks all work flawlessly with the other technologies used in the organization.
9. The technologies used by individuals within my group are integrated well.
10. Technologies used in the organization can convert and open files from other technologies easily.

Step 3 – Assess the Content Validity of the Items

The third step was to access the content validity of each item to ensure that it is conceptually more related to its focal construct than the others within the model. MacKenzie et al. (2011) indicate that the development of clear content validity, "the degree to which items in an instrument reflect the content universe to which the instrument will be generalized", is crucial to ensuring a valid and reliable construct to be used in future research. The recommendation is to utilize a variation of a card sorting procedure, displayed in Table 2.A1 below, which lists all items on the left column, the focal constructs and definitions in the header rows, and ask each individual to rate each item in how well it relates to various constructs on a 1 – "Very Low" to 5 – "Very High". In addition to the focal constructs it is recommended to include additional constructs that are both similar and dissimilar to ensure discriminant and convergent validity. The results from these responses were then comparing the mean ranks of each item-construct relationship similar to a factor loading.

[See Table 2.A1.]

To collect data for this procedure it is recommended to find participants that (1) have the intellectual ability to rate the constructs and (2) be representative of the intended population. As the focus of these constructs is on an organization's number of technologies utilized by individuals a representative sample was collected from employed US participants through an online crowdsourcing market (Steelman et al. 2014) to allow for both a large sample and valid participants. Each participant was paid $0.50 to rate the items in this task.

A series of data collections were repeated in this phase to arrive upon a consistent set of items that reflected the constructs of interest. In each data collection, individuals rated the items against IT differentiation, IT integration, and a similar construct IT variety[g]. The first sample of 109 responses provided multiple items that either cross-loaded significantly, loaded on the wrong construct, or did not load onto any construct. In each survey, an open-ended question was provided to gather feedback from the participants in reference to problems with the survey, definitions, and items. Within the first data collection it was noted that the definitions between IT differentiation and IT variety were very similar and required further clarification. After adjusting the definitions for clarity a second data collection was gathered consisting of 100 responses. In analyzing the loadings for this data collection specific items were identified that had poor loadings. The items were then ranked in descending order of loadings for their respective constructs to identify the top five items for IT differentiation, IT integration, and IT variety. The final data collection in this step consisted of 51 responses and provided loadings that were as expected and no cross loadings between constructs.[h]

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[g] IT variety was defined as the number of ITs available in the market to complete a specific task.
[h] The specific items that were retained are discussed below during the full data collection step.

Step 4: Formally Specify the Measurement Model

After the set of items were analyzed to determine their relative loadings on the constructs' definitions the formal measurement model was specified. In this instance IT differentiation, IT integration, and IT variety were modeled as reflective measures as each item was expected to be highly inter-correlated and a reflection of the constructs' items and not a formation of the construct (Hair et al. 2006).

Step 5: Collect Data to Conduct Pretest

After the intended items were selected and a formal measurement model determined, the collection of pretest data was conducted to empirically validate the results through traditional statistical methods. A recommended threshold for the number of sample individuals include a range from 100-500 respondents (Comrey and Lee 2013) for the initial testing of the psychometric properties.

Step 6: Scale Purification and Refinement

Once the initial set of pretest data was collected, the empirical validation and refinement of the instrument began. Utilizing the formal model as specified in Step 4, an exploratory factor analysis was conducted to ensure similar construct loadings as prior steps. After dropping some items, which were problematic in their loadings, a confirmatory factor analysis was conducted utilizing structural equation modeling to validate the results (Bollen 1998).

This began by ensuring a proper solution was modeled that (a) converges and (b) none of the variance estimates were negative. Following a proper solution, the model can be examined through the significance of the individual relationships between constructs via z-tests at the appropriate significance level, the chi-square statistic, a series of goodness-of-fit indices (RMSEA, CFI, TLI, chi-square/d.f. ratio), the average variance extracted, the Cronbach's alpha and composite reliabilities, and the significant lambda values of each item. For any items that do not meet these requirements an elimination procedure was conducted to drop those with low validity, reliability, or strong and significant measurement error (Bollen 1998). Utilizing an iterative procedure of dropping items, which were problematic, and adjusting model based upon the modification indices, a sufficient model was found.

Step 7: Gather Data from New Sample and Reexamine Scale Properties

After the initial scale was refined and purified with a single data collection, an additional data collection was gathered to validate the refinements. Utilizing a reduced survey questionnaire, a sample of 200 employed U.S. participants were collected through the online crowdsourcing market (Steelman et al. 2014). This data collection was utilized for the following steps to assess the scale validity and reliability for future research usage.

Step 8: Assess Scale Validity

After a consistent and valid survey instrument was found the empirical results were validated a final time with this sample. Additional tests are recommended to experimentally manipulate the levels of each construct through vignettes or experimental designs. An alternative approach is to utilize known-group comparisons to compare known differences across groups. As this is (a) an initial development of the focal constructs, (b) known groups of individuals were not accessible at this point, and (c) the inability to experimentally manipulate an organization's level of IT differentiation and IT integration is not possible, this step was conducted in an alternative manner. This process was conducted by examining the expected correlations and relationships between constructs as predicted by prior theory. Additionally, the expected relationships within the nomological network were examined.

The scale assessment conducted in this phase consisted of the entire survey questionnaire in addition to the constructs developed through this procedure. A confirmatory factor analysis utilizing structural equation modeling provided a sufficient model (Bollen 1998) with a chi-square = 902.911, RMSEA = 0.055, CFI = 0.933, TLI = 0.924, and SRMR = 0.054.

Step 9: Cross-Validate the Scale

This step focused on cross-validating the scale across different groups, cultures, or demographics. This was conducted by collecting two additional samples of individuals through an online crowdsourcing market sample, restricting responses to only U.S. respondents and those who had not participated in any prior surveys (Steelman et al. 2014). The survey instruments were then compared to prior findings in this procedure to identify any significant problems that may have arose during an alternative sample. Each of the models provided consistent findings and loadings with the prior estimations.

Step 10: Develop Norms for the Scale

The final procedure for this validation process was to create norms and expected behaviors of the survey instrument for future empirical research. Based upon the scale anchors utilized and the item lead-in information a survey instrument and the participant instructions are provided below.

Full Survey Instrument and Instructions

The focal items utilized in this essay are provided below. Each item was measured on a 5-point scale from 1 = “Strongly Disagree” and 5 = “Strongly Agree”.

Introduction to IT Integration, IT Differentiation, and Individual Performance questions: For the following questions keep in mind all of the technologies that are utilized by individuals in your company for the completion of your organizational tasks.

IT Integration (Author developed)

1 *The technologies within my organization work together seamlessly.*

2 *The technologies used by individuals within my group are integrated well.*

3 *It is easy to share information and tasks from my technology to others within the organization.*

4 *The technologies I use within the organization are integrated with the others in the organization.*

5 *The technologies within the organization all interact with each other easily*

IT Differentiation (Author developed)

1 *There is a large differentiation in technologies between employees.*

2 *The types of technologies I use is different than those of other employees.*

3 *Employees within the organization all tend to use different technologies.*

4 *The technologies used within the organization are very different between individuals.*

5 *Employees tend to select different types of technologies for their tasks.*

Individual Performance (Author Developed)

1 *The technologies I use for completion of my tasks increase my performance.*

2 *I receive significant benefits from using these technologies to complete my tasks.*

3 *These technologies improve my overall effectiveness for my tasks.*

4 *These technologies are frequently used to improve the performance of my tasks.*

5 *My performance is increased from the use of these technologies.*

Work-Life Conflict (Ahuja et al. 2007)

If you are not married and/or do not have children, you can choose to respond to these questions in terms of your life outside of work in general (for example, replace “family” with “friends” and think of your other commitments, such as gymnasiums, book clubs, or any other hobbies).

1 *The demands of my work interfere with my home and family life.*

2 *The amount of time my job takes up makes it difficult to fulfill family responsibilities.*

3 Things I want to do at home do not get done because of the demands my job puts on me.

4 My job produces strain that makes it difficult to fulfill family duties.

5 Due to work-related duties, I have to make changes to my plans for family activities.

Job Satisfaction (Hackman and Oldman 1975)

1 Most people on this job are very satisfied with the job.

2 People on this job often think of quitting.

3 Generally speaking, I am very satisfied with this job.

4 I am generally satisfied with the kind of work I do in this job.

5 I frequently think of quitting this job.

Controls

1 Job Position: Please give us a short description of your current job position.

2 Tenure: How long have you been in your current position (in years)

3 Gender: Please indicate your gender:

4 Education: What is the highest level of education you have completed?

5 Age: What year were you born?

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Appendix C. PLS Robustness Analysis

The following results, in Table 2.C1, provide the estimation for the complete research model utilizing the two-step estimation procedure with PLS-generated latent variable scores instead of mean-value variables. The second step in this analysis utilizes OLS for estimation of structural model due to software limitations within SmartPLS 2.0 when examining multiple moderating relationships. The results from this analysis provide a similar pattern results, indicating further support for the insights found.

[See Table 2.C1.]

Chapter 2. Tables and Figures

Table 2.1. Organizational Interviewees

#	Organization	Interviewee	Job Description
1	Retail	RET1	Infrastructure development, focusing on new innovations and project planning for new technology roll-outs.
2	Retail	RET2	Infrastructure deployment, focusing on the large scale roll-out across the organization.
3	Retail	RET3	Vendor relationships and management with suppliers.
4	Retail	RET4	Legal counsel, specializing in security and licensing management.
5	Retail	RET5	Operations management for entire organization.
6	Retail	RET6	Infrastructure leadership across development, deployment, and support.
7	Government	GOV1	Infrastructure architecture development for statewide operations.
8	Government	GOV2	Customer relations management, focusing on sales of new services.
9	Government	GOV3	Documentation and quality control for policies, standards, and procedures.
10	Government	GOV4	Financial leadership focusing on the management of statewide budget for agency.
11	Government	GOV5	Call center operations, handling day-to-day support problems.
12	Government	GOV6	Information security operations for data centers.
13	Government	GOV7	Information security leadership, focusing on data centers, statewide networks, and policy development.
14	Government	GOV8	Legal counsel for stage agency.
15	Government	GOV9	Operations and support leadership, focusing on servicing customer and agency requirements.
16	Government	GOV10	Security analyst specializing in data security for data center.
17	Technology	TECH1	Operations management for national organization leading technology rollout directives.
18	Technology	TECH2	Operations support for technology implementations at a retail customer location.
19	Technology	TECH3	Sales management, focusing on customer contact at a retail customer location.
20	Technology	TECH4	Project management for customer support at a retail customer location.
21	Technology	TECH5	Senior leadership for operations, sales, and support at a retail customer location.
22	Technology	TECH6	Networking infrastructure support for a retail customer connected via remote technologies.

Table 2.2. Study 1 Illustrative Quotes[a]

Impact	Level	Individual Performance	Job Satisfaction	Work-Life Conflict
IT Differentiation	Low	"[standardization] absolutely hinders creativity because we at our scale … it was a requirement to be at standard as you can be…" – RET1	"I don't want someone who's coming straight out of college and has only ever used Macs to have a PC simply because the PC is slightly less expensive….That's not a good corporate decision but I also don't want to take an engineer who has only ever worked on PC and forced them to learn Mac because that's the only way to can get a machine powerful enough to do their job. That doesn't make sense either." – RET1	"Come in the house, set down the car keys, get the laptop out, set it on the coffee table. Boot it up, launch your VPN client, and watch your email flow all evening long..." – TECH3
	High	"[TEC] has an open policy about everything we do internally. There are some restrictions…,but primarily our company empowers us to leverage the technology that's out there to help us either improve our efficiences in doing our day-to-day job…" - TECH3	"I think we've got people that hate carrying two devices, for example. It [BYOD policies] takes away some of that stigma or dislike or displeasure. Being able to use an interface that they're the most comfortable with, it's a satisfaction level that they get to pick. They don't have to carry two devices and find that balance." – GOV9	"Yes, certainly. Any time we can have more flexibility. We live in an ever changing, busier, more active world and lifestyle for most people. Anytime that you can have flexibility to take care of personal things and business things at the same time and be affected and get your job done, that's always best." - RET3
IT Integration	Low	"We moved from [DatabaseA], now we're on [DatabaseB]. They're getting that database moved over…[DatabaseA] had all our database in it, where we pull up the names and stuff, it'll be there...It *used* to load…" – GOV5	"That is challenging … We don't have a standard platform that we know we can use with all of our vendors... Particularly, you're going to invite a large group of multiple people that they can only use that same technology is challenging." – RET3	"For some people it's very difficult to draw the line in the sand of the e-mails there. They felt compelled that they have to answer at the moment … how do I turn it off, how do I take a vacation and truly get a vacation. Is the expectation of my company going to be because I have this device that I'm available 24/7, 365." – RET3

[a] Illustrative quotes describe how increasing levels of IT differentiation and IT integration (low to high) impact individual performance, job satisfaction, and work-life conflicts. In general, individual performance and job satisfaction are examined to how they can be increased while work-life conflicts are examined to how it can be decreased.

Table 2.2. Study 1 Illustrative Quotes (Cont.)[a]

Impact	Level	Individual Performance	Job Satisfaction	Work-Life Conflict
IT Integration	High	"…we developed a set of tools that would integrate with Microsoft Outlook to allow the ease of scheduling a video conference into your Outlook meeting. I look at your calendar, I see your availability... Now let me hit a button and it's going to schedule the bridge, the resources for the bridge, and then populate the bridge information into the body of my invite and then send it out to everybody in one motion." – TECH3	"... it's got our voice stuff built-in, so it's my soft phone, it's my desk phone controller, it can do desktop video conferencing. It also syncs to my phone …I can be sitting anywhere, literally, and my cell phone rings and it will be the … client kicking off and saying you've got this call, do you want to answer it…" – TECH6	"The bad part of that is I always have access to my email. Does that cut into my "work life balance" because, to your point, it's easy to sit in the recliner now and just surf my emails." – TECH3
IT Differentiation x IT Integration		"… access to the office remotely is a common thing ... All my work takes place on a VM. Now I can remote into that VM from any device, any where." – GOV10	"Equal is maybe a hard thing to describe. I don't think my Mac users feel less supported but I had less support for them. Many of the things in our network and in our systems were designed specifically for PC so there are many things here that flat out won't work on a Mac." - RET1	"The associate receives flexibility. I have an integrated experience, that's what I choose … if I wanted to, I could have a separate work and a separate personal, I choose to integrate them all…My photos of my vacation are carried around with me and my kids and everything else so I enjoy that flexibility. When I don't want to be disturbed is generally when I leave the country to go on personal vacation. I shut my access off." – RET6
		"… when I pick up my iPad in the evening now to look and see if I have two or three e-mails that maybe came in after I left the office that I can quickly respond … I would label myself as more engaged and probably more available because of that flexibility." – RET3	"what we did try after that was every time you got a Mac you get a virtual Windows machine on top of it." – TECH1; "Now we have to run, go launch VMware or go launch Parallels and now we're living back in the Windows world to run one set of tools…" – TECH3	"All the way out to using it for HR related activities as I'm a people manager as well. If you're one of my direct resources and you want to request a PTO day off, a vacation day, you submit it. I can access it from my phone." – TECH3

[a] Illustrative quotes describe how increasing levels of IT differentiation and IT integration (low to high) impact individual performance, job satisfaction, and work-life conflicts. In general, individual performance and job satisfaction are examined to how they can be increased while work-life conflicts are examined to how it can be decreased.

Table 2.3. Summary Stats[a]

	Variable	AVE	CR	# of Items	Mean	Std Dev	1	2	3	4	5	6	7	8	9
1	Age	1.00	1.00	1	23.21	11.65	**1.00**								
2	Education	1.00	1.00	1	4.28	1.31	0.01	**1.00**							
3	Gender	1.00	1.00	1	0.54	0.50	-0.02	0.00	**1.00**						
4	Tenure	1.00	1.00	1	4.94	5.20	0.31	0.00	-0.01	**1.00**					
5	Work-Life Conflict	0.82	0.96	5	2.66	1.06	-0.02	0.07	-0.02	-0.05	**0.91**				
6	Individual Performance	0.83	0.96	5	4.23	0.72	0.03	-0.05	0.01	0.01	-0.09	**0.91**			
7	Job Satisfaction	0.68	0.92	5	3.23	0.86	0.02	-0.05	0.10	0.00	-0.34	0.25	**0.83**		
8	IT Differentiation	0.77	0.94	5	2.74	0.99	-0.09	0.03	-0.05	-0.06	0.15	-0.06	-0.01	**0.88**	
9	IT Integration	0.69	0.92	5	3.51	0.79	0.02	0.08	0.11	-0.05	-0.21	0.24	0.34	-0.22	**0.83**

[a] N = 487; Square root of the average variance extracted (AVE) on the diagonal.

Table 2.4. PLS Loadings and Cross-loadings[a]

	1	2	3	4	5	6	7	8	9
Age	1.00	0.01	-0.02	-0.09	0.02	0.03	0.02	0.31	-0.02
Education	0.01	1.00	0.00	0.03	0.08	-0.05	-0.05	0.00	0.07
Gender	-0.02	0.00	1.00	-0.05	0.11	0.01	0.10	-0.01	-0.02
ITD 1	-0.07	0.03	-0.05	0.85	-0.17	0.01	0.02	-0.04	0.12
ITD 2	-0.10	0.03	-0.04	0.89	-0.17	-0.05	-0.02	-0.07	0.14
ITD 3	-0.08	0.03	-0.05	0.90	-0.22	-0.09	-0.06	-0.04	0.12
ITD 4	-0.08	0.03	-0.05	0.92	-0.21	-0.09	-0.04	-0.06	0.13
ITD 5	-0.08	0.03	-0.05	0.83	-0.20	-0.04	0.06	-0.06	0.15
ITI 1	0.01	0.05	0.10	-0.10	0.81	0.13	0.32	-0.05	-0.13
ITI 2	0.00	0.07	0.12	-0.18	0.86	0.19	0.29	-0.05	-0.16
ITI 3	0.04	0.08	0.08	-0.21	0.82	0.29	0.28	-0.04	-0.19
ITI 4	0.05	0.08	0.03	-0.25	0.80	0.23	0.23	-0.02	-0.20
ITI 5	-0.04	0.06	0.11	-0.17	0.87	0.15	0.28	-0.06	-0.19
IndPerf_1	-0.01	-0.04	0.01	-0.08	0.23	0.92	0.23	-0.02	-0.08
IndPerf_2	0.03	-0.04	0.01	-0.07	0.20	0.89	0.24	0.00	-0.12
IndPerf_3	0.07	-0.04	0.02	-0.06	0.22	0.93	0.23	0.04	-0.08
IndPerf_4	0.02	-0.04	0.01	-0.02	0.21	0.89	0.22	0.00	-0.08
IndPerf_5	0.02	-0.04	0.01	-0.06	0.22	0.91	0.22	0.03	-0.07
JobSat_1	-0.01	-0.03	0.11	0.03	0.31	0.21	0.82	-0.09	-0.23
JobSat_2	0.02	-0.03	0.09	-0.09	0.24	0.16	0.78	0.01	-0.35
JobSat_3	0.06	-0.06	0.12	0.04	0.32	0.21	0.90	0.03	-0.25
JobSat_4	0.02	-0.06	-0.01	0.05	0.23	0.27	0.79	0.03	-0.22
JobSat_5	0.01	-0.05	0.10	-0.11	0.28	0.19	0.85	0.04	-0.38
Tenure	0.31	0.00	-0.01	-0.06	-0.05	0.01	0.00	1.00	-0.05
WLC 1	-0.05	0.07	0.03	0.11	-0.17	-0.10	-0.31	-0.06	0.90
WLC 2	-0.03	0.06	0.02	0.13	-0.16	-0.10	-0.28	-0.06	0.92
WLC 3	0.01	0.07	-0.01	0.15	-0.20	-0.06	-0.31	-0.03	0.92
WLC 4	-0.03	0.06	-0.05	0.13	-0.21	-0.06	-0.33	-0.06	0.92
WLC 5	0.01	0.07	-0.05	0.15	-0.21	-0.12	-0.28	-0.02	0.88

[a] ITD = IT Differentiation; ITI = IT Integration; IndPerf = Individual Performance; Job Sat = Job Satisfaction; WLC = Work-Life Conflict

Table 2.5. Results[a]

	Individual Performance			Work-Life Conflict			Job Satisfaction		
	Control	**Direct**	**Interaction**	**Control**	**Direct**	**Interaction**	**Control**	**Direct**	**Interaction**
Constant	4.21***	4.14***	4.14***	2.40***	2.50***	2.50***	3.80***	3.68***	3.68***
Age	0.00	0.00	0.00	-0.00	-0.00	-0.00	-0.01*	-0.01*	-0.01*
Education	0.01	0.03	0.02	0.06*	0.04	0.05	-0.04	-0.01	-0.01
Gender	-0.15*	-0.13*	-0.12*	0.11	0.07	0.06	-0.06	-0.05	-0.04
Tenure	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.03***	0.03***	0.03***
IT Differentiation		0.01	0.02		0.10*	0.09*		0.05	0.06
IT Integration		0.17***	0.18***		-0.21***	-0.22***		0.30***	0.30***
IT Differentiation * IT Integration			-0.09**			0.07*			-0.10**
R^2	0.00	0.06	0.07	0.01	0.05	0.06	0.02	0.12	0.13

[a] N = 489; * p<0.05; ** p<0.01; *** p<0.001

Table 2.A1. Construct Definitions Rating Task Example

Items	**IT Differentiation** - is defined as the *organization's* level of IT variety between the *individuals'* IT Portfolios.	**IT Integration** - is defined as the level of coordination of effort among the *individuals'* IT Portfolios within an *organization's* IT Portfolio.
Item 1	1 – "Very Low" to 5 – "Very High"	1 – "Very Low" to 5 – "Very High"
Item 2	1 – "Very Low" to 5 – "Very High"	1 – "Very Low" to 5 – "Very High"
Item 3	1 – "Very Low" to 5 – "Very High"	1 – "Very Low" to 5 – "Very High"

Table 2.C1. PLS Analysis[a]

	Individual Performance			Work-Life Conflict			Job Satisfaction		
	Control	Direct	Interaction	Control	Direct	Interaction	Control	Direct	Interaction
Age	0.04	0.02	0.03	-0.01	0.01	0.01	0.03	0.02	0.03
Education	-0.05	-0.07	-0.08*	0.07*	0.09*	0.09*	-0.05	-0.09	-0.10*
Gender	0.01	-0.01	0.00	-0.01	0.01	0.00	0.12	0.07	0.08*
Tenure	0.01	0.02	0.01	-0.05	-0.06	-0.05	-0.01	0.02	0.01
IT Differentiation		0.00	0.02		0.10*	0.09*		0.07	0.09*
IT Integration		0.25***	0.26***		-0.20***	-0.21***		0.35***	0.36***
IT Differentiation * IT Integration			-0.12**			0.08*			-0.10**
R^2	0.00	0.06	0.07	0.01	0.07	0.06	0.02	0.13	0.13

[a] N = 497; * p<0.05; ** p<0.01; *** p<0.001

Figure 2.1. Organizational Sub-Task Example

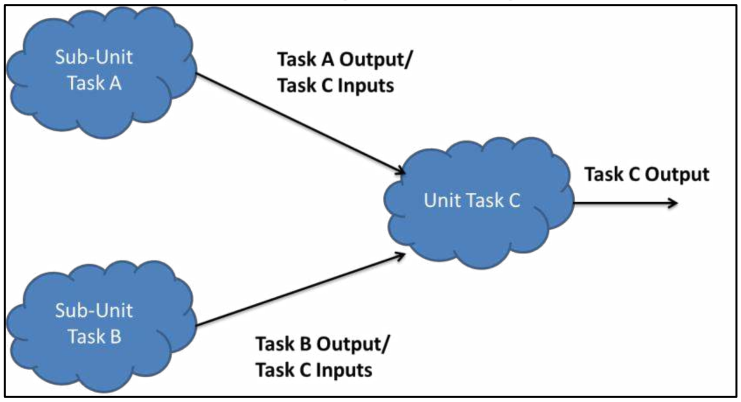


Figure 2.2. IT Differentiation Scenarios

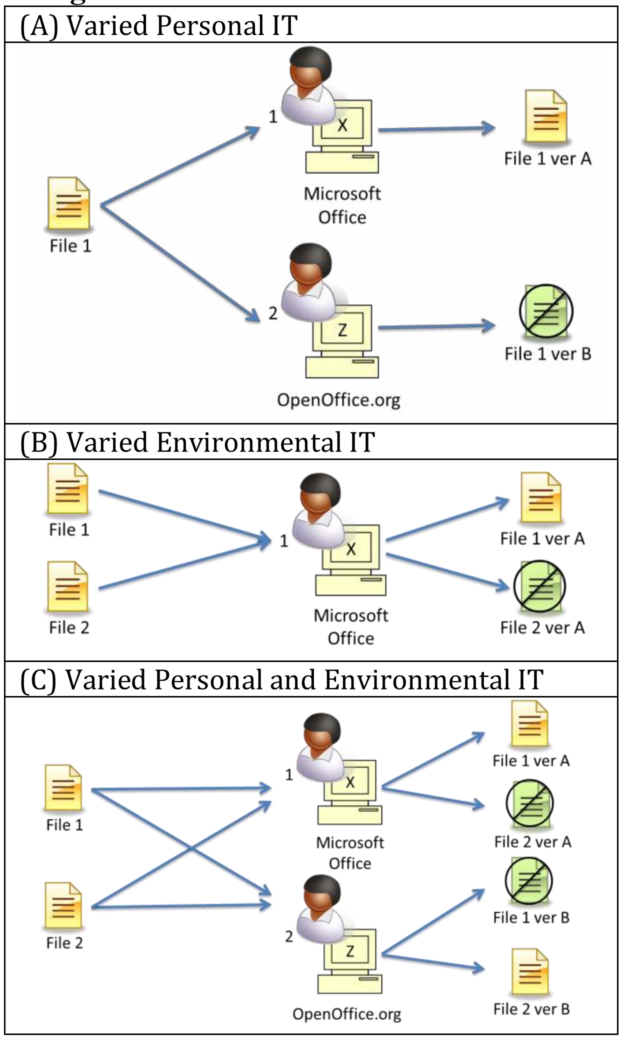


Figure 2.3. Qualitative Analysis Process

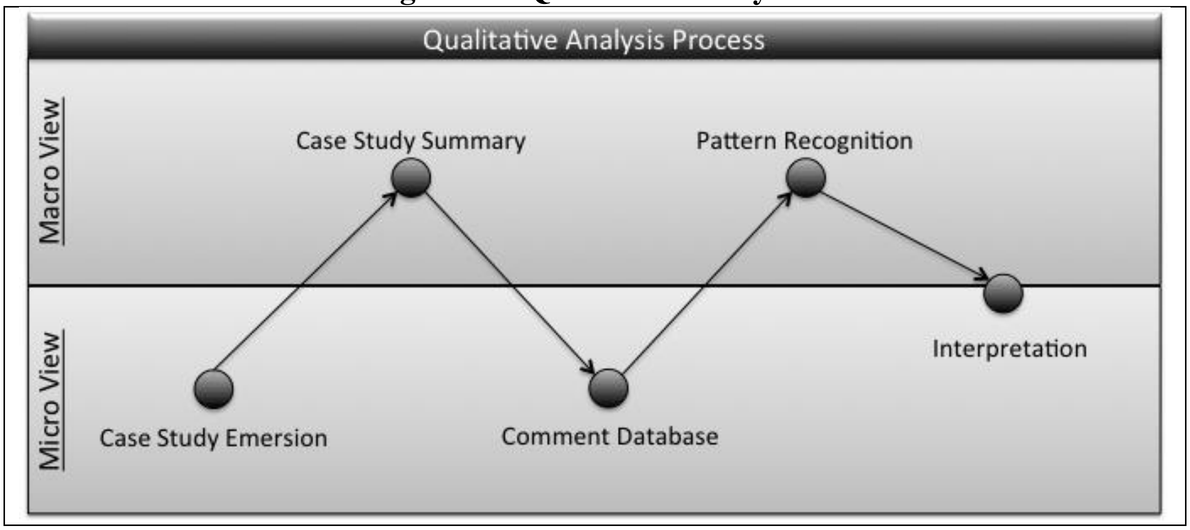


Figure 2.4. Research Model

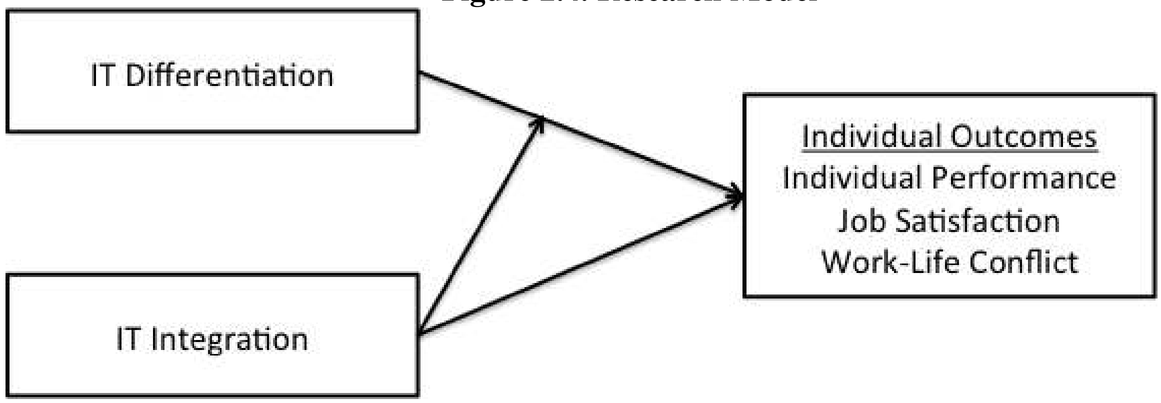


Figure 2.5. Interaction Plot for Individual Performance

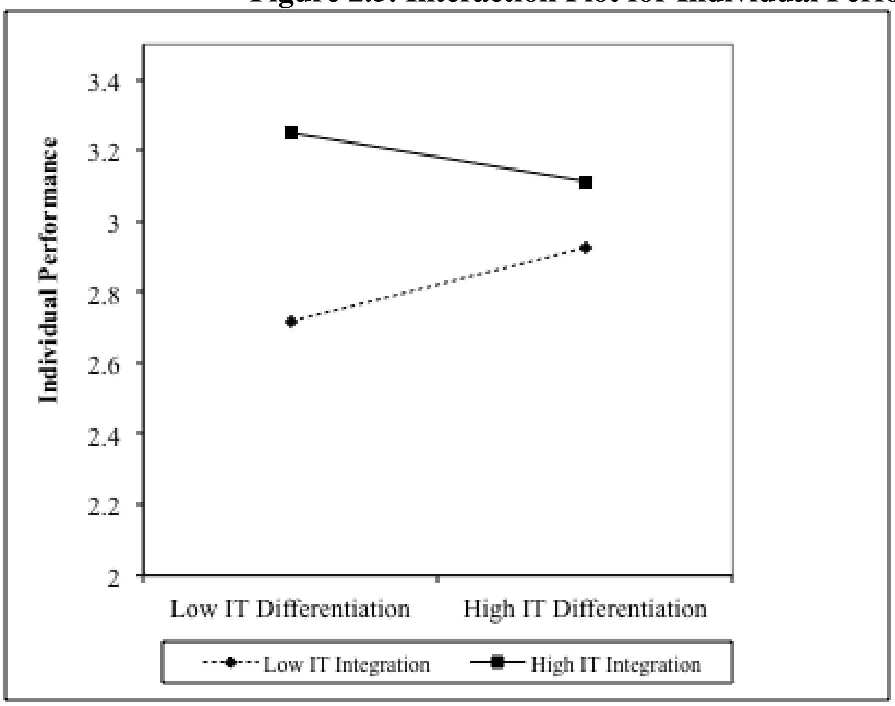


Figure 2.6. Interaction Plot for Work Life Conflict

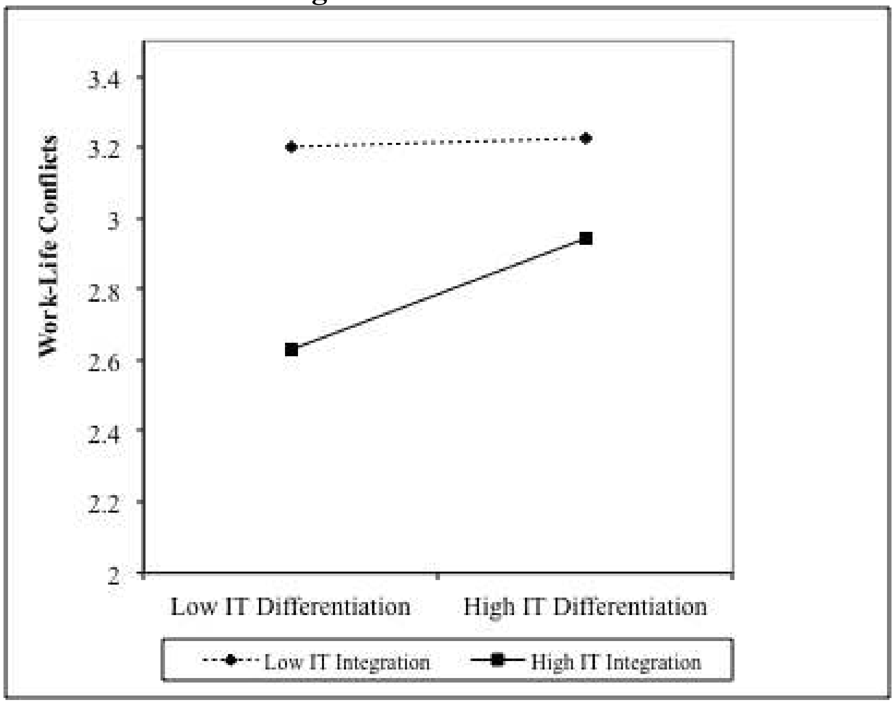


Figure 2.7. Interaction Plot for Job Satisfaction

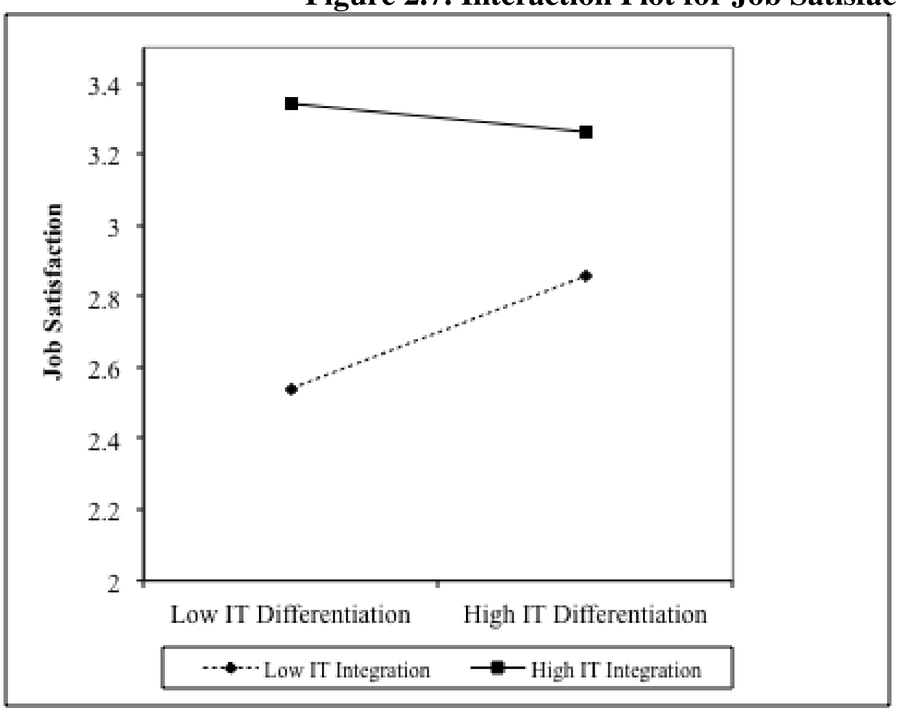
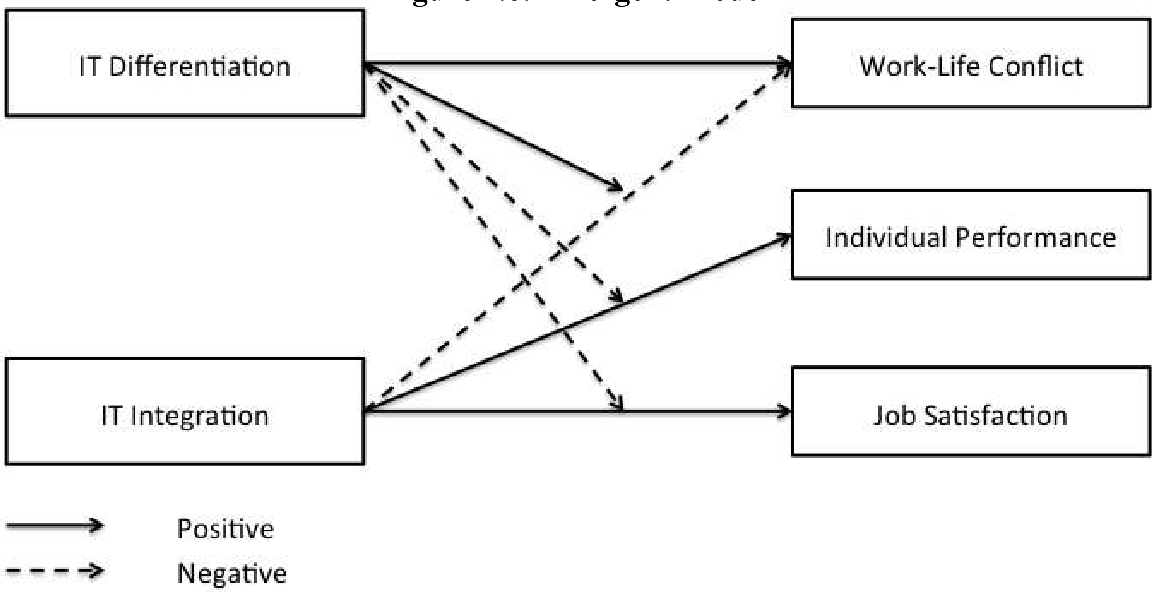


Figure 2.8. Emergent Model



Chapter 3. The Development and Management of Organizational IT Portfolios: Managing the Task Environment and Organizational Performance

Introduction

Extensive prior research on information systems (IS) indicates that investments in organizational information technology (IT) can provide significant impacts on organizational performance (Brynjolfsson and Hitt, 1996; Dewan and Min, 1997; Bharadwaj 2000). Further, by taking a contingency approach to this issue, researchers have begun to develop a deeper understanding of IT's performance impacts under different environmental contexts (Melville et al. 2007; Chiasson and Davidson 2005), business strategies (Sabherwal and Chan 2001), and investment categories (Aral and Weill 2007). However, until recently, the examination of the ***specific*** types of IT, the ***variety*** of IT, and the ***level*** of specific IT investments has been restricted by data collection issues arising from limited management disclosure of IT investments. The impact of organizational IT investment is typically examined by considering it as the dollar amount invested or a count of ITs, limiting the understanding of the differential impacts of specific organizational ITs and their usage (Devraj and Kohli 2003). For example, does the investment of a single $6 million IT provide the same performance impacts as three ITs for $2 million dollars each?

Research on the strategies and capabilities that organizations should employ and develop to attain a competitive advantage has emphasized the concepts of organizational agility, or the ability to quickly adjust and react to different environmental conditions (Overby et al. 2006; Sambamurthy et al. 2003). The main rationale is that the environments in which organizations compete in are highly dynamic, and require adjustments to organizational assets to ensure that they are positioned to handle these changes and sustain their advantages. One approach to enhancing organizational agility is through the implementation and reconfiguration of organizational IT assets to build a flexible IT infrastructure (Duncan 1995). These flexible IT infrastructures, which can be scaled and adapted to the environmental requirements (Byrd and Turner 2000, 2001) through the inclusion of emerging technologies and redesign of business and IT processes (Duncan 1995), allows organizations to be agile in their respective environments (Tallon and Pinsonneault 2011).

IT flexibility enables organizations to better use IT to address rapid changes in their environments (Chung et al. 2003). However, some argue that the emphasis on the implementation of flexible IT environments leads to duplicate technologies in the organization and thus increases operating costs (Kettinger et al. 2010). This has been the basis for many arguments toward standardization and large-scale implementations such as enterprise resource planning (ERP) systems, which provide increased stability and consistency across the organizational IT environment. While standardization can be important in creating efficiency in some organizations, global standardization of organizational IT systems can be highly problematic when the business conditions and environments vary and the global IT infrastructure is unable to be reconfigured to accommodate the required changes (Kettinger et al. 2010).

The development of a flexible IT infrastructure is through the balance of IT variety required to meet environmental and task demands and IT integration to ensure consistent communication across the organization (Tallon and Pinsonneault 2011). By adjusting the variety of IT investments in the organization over time in relation to specific environmental demands, the organization is able to configure its IT infrastructure to ensure the needs of the organizational tasks are met[i]. While IT variety allows organizations to meet environmental demands, they must also integrate these ITs during the influx and removal of IT assets. Organizations have consistently struggled integrating legacy systems with recent IT purchases to ensure a stable workflow for employees. For example, during an environmental shift, an organization determines that it must invest in an enterprise system (ES) to meet its customer demands. During the implementation, the new ES must integrate with the existing IT infrastructure to perform as expected. If problems arise in this integration there is the potential for significant workflow problems during the transition that would hinder the organization's ability to complete its tasks.

Agile organizations are able to simultaneously balance the conflicting goals of stability and flexibility to survive and succeed in the face of environmental changes as flexibility without some level of stability leads to chaos in the organization (Volberda 1996; Lu and Ramamurthy 2011). Organizational agility and IT flexibility are organizational capabilities that should be viewed from an evolutionary view, rather than at one point in time, to examine how organizations adjust and reconfigure their assets over time in relation to the environment. Moreover, while there is some empirical evidence indicating that organizational IT investments towards flexibility and agility in the organization lead to performance, research on exactly ***what combination of IT*** is implemented in the organization to achieve this has been limited. More

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[i] For example, since the 2000s, organizations have tried to leverage the significant amounts of data that is available through social networking platforms (i.e. MySpace, Facebook, Twitter). However, the technologies that were currently in the organization in early 2000's were not developed to handle the size and type of data coming from theses platforms (Aral et al. 2013). To ensure that they could capture, analyze, and utilize this data for strategic decision-making, many organizations now invest in new "big data" analytic software and databases. The IT infrastructure required adjustment and reconfiguration to meet the changing demands and help develop a competitive advantage.

specifically, how are organizational IT infrastructures managed and configured to allow for a flexible IT infrastructure, providing the organization the ability to meet its environmental demands, and still ensure adequate integration across the infrastructure to allow for collaboration. To examine the portfolios of ITs, this essay draws upon Lawrence and Lorsch' (1967a, 1967b) theory of differentiation and integration.

Prior literature has also focused to some extent on how individuals and organizations should select which IT to implement within their organization to meet specific tasks and environmental demands. The Task-Technology Fit (Goodhue and Thompson 1995; Goodhue 1998) theory, one of the foundational approaches to address this issue, provides insights into the technologies ITs that provide individuals the best performance when completing specific tasks. However, a potential limitation to this perspective, especially at an organizational level, is that in an organization is comprised of a portfolio of tasks to complete as well as a host of alternative technologies for employees to use in those tasks (Gebauer et al. 2010). Accordingly, this essay focuses on the portfolio or organizational tasks as well as the portfolio of ITs. Moreover, to provide deeper insights into how organizations can configure their organizational IT portfolio to increase their overall performance, it builds upon the TTF literature and examines the effect of the IT configuration as a moderator of the effects of the task portfolio on organizational performance.

Thus, this essay focuses on the development of organizational IT infrastructure flexibility though the configuration and adjustment of the organizational IT portfolio, viewed in terms of differentiation and integration. Additionally, the characteristics of the organizational task portfolio are examined to provide insights into the organizational task environments for which specific IT configurations provide an increase in organizational performance. Utilizing a combination of an in-depth organizational case study and a series of agent-based simulations this essay takes a process theory view of the management of organizational IT over time to develop the theoretical model. This essay attempts to address the following research questions to provide insights into the management of IT portfolios in the face of varying organizational task environments over time.

(RQ1) How does the organizational IT portfolio affect performance over time?
(RQ2) How does the organizational IT portfolio moderate the effects of the organizational task portfolio on performance?

The remainder of this essay is structured as follows. The next section develops the theoretical foundations for the essay by deriving two attributes of the organizational IT portfolio, IT differentiation and IT integration, from Lawrence and Lorsch's (1967a) theory of differentiation and integration, discussing the characteristics of the organizational task portfolio, and proposing the initial research model. Subsequently, the methods used in this essay, a qualitative case study and an agent-based simulation, are described. The results of the agent-based simulations and insights from the case study are then discussed to explore the impact of the IT portfolio configuration on managing the organizational task environment and performance. Finally, the essay's contributions, limitations, and implications for practice and research are discussed.

Theoretical Foundations

Differentiation and Integration of IT Portfolios

There has been extensive literature on the management and configuration of organizational assets to provide increased performance and productivity. A prominent theory in this area is the theory of differentiation and integration introduced by Lawrence and Lorsch (1967a), cited over 10,000 times, focuses on two complementary states of the organization – differentiation and integration – which when aligned to the environmental conditions, increase performance for the organization.

Lawrence and Lorsch (1967a, p3) view the organization as "a system of interrelated behaviors of people who are performing a task that has been differentiated into several distinct subsystems, each subsystem performing a portion of the task, and the efforts of each being integrated to achieve effective performance of the system." For example, in a typical organization, a variety of departments (i.e. accounting, marketing, finance) perform specialized sub-tasks. These sub-tasks are then shared and combined to complete the larger organizational tasks. This division of labor across departments is the focal concept of differentiation in the organization. More specifically, differentiation is defined as the state of division of the organization into groups, each with their own particular attributes that handle different sub-tasks and requirements posed by the organizational environment (Lawrence and Lorsch, 1967a; Blanton et al. 1992). This builds upon the fact that complex organizations must be "departmentalized" to allow for individuals in the organization to know their specific roles and reduce the expectation to perform "anything at any time" (Dougherty 2001).

While the concept of differentiation provides insights into how the organization can develop abilities to address specific demands in the environment, the accomplishment of organizational goals, specifically those that are highly interdependent, requires the integration between the differentiated groups. Integration is viewed as "the process of achieving unity of effort among the various subsystems in the accomplishment of the organization's tasks (Lawrence and Lorsch 1967a, p4)."

Thus, successful organizations simultaneously balance the ability to address and respond to environmental demands through organizational differentiation while ensuring a sufficient level of integration between subunits for the completion of organizational tasks. For example, the marketing and sales departments may be able to complete their specific sub-tasks (i.e.

advertising and sales transactions) more effectively by developing their own attributes and abilities to meet demands. However, when completing organizational tasks, such as the long-term sale of merchandise, both departments must work together to integrate their individual efforts to aid in organizational performance.

Lawrence and Lorsch's (1967a) theory has been utilized to examine a variety of organizational phenomena such as the development of innovations (Doughtery 2001), supply chain integration (Terjesen et al. 2012), and organizational ambidexterity (Jansen et al. 2009; Raisch et al. 2009). Additionally, information systems research has explored these relationships in IT governance (DeSanctis and Jackson 1994), data integration (Gattiker and Goodhue 2005; Goodhue et al. 1992), and the impact of IT organizational structure on IT support effectiveness (Blanton et al. 1992). However, prior studies on differentiation and integration have examined these aspects for organizations, teams, or individuals, and not for specific assets such as IT. By contrast, this essay utilizes a bottom-up approach of IT adoption and use (Nan 2011). Thus, instead of focusing on organizational structure, it examines the differentiation and integration of *specific* IT assets in the organization's IT portfolio.

The following theoretical development utilizes a social and technical view of IT assets to provide a holistic view on how IT is selected, managed, and appropriated in the organization (Waring and Wainwright 2000). For example, if we view differentiation and integration from an IT asset perspective, we may find an organization that has been differentiated into multiple sub-units (i.e., departments, groups, teams) yet utilize a standardized ERP system across the organization. From a structural perspective, we may find a significant level or differentiation; however, from the IT assets perspective the sub-units are utilizing the same technology and lack differentiation in their IT usage.

This essay contextualizes the level of differentiation and integration in the organization to the ***actual*** ITs utilized instead of simply the organizational structure. This contextualized theory provides an extension to the differentiation and integration theory (Lawrence and Lorsch, 1967a) and positions it in the information systems research nomological network. Expanding upon the prior definitions of differentiation, **IT differentiation** is defined as the *organization's* level of IT variety between the *individuals'* IT portfolios. The adoption and utilization of specific ITs by individuals in the organization are meant to address the requirements posed by their relevant sub-tasks and environments. Similarly, developing from prior theory, **IT integration** is defined as the level of coordination of effort among the *individuals'* IT portfolios in an *organization's* IT portfolio. In line with prior theory, this conceptualization aims to provide insights into how organizations manage and configure their IT assets in an attempt to increase their performance amidst changing environments. This approach provides a decomposed and technical view to how organizations can develop a highly flexible IT infrastructure through the simultaneous balance of IT differentiation and IT integration.

Organizational Task Portfolios

Researchers have been examining how ITs can impact performance of individuals, groups, and organizations for decades. While prior research has indicated that the adoption and use of technologies are a key function in increasing performance (e.g., Davis 1989; Zigurs and Buckland 1998), it is not the sole indicator. The task-technology fit (TTF) literature indicates that it is not only the specific *technologies* that are used for a task but the ability to meet the specific requirements of the *task* that are needed to produce the expected level of performance (Goodhue and Thompson, 1995; Goodhue 1998). This perspective indicates that the characteristics of the technology and the attributes of the task must align to lead to an increase in both technology utilization as well as performance on a task.

Individuals use the technologies as a *tool* to help complete their tasks. These tasks are "the actions carried out by individuals in turning inputs into outputs (Goodhue and Thompson 1995, p. 216)". TTF reflects how well the selected specific technologies aid the individual in completing the "portfolio of tasks" (Goodhue and Thompson, 1995). In other words, the task characteristics moderate the perceived ability of the technologies to "fit" the needs of the tasks (Goodhue 1998).

As noted earlier, individuals in an organization have a "portfolio of tasks" that constitute their job roles within the organization. Moreover, when examining the implementation and selection of ITs at the organizational level, the composition of an organizational portfolio of tasks across all individuals must be examined. While the TTF literature began at the individual level, it has since been explored to the group and organizational levels through the perceived TTF of technologies used to support groups in the organization (Zigurs and Buckland 1998; Maruping and Agarwal 2004). Initial forays into the TTF literature focused on highly contextualized tasks and technologies to explore the impact of fit in specific scenarios (Lee et al. 2007; Dishaw and Strong 1998; Gebauer et al. 2010). However, this has been noted as potentially limiting the generalizability of TTF findings (Gebauer and Ginseng 2009), especially at group and organizational levels that are comprised of both a portfolio of tasks and a portfolio of ITs.

The research on tasks within the organization has drawn upon the job-design literature, which explores the impact of various task characteristics on performance within the organization (Hackman and Oldman 1975). The categorization of tasks can be viewed at many levels from highly context specific to very abstract depending on the focus and anticipated generalization of the research. Given this essay's focus on a generalizable view of how organizations configure their IT portfolio to increase their performance on all tasks across the organization, a general set of common task attributes were selected.

The job-design literature has commonly focused on three task characteristics[j] – variety, complexity, and interdependency – to help organizations design more effective and efficient processes (Hackman and Oldman 1976; Saavedra et al. 1993; Ang and Slaughter 2006). These task characteristics provide a broad overview of the organizational portfolio of tasks across the organizational employees. *Task variety* is the number of unique tasks that employees complete within the organization. *Task complexity* is the number of skills and technologies required to complete each unique task. *Task interdependency* is the number of tasks that are required to be completed in conjunction between the individual employees.

To explore the ability for organizations to configure their organizational IT portfolio to meet the needs of their organizational task portfolio, the initial research model in Figure 3.1 is explored. This model includes the direct impacts of organizational IT portfolio on organizational performance (RQ1) as well as the moderating effect of the organizational task portfolio on performance (RQ2). The direct effect of the organizational task portfolio is included in the examination but not the focus of this study due to the extent of prior research (Jehn et al. 1999; Bakker et al. 2004; Fried and Ferris 1987).

[See Figure 3.1.]

To explore this model and address the research questions in this essay, a multi-step theory development and extension process is utilized. Figure 3.2 depicts the research process. This process begins with the initial model that describes the basic relationships explored between the organization's portfolio of tasks and technologies. Next, the impacts of the organizational IT and task portfolios on both organizational and individual task performance are examined. Additionally, due to this theory examining a new context and conceptualization of the IT portfolio, an exploratory mixed-method approach is adopted (Venkatesh et al. 2013). This approach utilizes a two-step process integrating both a qualitative case study and an agent-based simulation (ABS) to provide increased validity and richness to the theory development (Kane and Alavi 2007). The qualitative interviews utilized in this process provide real-world insights into the impact that the IT portfolio may have on organizational performance. The ABS, based on the insights derived from prior theory and the qualitative interviews, models the relationships among the organizational IT portfolio, organizational task portfolio, and performance. The use of a modeled reality through the ABS allows for novel theory development while reducing alternative environmental variables (Gilbert 2008). Finally the emergent model, derived from the hypotheses and insights collected during the analysis, is evaluated through a series of robustness tests to ensure the consistency of the findings.

[See Figure 3.2.]

Research Methods

A combination of an in-depth case study and agent-based simulations are used to explain, explore, and evaluate the research model, and thereby address the research questions in this essay. The use of ABS is recommended for the development of novel theoretical perspectives that include the analyses of both the behaviors of the individuals and the evolution of the network (Davis et al. 2007). ABS is especially beneficial when a full range of data may not

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[j] While these three task characteristics are most commonly used, they are not the only ones to categorize a specific task. The limitations of this are addressed in the discussion.

easily be found in a field study (Kane and Alavi 2007) and patterns cannot be easily understood without a bottom-up evolutionary approach to individual relationships (Macy and Willer 2002).

The use of ABS to develop theoretical insights starts with a simplified model for theorizing, as recommended for initial "thought exercises" and development (Axelrod 1997; Macy and Willer 2002). This model is then explored and refined via increasing levels of complexity to expand the theory to more closely model reality (Davis et al. 2007). The ABS provides the foundation for the expected outcomes in a real-world context while simplifying alternative environmental variables.The simulation model is based on an in-depth case study conducted through interviews (Kane and Alavi 2007). The insights from the case study are used to model the behaviors and parameters in the simulation, and explore and validate the simulation results (Rudolph and Repenning 2002).

Case Study Method

An in-depth case study was conducted to explore the management of organizational IT portfolios, and provide a basis for the simulation (Eisenhardt 1989). An organization that was in the process of implementing new IT management policies was used for the case study to understand the rationale and expectations associated with the changes. Semi-structured interviews with six employees in the organization and four employees of the organization's selected IT vendor[k] provided the data. Please refer to Table 3.1 for a description of each interviewee. Interviews ranged from 32 to 100 minutes, and were transcribed to produce 184 pages of transcripts. In addition, a set of internal documents, including presentation slides and IT policy documents, were reviewed.

[See Table 3.1.]

A multi-step procedure was used to analyze the interviews and ensure consistency of the interpretation across the participants. This process included an iterative analysis between macro- and micro- perspectives of the qualitative data to develop generalized relationships and extract unique details from each individual. The specific steps consisted of: (1) case study immersion; (2) case study summarization; (3) development of a qualitative comment database; (4) pattern recognition in the database; and (5) an interpretation of the patterns and relationships.

To begin, each interview was read in detail to allow for an immersion into the case study and identify the general attributes about the organization (Marshall and Rossman 2010). This initial reading of the transcripts provided an overview of the perspectives of individual respondents, as well as the similarities and differences among them. During this phase, general notes were made about important aspects, stories, and contradictory comments that were later captured during the detailed analysis. It is important to note that specific constructs were *not* identified or coded in this step.

After each interview transcript was read in detail, a high-level summary of the organizational environment, culture, and IT initiatives was developed. This summary was used to identify over-arching themes and attributes regarding the specific case study based on a synthesis of the perspectives from each individual (Miles and Huberman 1994).

Next, each interview transcript was entered into a qualitative database utilizing Microsoft Excel to allow for efficient coding, interpretation, and pattern recognition (Sabherwal and Chan 2001). This qualitative database included 1,793 lines of unique comments across the 10 interviews. Each unique comment was coded in relation to the focal constructs of the research

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[k] Please refer to Appendix A for the interview protocol and a description of the interviewees.

model to identify relevant insights for each construct. During this coding process each interview was read in fine detail, inspecting each comment and story to identify specific insights relating to the aspects of the organization's IT.

Next, the comments were sorted based on the focal constructs to decontextualize the comments from a specific respondent and flow of the interview conversations. The resulting patterns of relationships were then generalized to a macro-level for further interpretation.

The insights and patterns of relationships among constructs were used in the final step of interpretation to provide support for the general relationships examined and simultaneously providing detailed stories and insights from each interview respondent. This multi-step analysis procedure was utilized to provide a summary of the organization and explore the organizational IT management procedures utilized to configure the IT differentiation and IT integration of the IT portfolio.

Case Summary

The organization participating in this study, **GlobalRetailer**, is a large, multi-national retailer, which operates thousands of locations and employs many thousands of employees at various levels. In addition to the traditional brick-and-mortar (**B&M**) locations managed by GlobalRetailer, a significant e-commerce (**ECom**) presence is managed to handle products available both in-store and those only available online via GlobalRetailer's distribution networks. B&M and Ecom overlap somewhat in their operations and services due to the retail nature of the organization and its products, but they service customers in different ways. Additionally, the operational bases of B&M and Ecom are located in vastly different environments, with Ecom being located in the hub of Silicon Valley and B&M being located in Midwest U.S. Due to the information intensive nature of handling thousands of stores and a significant online presence in parallel, GlobalRetailer has developed a strong team of IT professionals and a growing IT infrastructure to remain ahead of the curve in this highly competitive environment. GlobalRetailer is continually increasing its IT resources and capabilities to ensure both its customers' and employees' needs are met in the most effective and efficient manner.

Throughout this investigation, attention was paid to the policies and procedures that GlobalRetailer uses to manage the IT needs of its stores, Ecom, and B&M. Due to the unique nature of each aspect of the organization, alternative policies and procedures were put in place to ensure efficient and effective use of IT resources. In the following sections the insights developed during these interviews at GlobalRetailer are used to explore and interpret the findings of the agent-based simulation.

Agent-Based Simulation Method

The analysis and development of the theoretical model progresses with an iterative interpretation between the ABS and the case study insights from GlobalRetailer. First, a description of the ABS procedure is provided to outline the development, measurement, and analysis of the model. Here the environment, organization, and individuals are formally defined to provide clarity to the simulation's development. Following the description of the simulation model, the impacts of the organizational IT portfolio attributes, IT differentiation and IT integration on performance, are examined. Next, the delicate nature of a balanced IT portfolio is examined in further detail to determine potential optimal states for organizational IT portfolio configurations. Lastly is an exploration of the impact of IT portfolio configurations on an organization's ability to address various task demands. Throughout the exploration of the simulation, the use of qualitative insights and comments from GlobalRetailer are utilized to validate the model and provide a deeper understanding to the results (Kane and Alavi 2007).

Simulation Model Specifications

The discussion of the computational model begins with the basic specifications of the environment, organization, and individuals, which is depicted in Figure 3.3. The following specifications are used to achieve a simple yet insightful model. The model consists of an organization, its employees, a set of tasks and sub-tasks, and the ITs needed to complete the sub-tasks. Each individual in the ABS has his or her own set of behaviors and attributes and acts independently to influence perform subtasks.

[See Figure 3.3.]

To begin, the environment has the following basic specifications:

- *It includes a finite set of sub-tasks for the individuals to perform.*
- *It includes a finite set of technologies for the individuals to utilize in their individual sub-tasks.*
- *Each technology in the environment has a specific ability to complete each sub-task in the environment.*
- *Each technology in the environment has a specific ability to communicate and convert the outputs of each of the other technologies in the environment.*

Furthermore, there is an optimal IT that can be used to most successfully complete for each sub-task. The model also includes a conversion ability for each pair of ITs in the environment. Greater conversion ability between two ITs implies reduced loss of information and fidelity during sub-task hand-offs and conversions between those ITs. Therefore, within each simulation there is a specific combination of sending and receiving ITs in the environment with the highest conversion ability in the environment.

The following specifications apply to the specific sub-tasks and tasks in the organization:

- *An organization comprises of individual actors who* ***independently*** *complete assigned sub-tasks that are then combined with other sub-tasks to complete specific organizational tasks.*
- *The completion quality of the organizational tasks is a function of the individuals' sub-task completion quality and the interactions among individuals to combine the outputs of individual sub-tasks through specific technologies.*

- *Each individual shares his or her sub-task output with at most one individual, based upon sequential interdependency.*[1]

Organizational performance is then determined through the completion quality of various interdependent tasks, computed as a function of the individual sub-task completion quality, the specific technology conversion abilities, and the variation of sub-task compositions for organizational tasks. While the above specifications provide a basis for the distribution of sub-tasks and tasks, the following specifications outline the variations in attributes and behaviors of individuals completing each sub-task.

- *Each individual in the organization is assigned a random sub-task to complete during each simulation.*
- *Each individual in the organization begins with a random set of technologies in his or her individual technology portfolio.*
- *Each individual only uses technologies from within his or her own specific technology portfolio at each time period.*
- *In each time period an individual utilizes his or her own task knowledge and technology knowledge with selected technologies to complete the sub-tasks.*
- *After each sub-task, the individual's level of knowledge of the sub-task and technology utilized increases from experience.*

These individual behaviors and attributes provide the basis for determining the individual sub-task completion quality in the organization. While organizational performance focuses on the completion quality of tasks, which are a combination of sub-tasks, the individual performance is developed independently of others in the organization as they complete their sub-tasks.

The primary benefit of utilizing a bottom-up approach in ABS is the ability to examine how individuals' behaviors influence the organization over time (Axelrod 1997; Macy and Willer

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1 Alternative forms of dependency may be modeled (i.e., reciprocal, pooled, etc.) but, for simplicity, this essay is limited to sequential dependency.

2002). An outline of the simulation procedures, timeline, and the specific behaviors conducted during each time period is depicted in Figure 3.4 and discussed in further detail below.

[See Figure 3.4.]

During each time period, each individual's primary goal is to complete his or her own assigned sub-task. To complete the sub-task, a specific technology must be selected from the individual's personal IT portfolio. This selection is based on each individual selecting the "best" technology to use for the sub-task based on each technology's ability. This specification is based on the TTF theory (Goodhue 1998), discussed earlier. After using this technology, each individual will evaluate the performance at his or her sub-task and determine if the technology has worked successfully. If an individual has a repeated series of issues completing the sub-task with a specific technology, (s)he will search for an alternative and switch technologies in their personal IT portfolio. This evaluation and search will drive the evolution of both personal and organizational IT portfolios through the addition and removal of ITs over time.

The development of the ABS model is based on these initial specifications of individuals, organization, and environment. The following section describes the computational modeling of the focal constructs in the model – the organizational and individual performance, IT differentiation, IT integration, and task characteristics – to provide a basis for estimating these constructs in the ABS.

Measurement

This section describes the formal computation calculations, which estimate the focal constructs in the research model: individual and organizational performance, IT integration, IT differentiation, task variety, task complexity, and task interdependency. Two types of variables are examined within these simulations: those that change over time, and those that are specified throughout the simulation. The calculations for the variables that change over time – individual sub-task performance, organizational task performance, IT differentiation, and IT integration – are described in Table 3.2.

[See Table 3.2.]

Performance.

In each time period, each individual must complete his or her own assigned sub-task. To complete a sub-task, each individual selects an IT from his or her personal IT portfolio, and then attempts to complete the assigned sub-task by using his or her own knowledge of the task and the IT. Each IT has a specific ability to complete each task in the environment. Table 3.2 includes the equation for calculating an individual's sub-task performance.

Groups of individuals work on multiple tasks in parallel to complete organizational tasks. The completion of a task is contingent upon the completion of both individual sub-tasks and the level of sub-task combination between the individuals in the group. For example, individual A utilizes Pages for the development of a report and proceeds to share his or her output to individual B who utilizes Word for the formatting of the report. During the conversion from Pages to Word there is a potential for loss of fidelity and consistency of the output from Individual A. This conversion between Pages and Word has no impact on the individuals' sub-task completion, performed independent of one another; however, when combining the outputs for an organizational task, it reduces the quality of task completion. Table 3.2 also includes the equation for calculating the organizational task performance. For example, if individuals A, B, and C are working on a task and have each completed individual sub-tasks, we would estimate the product of all individual sub-task completion values and multiply it by the product of the number of conversions between each individual and his or her technology. This estimates the task completion value as a function of the individual sub-task completion values and the ITs used by the individuals.

In summary, these calculations estimate an individual's own sub-task performance, independent of all other individuals in the organization, as well as the task performance as a component of individual sub-task performance and the associated technology conversions between individuals. To generate levels of individual and organizational performance at the network levels, the average individual sub-task performance and the average organizational task performance are utilized.

Attributes of the IT portfolio: IT integration and IT differentiation.

The two focal attributes of the organizational IT portfolio – IT differentiation and IT integration – are estimated based upon the technologies implemented within the organization at each time period. A variety of alternative measures are compared to capture differing perspectives of each attribute before settling on the focal estimations presented in Table 3.2. For the sake of brevity, the focal measures are described here with the alternatives discussed in Appendix B.

Each technology within the environment has a unique ability to convert inputs and outputs from another technology in the environment. This conversion value is randomly generated during the beginning of each simulation. The set of conversion ratios between all technologies in the environment generates a K by K matrix where K is the set of all technologies in the environment. The level of IT integration is estimated at each time period, T, as a combination of the conversion ratios of technologies in the organization. While the calculation of organizational task performance utilizes the conversion ratio between two specific technologies, the equation in Table 3.2 uses the combination of all possible technology conversion ratios to estimate the level of IT integration for the organization.

Two distinct processes influence the level of IT integration in the organization. First, the initial level of IT integration is varied systematically by adjusting the average conversion rate between ITs from 0.1 to 1. Additionally, the level of IT integration in the organization is driven by the individuals' selection and switching behaviors such that removing technologies that are unsuccessful and replacing them with alternative technologies alters the IT integration of the organization but not that of the environment.

The level of IT differentiation within the organization is estimated by comparing the IT portfolios of each of the individuals within the organization to each of their colleagues. The estimation presented in Table 3.2 utilizes a mean-difference estimation to compare the IT portfolio of individual A to the average IT portfolio of all of the employees within the organization. This calculation provides insights into on average, how different the employees are within the organization. The level of IT differentiation within the organization is adjusted over time as individuals add and remove technologies from their IT portfolios to meet their specific task demands.

Attributes of the task portfolio: Task variety, complexity, and interdependency.

Although the level of performance and organizational IT portfolio attributes change over time due to variations in both the individuals and technologies completing each task, the portfolio of tasks conducted within the organization remains stable across time. Due to this relative stability, the modeling of the focal task characteristics (variety, complexity, and interdependency) was directly set within the simulation.

This essay focuses on three specific organizational task characteristics (variety, complexity, and interdependency), which have been shown to have significant impacts on individual and organizational performance (Saavedra et al. 1993; Ang and Slaughter 2006). As the ABS is based upon the simplified actions of individuals, simplified versions of each task characteristic were used to provide clarity to the model while retaining their foundational impacts.

The level of task variety, or the number of unique sub-tasks available to be assigned to individuals, is examined at 1, 5, and 10 sub-tasks to provide a range of environmental variability in the sub-tasks. The level of task interdependency, or the number of sub-tasks required to complete a single task, is examined at 1, 3, and 6 sub-tasks required for each task to provide a range of both small and large groups. The level of task complexity, or the number of skills and technologies that each sub-task requires for completion by an individual, is examined at 1, 2, and 3 technologies to examine both simple and complex sub-tasks. In this simulation, a unique technology must be used for each component of the sub-task. Therefore, as the level of task complexity increases there is a required increase in the minimum number of technologies an individual owns in his or her personal IT portfolio to complete all sub-tasks successfully.

Simulation analysis.

This study utilized the NetLogo (Wilensky 1999; Railsback and Grimm 2012) simulation software developed at Northwestern University to conduct the ABS. To provide an exploration of the evolution of the organizational IT portfolio over time each simulation was conducted for 500 time periods and replicated for a minimum of 10 iterations for each set of parameter settings to provide consistency and robustness for the subsequent analyses. The parameter settings utilized in each of the models are provided in Table 3.3 indicating the primary values and those utilized for sensitivity analyses.

[See Table 3.3.]

The data resulting from these simulations are examined first using time-series graphs and then through regression analyses, as done in prior research (Kane and Alavi 2007). One major benefit of utilizing ABS is the ability to examine how effects emerge over time in the environment (Macy and Willer, 2002). Therefore, extensive time-series graphs of organizational and individual performance under varying conditions help investigate the evolutionary effects.

Additionally, to empirically test the research model, a series of regression analyses are conducted in STATA 12 (StataCorp 2011) to examine the effects of IT differentiation and IT integration on individual and organizational performance.

Emergent Relationships

This section describes the insights and support found for the initial exploration of the impacts of both the organizational IT portfolio and task portfolio on performance through both the agent-based simulation and the case study. The insights attempt to explore and extend the initial research model in Figure 3.1 to determine how the organizational IT portfolio impacts performance under different implementations of organizational task portfolios.

IT differentiation and its effect on performance.

Insights from the case study: Across GlobalRetailer, the tasks and technologies that Ecom and B&M are utilizing to meet the demands of their customers and employees are fundamentally different due to the speed of each environment and shopping experiences provided. These two groups in GlobalRetailer operate in different environments, and have very different mentalities and cultures.

> "They're two totally different mentalities. [B&M] here is very, very conservative about everything because they've always striven for standardization because everything you have to multiply by 10,000 stores. Then because most of the home office users are here, they're just very conservative about their policies. They don't like to deviate from anything. A lot of the people that work there [Ecom] came from places like eBay or Facebook or Intel because all those companies are based out there. They want to have a lot more freedom, and they want to do more things like open stack, and they think that they can engineer at that level and that they have all these skills to do stuff like that." – V2

The technology needs and support costs between Ecom and B&M are also quite different due to the size and needs of each group. While Ecom must be agile in managing its smaller workforce and advanced technology needs, B&M must focus on managing a large workforce, thousands of similar store environments, and consistency across operations for ease of support.

It was a completely different culture. It was very Californian. They would use whatever they wanted to. They weren't burdened by the 30,000 employees they had in [B&M location]. If this person wants this, then 20,000 other people are going to want it. They just did whatever they want. They didn't have to deal with the scale issues that [B&M] had to deal with. It's easy to support 10 people with Macs … supporting 10,000 or 40,000 is a different story. – V4

Allowing each part of the organization to utilize specialized ITs for their environment is critical for GlobalRetailer to ensure efficient and effective completion of their specific tasks. Ecom benefits in efficiency directly from its ability to differentiate technology from the traditional and conservative B&M group due to the speed and demands of the online environment. Throughout the interviews, Ecom's need for different technologies was mentioned as a driving force behind its productivity and innovation.

I think the benefit particularly in [Ecom] is them being able to do things more quickly… that's what their function is. They need to be able to deliver things more quickly. Their development life cycle is a lot shorter. People in the online world are expecting features quickly, they're expecting changes quickly, they expect the website to change, they expect to see different products, they expect to see different functionality, and they have to be able to deliver that. I think that's probably the biggest benefit. – GR2

Insights from the simulation: To examine how this relationship of IT differentiation evolves in the simulation, a series of graphs are developed in Figure 3.5 which depict how varying levels of IT differentiation impact both individual sub-task and organization task performance over time. In Figure 3.5, the mean level of sub-task and task completion performance are mapped across the 500 time periods of the simulation[m]. In each graph, four categories of IT differentiation are plotted[n]: very low (0.2), low (0.4), high (0.6), very high (0.8).

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m Due to file size constraints in Netlogo and the analysis software used, the simulation time periods are captured every 10 periods such that 50 in the figures is equal time period 500 in the simulation.

n Categories of extremely low (i.e., 0) and extremely high (1) IT differentiation were not plotted due to their limited presence in the models over time as individuals converged on specific technologies.

[See Figure 3.5.]

The results indicate that there is a significant positive effect of IT differentiation on both sub-task and task performance such that increased IT differentiation across technologies provides the organization and its employees the ability to meet the various task demands and differences. For example, when individuals are working on different sub-tasks such as those in Ecom or B&M there are inherently alternative technologies that can provide the optimal performance for these specific tasks. When individuals are selecting a technology for their sub-tasks based on the best task-technology fit (Goodhue and Thompson 1995; Goodhue 1998) there will be an increased performance gain for both the individual sub-tasks and the organizational tasks. Therefore, ***we hypothesize that IT differentiation has a positive impact on both sub-task and task performance.***

IT integration and its effect on performance.

Insights from the case study: The configuration and management of IT integration in the organization is critical to ensure that the employees can work together to complete their organizational goals. Allowing individuals to work together more efficiently and effectively reduces both the time and cost related to completing these tasks. GlobalRetailer has spent a significant amount of time and resources to develop an integrated collaboration toolset to empower its employees to work together. The most recent implementation is a fully integrated messaging and communication toolset that allows individuals to integrate all of their devices (tablets, mobile phones, desktop phones, and computers) and remain in seamless contact with their colleagues.

> We mitigated that one through what is called [CollaborationTool A] … in fact I got a phone call as I was sitting here, my work number rings my mobile phone too so I could give out my work number and it will ring my desk, my laptop, my tablet and my phone. – GR1

> This is my second company where I've gone down this path. A lot of learnings from the first go on how to leverage [CollaborationTool B] and conference calls and instant messaging presence and chat and how to integrate those together. We didn't do as good a job integrating them at my last place because we went with [CollaborationTool C] as the IM presence and chat tool and [CollaborationTool B] as the video web and audio conferencing tool and they don't integrate well. – GR1
> Here where I'm doing [CollaborationTool A], all my [CollaborationTool B] has show up in my [CollaborationTool A] client and it's click to join. My [CollaborationTool A] client alerts me when my [CollaborationTool B] is about to start, click to join. Everything is more tightly integrated and that's making the uptake feel a lot more seamless. – GR1

The issues that arise during the collaboration, both within and outside of the organization, cause unnecessary issues, especially in tasks that should be fairly simple to accomplish for a large organization.

> … they're implementing a global collaboration strategy right now for voice and video and [CollaborationTool B] and just integrating all of that so that it's available to everybody. Because if they're on a different solution than B&M Mexico and everything else, so they can't even use some of these chat tools. Once they get on that global collaboration strategy, once they complete the mission that they're after, I think that's really going to enable a lot of great things with these devices and what they do. Because we have. I know we take advantage of it all the time, so we don't think about it as much. They're totally challenged by that, and when you think that there are 27 countries, that's going to make them so much more productive. – V2

Some of the integration issues in the organization that hinder the ability of individuals to complete their required tasks come down to simple version compatibility problems that arise as different portions of the IT infrastructure are upgraded before others.

> Some of those things are what I'll put more in the … They're in the realm of silly. I have applications that will only work in Internet Explorer Version 6 or Internet Explorer Version 8 and IE 6 compatibility mode and you can't install a browser that old on a Mac so those apps are completely inaccessible to any Mac. They're also completely inaccessible to any PC running Windows 8 so they've been inaccessible from modern systems and it has nothing to do with Mac. It just a really old application and they haven't been … They haven't gone undergone the minor revisions necessary to run in a modern browser. – GR1

Insights from the simulation: The interviews and recent GlobalRetailer IT initiatives indicate the desire for IT integration to drive productivity. To examine this relationship on both sub-task and task performance across the organization a second series of simulation graphs were developed in Figure 3.6 which depict how the varying levels of IT integration impact the performance of both individuals and the organization over time. In these graphs, a similar approach was utilized to plot four categories of IT integration[o]: very low (0.2), low (0.4), high (0.6), very high (0.8).

[See Figure 3.6.]

These results indicates a slightly different relationship on performance than IT differentiation as there is a significant benefit to organizational task performance with the presence of increased IT integration while there seems to be little to no effect on individual sub-task performance. For example, the reduction in conversion loss between individuals' technologies during sub-task hand-offs provides increased efficiency for organizational tasks but individuals who are working independently are not impacted by the technologies that others in the organization utilize and simply focus on their own work. This relationship with individual sub-task performance provides an intriguing difference from the expected benefits based on prior theory and led to a deeper examination of the research model through a contingency analysis to explore these findings. Based on these findings ***we hypothesize that IT integration has a positive impact on organizational task performance.*** However, the impact on individual sub-task performance is unclear at this stage and not hypothesized**.**

The interaction of IT differentiation and IT integration and its effect on performance.

Insights from the case study**:** Until this point, IT differentiation and IT integration have been examined independently. While they differ in how they impact either individual sub-task or organizational task performance, they are not managed in isolation. These attributes of the IT

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[o] Categories of extremely low (i.e., 0) and extremely high (1) IT integration were not plotted due to their limited presence in the models over time as individuals converged on specific

portfolio should be examined and managed in conjunction to ensure the ability to meet specific sub-task demands through IT differentiation, while simultaneously ensuring the ability of these technologies to interact seamlessly through IT integration, to ensure the completion of organizational task goals.

To allow individuals to have freedom in how they complete their specific sub-tasks, GlobalRetailer has taken a few different approaches to allow differentiation in the IT while ensuring significant integration across the organization. GlobalRetailer understands that each individual has different technology needs, experience with specific ITs, and preferred ITs to complete their tasks. To enable some flexibility and freedom across the organization, a "freedom in the framework" approach is utilized.

> … the corporation is doing its best to balance the cost of letting everybody do it their own way versus the value from everybody doing it the same way. I'll call it freedom in the framework is the approach that we typically use. We use here. We use at my last two companies. Here are three tools that you may use to accomplish this. Surely, one of them will meet your requirements. – GR1

This freedom is also evident through policies such as "Bring-Your-Own-Device" (BYOD) initiatives that provide further freedom to employees who previously had limited choices for IT usage.

> They generally would potentially have to come to work so if you are a store manager, before you had BYOD, you had to be in the store 100 hours, 110 hours a week. That's not life man. That's not life at all. Here it's like … I'm going home just to be sitting out on my back porch or cutting the grass and playing with the kids and being able to check the sales in your stores or see what is going on and if you can control it, it allows you to be flexible so you don't have to be there all the time. – GR6

This flexibility through BYOD policies provide employees the ability to work more efficiently and effectively with their time while also remaining more satisfied with their tasks.

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technologies.

Insights from the simulation: This freedom in the technology selection and simultaneous management of the integration of technologies across the organization is depicted in Figure 3.7, which indicates the interaction of IT differentiation and IT integration on performance across the 500 time periods of the simulation. In these graphs low and high levels of IT differentiation and IT integration were generated utilizing one standard deviation above and below the mean (Cohen et al. 2003) to develop four unique scenarios: Low Integration/High Differentiation, Low Integration/Low Differentiation, High Integration/High Differentiation, and High Integration/High Differentiation.

[See Figure 3.7.]

When examining the impact of the interaction between IT differentiation and IT integration on sub-task performance it is evident that the freedom in technology selection (i.e., high differentiation) has a significant positive impact. However, while providing a high level of IT differentiation to employees is beneficial, a high level of IT integration is insufficient to ensure sub-task performance.

When examining this relationship at the organizational task level, it is evident that a high level of both IT differentiation and IT integration creates an optimal scenario. Allowing individuals to select the best technologies for their individual sub-tasks leads to optimal performance of sub-tasks, which can then be seamlessly integrated together. At the other extreme, the lowest organizational task performance scenario results when both IT differentiation and IT integration are low, such that individuals are using sub-optimal ITs that can also not be combined when working in groups. These results support the simple theoretical relationships derived form Lawrence and Lorsch (1967a) at the organizational level. However, the individual sub-task performance is only driven by IT differentiation. Therefore, ***we hypothesize that the***

interaction of IT differentiation and IT integration has a positive impact on organizational task performance (but not on individual sub-task performance).

Organizational task portfolio characteristics and their effects on performance.

Insights from the simulation: While the above impacts provide a general perspective of the impact of IT differentiation and IT integration on both sub-task and task performance, they do not take into account the differences *across* organizations in terms of their portfolios of tasks. As discussed earlier, three task characteristics – variety, complexity, and interdependency – based on the task design literature (e.g., Hackman and Oldham 1975, 1976) are used in this essay to characterize task portfolios. Before examining the ability of the IT portfolio to address these characteristics of the task portfolio, a baseline model is established to determine the direct impact of these task characteristics on both individual sub-task and organizational task performance. This is done through a series of simulation graphs, provided in Figure 3.8. Subsequently, the effect of IT differentiation and IT integration on the ability to address the demands of the tasks is examined to identify which configurations of the IT portfolio will allow organizations to ensure adequate performance in the light of their specific task portfolios.

[See Figure 3.8.]

Task interdependency: Based on prior theory and the specifications of the ABS, an individual completes the sub-tasks independently of others in the organization, while the tasks are combined from the efforts of multiple individuals. The top row of Figure 3.8 depicts the impact of task interdependency on sub-task and task completion performance across three levels of task interdependence: low interdependence (one individual in a group), medium interdependence (three individuals in a group), and high interdependence (six individuals in a group). Consistent with the assumption that individuals work independently on their sub-tasks, Figure 3.8 shows that task interdependence does not affect sub-task performance. However, as task interdependency increases, organizational task performance decreases significantly due to communication and conversion costs. The greater the extent to which individuals work together to complete an organizational task, the higher the number of ITs needed to integrate the sub-tasks, leading to greater communication and costs. Thus, ***we hypothesize that task interdependency negatively impacts organizational task performance*** but does not affect individual sub-task performance**.**

Task complexity: In the second row of Figure 3.8, the impact of task complexity, or the number of skills and technologies needed to complete a specific sub-task, is examined on sub-task and task performance across three levels of complexity: low complexity (one technology), medium complexity (two technologies), and high complexity (three technologies). Figure 3.8 indicates that increased complexity has a significant negative impact on both sub-task and task performance. When individuals are required to use greater number ITs and skills to complete their own sub-tasks, the loss of performance due to conversion costs increases. This effect is amplified in organizational task performance as each individual is facing the conversion costs in his or her own tasks while also having to deal with the combination with other individual sub-tasks. Therefore, ***we hypothesize that task complexity will negatively impact both organizational task and individual sub-task performance.***

Task variety: In the bottom row of Figure 3.8, the impact of task variety, or the number of sub-tasks available across the organization to be assigned to individuals, on sub-task and task performance is examined. This is done across three levels: low variety (one sub-task), medium variety (five sub-tasks), and high variety (ten sub-tasks). A similar impact as that of task interdependency is found in Figure 3.8.

Individuals in an organization are typically hired to complete a specific set of tasks or job roles during their immediate tenure. In the simulation, individuals are assigned a single sub-task at the beginning of the simulation and focus on this sub-task throughout their tenure in the simulation. The number of different sub-tasks, from low to high, that are being completed in the organization does not impact the performance of the sub-tasks. This is similar to the fact that employees in various departments may not have significant impact on an employee's immediate sub-tasks when working on independent sub-tasks[p]. Alternatively, when examining the impact of task variety on organizational task performance, the number of unique sub-tasks has a negative impact on overall performance. Further, this impact appears to level out with increasing levels of task variety such that after 5 to 10 different tasks, the decreased performance stabilizes. Hence, ***we hypothesize that task variety negatively impacts organizational task performance.***

The interaction of the organizational IT and task portfolios.

Thus far, there is evidence of how both the organizational IT portfolio and the task characteristics impact individual sub-task and organizational task performance. This section examines how each configuration attribute of the organizational IT portfolio, IT differentiation and IT integration, can allow organizations to address the variations in ***specific*** characteristics of the task portfolio.

When examining the impact of IT differentiation in the face of the three task characteristics (variety, complexity, and interdependency), a series of important insights arise which provide clear directives to organizational IT planners. First, examining the effects of the four levels of IT differentiation in the face of different levels of task variety, as shown in the top row of Figure

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[p] This implies that individuals' own sub-tasks are not impacted by the inputs from individuals with whom they interact. This implication will be discussed shortly.

3.9, indicates that when task variety is low (one sub-task) the need for an extremely differentiated set of ITs (0.8) is eliminated as individuals select the best IT to complete that sub-task. Individuals naturally settle on a shared set of IT that work for the specific sub-tasks and do not need many ITs to meet the demands. This relationship is also indicated in the interviews, specifically in the discussion around the management of 10,000 B&M stores, which perform similar tasks and require consistency across their technologies.

> If you look at the stores, a good example in GlobalRetailer…we have 11,000 stores. They're not all the same but they're the same as we can make them. We would like to make them more same. My team is actively working on things to making them more the same because it is less expensive for us to support them the closer they are to the same. – GR1

In most instances, individuals in different roles across the organization complete fundamentally different tasks. Therefore, as the level of task variety increases (five and ten sub-tasks) there is a significant benefit to differentiated IT portfolios as targeted ITs are more helpful than using the same standardized IT across the organization. Further evidence of this is depicted in Figure 3.9, which depicts the interaction of IT differentiation and IT integration with task variety. In this figure, when there is a low level of task variety in the environment (1 task) there do not appear to be any organizations that have an IT portfolio with very high IT differentiation (0.8); however, under high levels of task variety (10 tasks) the organizations configure their IT portfolios with only moderate to high levels of IT differentiation (0.4, 0.6, 0.8). For example, while GlobalRetailer is primarily a PC environment, certain jobs at the organization need a Mac platform to complete their tasks more effectively.

> We do have a few hundred Mac users here in the [B&M] office and those are like people over in the advertising and marketing, creative type departments. – Operations

The corporate policies only allow certain individuals to utilize a Mac technology based on the anticipated needs, but several informants indicated that this restriction limits efficiency and effectiveness.

> That's not a good corporate decision but I also don't want to take an engineer who has only ever worked on PC and forced them to learn Mac because that's the only way to can get a machine powerful enough to do their job. That doesn't make sense either. – GR1

Individuals who are provided the opportunity to switch from their existing PC platform to a Mac platform saw significant gains in their productivity on their tasks.

> So I experienced a slow down at first to get used to it. And then a massive productivity gain. Massive. – GR4

Furthermore, when dealing with the scale of B&M, allowing a significant level of IT differentiation causes more problems than it addresses due to the level of interdependency between individuals.

> …yes, it absolutely hinders creativity because we at our scale, at scale at my last company, it was a requirement to be at standard as you can be. – GR1

The results for the impact of IT differentiation at various levels of task variety in Figure 3.9 support the above relationships for both individual sub-tasks and organizational tasks. Allowing individuals to address their task variety through greater IT variety improves both sub-task and task performance. Thus, ***we hypothesize that IT differentiation moderates the relationship between task variety and both sub-task and task performance such that greater differentiation is more beneficial at higher task variety.*** The following remark is consistent with this expectation.

> I'm sure that there is benefit to different parts of the organization having different technology. For example, architecture, they have some different tools that they use that are specifically for them to do what it is that they do everyday that aren't suited for engineering people, right? They're just different skill sets and they'll use different technology to do that. – GR2

[See Figure 3.9.]

While each individual at the organization complete specific tasks in their departments, many of the day-to-day tasks are similar across the organization. For example, people in Marketing, Engineering, or Sales may have a portion of unique tasks, but many of them spend significant time in meetings, on video calls, and drafting reports in an office suite of ITs. These tasks are fairly simple compared to the unique aspect of each individuals job, and do not necessarily need an increased level of differentiation.

> Yeah. When my kids ask me this question, the answer is usually I go to meetings, talk to people, answering email. By and large, that is the sum total of my work. Occasionally, I'll approve statements of work. Occasionally, I'll approve some contracts. Occasionally, I'll approve travel or training. Most of the work I do though is centered around the Microsoft Office Suite. PowerPoint work, Outlook for email, more documents, spreadsheets, business case analysis because my job is very heavily management oriented, leadership oriented and so I don't in my day to day need many technological tools. – GR1
>
> I use a cellphone technology when I'm working remotely because I work remotely 3 days a week. I use that technology as well the [CollaborationTool B] meeting platform if I need to share a presentation or those types of things. Hopefully, [CollaborationTool A] is going to do some of that more effectively. … A lot of e-mail communication. We have an internal shared board connect site where we manage our workflows.…A lot of interactions with our legal teams, some that are here onsite and some that are party offsite. – GR3

Figure 3.10 examines the impact of IT differentiation across various levels of task complexity, from simple to complex tasks. When examining the impact of IT differentiation across these varying levels of complexity there appears to be a lack of significant benefits for both sub-task and task performance due to IT differentiation when tasks are fairly simple (one sub-task). However, once the tasks become more complex and require additional skills and technologies, the specialization of ITs in individual IT portfolios through greater IT differentiation becomes more beneficial.

[See Figure 3.10.]

> A large majority of the basic communication type tools are standard across the organization. I'm not seeing much difference in those. The difference would be in applications that they specifically need for coding or those types of things that are role

> specific versus we need are our tool kit and connect site and things that are specific to sourcing events. – GR3
>
> If I look at the people who were in transportation, they're in our transportation system all the time in addition to using the office suite. … my Ecom operators, they're most often in monitoring tools. … my Ecom developers, they're most often in their development tools … my developers here in B&M, development tool. If my operators are here, monitoring tools. If my engineers here, it depends on what type of engineering they do…. that last 10% average is very job dependent. – GR2

This relationship exists for both sub-task and task performance across the organization with varying levels of task complexity. At lower levels of task complexity, there is a limited benefit to differentiated ITs. However, as the level of complexity increases to two and three unique ITs, the impact shifts such that IT differentiation is required to address the complexity. Additionally, with the increase in the number of ITs needed and used by individuals, an organization possessing a very high level of IT differentiation does not appear to exist as individuals identifying and converging on shared ITs that many individuals use across the organization regardless of their task (i.e., office suite technologies). This reiterates the fact that many of the individuals at GlobalRetailer have some overlap in the ITs used for their simple tasks but differentiate their specific tasks. This relationship is viewed for both the sub-task and task performance levels. Thus, from this perspective, ***we hypothesize that IT differentiation moderates the relationship between task complexity and both sub-task and task performance.***

While the prior two relationships between IT differentiation and both task variety and complexity have a positive relationship such that increased IT differentiation is beneficial to both individuals and the organization, task interdependency exhibits a slightly different relationship. Figure 3.11 depicts the impact of IT differentiation across low, medium, and high levels of task interdependency. The relationships of IT differentiation and task interdependency depicted in Figure 3.11 indicate that individual sub-task performance is not impacted by the level of task interdependency, or number of individuals working together in group. This follows expectations of the simulation model as each individual is working independently of others in the organization when completing his or her sub-task. This is evident in GlobalRetailer as well for those individuals that are working in vastly different organizational roles.

I rarely talk to a few people over in our advertising group. – GR5

When examining the impact on organizational task performance the differences become evident across increasing levels of task interdependency. To start, when examining a low level of task interdependency such that everyone is in a group or project of one, the relationship is the same as those of the sub-task performance, as expected. However, once the group levels begin to increase the beneficial impacts of differentiation begins to diminish.

> Yes. If they're all working on the same application, or working on the same project attempting to deliver a holistic package to customer, you couldn't have one of them trying to develop in a Windows platform and a Java platform, because it's my thing: "I'm a Windows guy" or "I'm a Java guy", and they're not going to deliver a holistic package. So early on they all have to be in alignment that this is what we're using, this is how we're doing it, these are our techniques, this is our strategy to develop this application, and they all have to develop the same language, same version, same operating system, all that kind of stuff. – GR2

For individuals who are consistently working with many others across the organization via meetings and collaboration tools, having different ITs can make it to difficult to share even simple documents.

> We do run in to that even internally because we don't necessarily ... A lot of times we get a technology here in B&M office before the entire global company gets that technology. Instant messaging technologies, we typically pilot it first. We've got two platforms that running simultaneously right now. Some folks I can talk to on one, some folks I have to go on the other one, right? That complicates your job a little bit in getting folks to understand which one they can contact you through so that they know you're not just offline and gone rouge. That is challenging and we don't have something similar that from a really capability of [CollaborationTool B] meeting type things. We don't have a standard platform that we know we can use with all of our vendors today because they have things ... they have technologies which they use. We have technologies that we use in finding something. Particularly, you're going to invite a large group of multiple people that they can only use that same technology is challenging. – GR3

By examining sub-task performance in Figure 3.11 there is evidence that there is no effect of task interdependency on individual sub-task performance as the number of individuals working in a group increase. Again, this is under the assumption that individuals complete their own work in isolation and then combine them for the completion of organizational tasks[q]. However, when looking at the impact on organizational task performance there is still some evidence of increased benefits for IT differentiation but the strength of this relationship reduces with increasing levels of task interdependency. Therefore, ***we hypothesize that IT differentiation moderates the relationship between task interdependency and task performance.***

[See Figure 3.11.]

Figure 3.12 depicts the examination of the effect of IT integration on organizations in managing various levels of task variety. It is evident from Figure 3.12 that greater IT integration does not provide any benefits to the management of varying levels of task variety on either individual sub-task or organizational task performance. This non-significant effect is not surprising given the fact that IT integration focuses on the conversion and combination of outputs of *technologies* utilized during individual sub-tasks and not the *sub-tasks* themselves. For example, individuals could all select the same IT to complete various sub-tasks and thereby have no issue in combining their outputs. Alternatively, individuals could all be completing the same sub-task and utilizing different ITs based on their knowledge and ability with the ITs and run into issues combining their works. Therefore, it appears that that IT integration does not moderate the relationship between task variety and either sub-task or task performance.

[See Figure 3.12.]

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[q] This implication is discussed in further detail below.

The effect of IT integration on managing task complexity in the organization exhibits a similar relationship as that on task variety for sub-task performance. Figure 3.13 depicts the impact of IT integration across varying levels of task complexity. This figure shows that as the level of task complexity increases, IT integration does not seem to provide any benefits to individual sub-task performance. This is similar to the main effects of IT integration across all levels of sub-task performance. However, when examining the impact of IT integration on organizational task performance across varying levels of task complexity the benefits of IT integration become present. As the number of technologies and skills required to complete each sub-task increases, there is a subsequent decrease in performance in general as shown above. However, across each of level of task complexity the benefits of IT integration are still present, yet are harder to achieve due to the increase in the number of technologies required to integrate efficiently.

> I don't know that the end user tools have as much to do with their interoperability as the upstream technology that they're developing for. If I got three different Java development tools, that probably doesn't impact me as much as if I'm running through different Java servers in the environment app servers. Three tools, one server, no problem. I can pull a piece of code out and anyone of the three types of end user tools should be able to function with it. – GR1

When examining the impact at the organizational task level there is significant evidence of a strong moderating effect such that IT integration has a strong impact at lower levels of task complexity and a lowered effect as the level of complexity increases. Therefore, ***we hypothesize that IT integration moderates the relationship between task complexity and organizational task performance.***

[See Figure 3.13.]

Lastly, in Figure 3.14, the impact of IT integration across varying levels of task interdependence is examined. The results indicate a similar relationship to that of IT integration at a macro level such that there is no evidence of benefits to individual sub-task performance. Therefore, regardless of the number of individuals working in a *group* to complete an organizational task, the *individual's* sub-task performance is unaffected by increases in integration in the organizational IT portfolio. Also, when viewing the effect of organizational task performance, there is a significant positive effect such that as the level of task interdependency increases, the need and benefits of increased IT integration become evident.

> If I want to share a PowerPoint, let's just start a [CollaborationTool B] and I can share it through PowerPoint. I don't need to email it to you. I can just share it with you. We make heavy use of SharePoint environments. Very typically, folks will just go put the PowerPoint in the SharePoint. They'll have the meeting just as a conference call and let everybody pull the PowerPoint on their own. That's another typical modality. That one's great for when everybody's on PC, not so great when everybody's alternative devices but again, we're getting there. – GR3
>
> In our [Ecom] office, we have a lot of challenges because our technologies are incompatible; our video conferencing up until about three weeks ago, our video conferencing was different, how we connect to them, how they connect to us was always a challenge. They usually take us five or ten minutes to get up on a video/audio conference call. The [Ecom] office, they use different tools than we do. Different project management tools than we do, so us sharing projects, like they tried to share a presentation with us for our staff meeting, and it was in a format that we don't have access to, so we couldn't open up the presentation because we didn't have access to the software that they were using. It was a PowerPoint, but they were storing it in a different collaboration tool that we didn't use; we could not get it to work here, so they had to pull it out of that and send it to us differently. It's just challenges like that that I think particularly some of the offices we integrated later to the [B&M] office, they have a different technology stack that they're on. – GR2
>
> One of the reasons was they'd integrate later into the [B&M] office, so for example our [Ecom] was running separately from the [B&M] office for many years. It was started differently, it was ran by different management, we were very loosely affiliated; the only thing they had the same about them was GlobalRetailer, they had the name GlobalRetailer on it. And then over the last five or six years we've tried to integrate them into [B&M] office operations. – GR2

When examining the impact of IT integration at low levels of task interdependency (one person in a group) the results are the same as those for sub-task performance, as expected. However, as the level of task interdependency increases across the organization the *need* for IT integration increases to manage the conversion and communication costs between individuals.

From this is it is evident that as more individuals and groups are required to combine their resources and sub-task outputs that there will be subsequent need for their technologies to work seamlessly to ensure successful task completion. Therefore, ***we hypothesize that IT integration moderates the relationship between task interdependency and organizational task performance.***

[See Figure 3.14.]

Based on this ABS analysis and the insights from the case study of GlobalRetailer, a series of hypothesized relationships were developed to contextualize and expand the initial research model. These initial relationships, depicted in Figure 3.15, are further tested through regression analyses in the following section to validate and ensure the robustness of the interpretation of the graphs.

[See Figure 3.15.]

Hypotheses Tests

While the case study and simulation graphs provide insights into the relationships between the attributes of the task portfolio, the configuration of organizational IT portfolio, and performance, they examine each effect in isolation. For a more holistic view of the relationships, an analysis of the impacts at the equilibrium period (t = 500) utilizing an ordinary least squares regression analysis provides further evidence and clarity. To test the above hypotheses, an OLS analysis utilizing STATA 12 (StataCorp 2011) was conducted for both sub-task and task performance levels utilizing all the explored interactions above. To compare both the relationships proposed as well as those without evidence of a direct impact, all possible interactions are modeled.

[See Table 3.4.]

Table 3.4 provides the results of this analysis, which examines the proposed relationships through both individual sub-task and organizational task performance. Model 1 examines the impacts of the task characteristics on organizational performance and supports their negative impact. The impacts of IT differentiation and IT integration are included in Model 2, which support their beneficial relationships on organizational task performance. In Model 3, the interaction between IT differentiation and IT integration is included, providing further evidence for the benefits of combining high levels of differentiation and integration. The interactions between the attributes of the IT portfolio (IT differentiation and IT integration) and the attributes of the task portfolio (i.e., the task characteristics) are included in Model 4.

The results reiterate the benefits of IT differentiation under increased task variety and complexity as well as the negative impact under high levels of task interdependency. Further, the non-significant impact of IT integration on task variety, the negative impact of IT integration on task complexity, and the positive impact of IT integration on task interdependency are also supported. Interestingly, the interaction of IT integration and IT differentiation becomes non-significant when the interactions with task characteristics are included. These non-significant findings are explored further in the following sections.

The analysis of the impacts on individual sub-task performance provides similarly consistent results with that of the proposed relationships. There is evidence in Models 5 through 8 that task complexity and task variety both decrease sub-task performance while task interdependency has no significant effect, as expected. IT differentiation provides a significant benefit in each model, but IT integration has – also as expected – no effect in any model, and the interaction of IT integration and IT differentiation is also not significant in any model. Additionally, when examining the interactions between the attributes of the IT portfolio (IT differentiation and IT integration) and the attributes of the task portfolio (i.e., the task characteristics), IT differentiation has significant moderating effects on the relationships between task variety and individual sub-task performance and between task complexity and individual sub-task performance, but not on the relationship between task interdependency and individual sub-task performance. As expected, IT integration has no moderating effect on the relationships between task characteristics and sub-task performance.

Robustness Checks

The results of this initial regression analysis generally support the propositions of the research model. However, to check whether the results are a function of the simulation parameters, a series of robustness and sensitivity analyses were conducted. To ensure that the simulation models remained as simple as possible to allow for clear interpretation each parameter setting was examined in detail (Kane and Alavi 2007). Table 3.3 outlines each parameter value used in the main and sensitivity analyses. After examining each parameter, those that had no significant impact on the research model were removed from the focus of this essay in an attempt to provide clear and concise insights (Gilbert 2008).

The main analysis of this study utilizes an equilibrium time period set to the last time period of the analysis, similar to prior studies (e.g., Kane and Alavi 2007). However, this analysis at a single time period throughout the simulation could bias the results by excluding the evolutionary nature of the individuals and organization over time. To address this potential issue, a series of analyses examining the model both across different time periods and in a longitudinal panel analysis were conducted. In Table 3.5, the model is estimated at the final 500th time period in Models 1 and 5, 400th in Models 2 and 6, 300th in Models 3 and 7, as well as a longitudinal panel analysis across all time periods (1-500) in Models 4 and 8. The models utilizing a single time period, as the primary analysis, each find a similar pattern of results across the alternative equilibrium points further supporting the emergent results.

[See Table 3.5.]

The longitudinal panel analysis in Models 4 and 8 were conducted utilizing a fixed-effect analysis with XTREG in STATA 12. In this model, the lagged values for organizational task and individual sub-task performance were included in their respective models, as well as the time period being examined. Time was included in the model due to the evolution of individuals' knowledge regarding their tasks and technology over time increasing the performance across time periods. The results of this analysis depict a similar pattern of results to that of the primary analysis. However, due to the increase in sample size from 810 to 39690 the significance levels of the effects become inflated and should be interpreted with caution due to their relatively small effect sizes. The results from this longitudinal analysis in Table 3.5 provide further support for the robustness of the model.

To ensure that the results of the main analysis were not a function of the single ABS data collection a second simulation was collect to be examined for robustness. Table 3.6 provides the results of this regression analysis utilizing a second dataset. The results are consistent with those of the main analysis, providing additional evidence of the robustness of the model.

[See Table 3.6.]

Next, to further explore the non-significant findings that emerged for the interaction between IT differentiation and IT integration in the main analysis, an additional model was constructed utilizing three-way interactions to examine if the moderation is altered under varying task characteristics. As shown in Table 3.6 none of the three-way interactions are significant indicating that the IT differentiation and IT integration interaction are consistent across the task characteristics examined. These results provide similar results to those of the main analyses. However, from this analysis it appears that while the balancing of IT differentiation and IT integration are important to ensure the ability to collaboration between individuals, a more complex relationship emerges between these IT portfolio attributes and the task demands. Achieving a high level of IT differentiation and IT integration, without considering the task portfolio, does not ensure that the organization has developed an optimal IT portfolio for its required tasks. The implications of this finding are discussed below.

Based upon the initial agent-based simulation, the organizational case study insights, and the robustness analyses the emergent model in Figure 3.16 summarizes the relationships found. The contribution, implications, and future research are discussed below.

[See Figure 3.16.]

Discussion

This essay contributes to the IS literature by examining the impact of the organizational IT portfolio on performance in a more detailed perspective. First, this research focuses on examining the performance implications of the organizational IT portfolio from a *configuration* level across ***specific*** ITs in the organization and not simply on the *aggregate* level of IT investment dollars as prior literature has typically utilized (Bharadwaj 2000; Dewan and Min 1997; Brynjolfsoon and Hitt 1996). Second, this essay examined how flexibility in the IT portfolio derived through technology variety can provide organizations with the potential for more efficient and effective technology usage for organizational environments with varying portfolios of tasks.

More specifically, this essay has focused on examining how the various configurations of an organization's IT portfolio can impact the performance of its individuals and organization as a whole. The development of IT differentiation in the IT portfolio provides individuals and organizations the ability to address the different demands of task variety and complexity in the organization. However, this increased level of IT differentiation has the potential to cause communication and collaboration issues between individuals when working on organizational tasks with other employees. To address this problem, greater IT integration between the organizational ITs is critical when task interdependency is high to ensure efficient and effective work between individuals.

While the theoretical insights indicate that a high level of IT differentiation and IT integration would lead to improved levels of performance within the organization, the resulting insights indicate subtle differences between individual sub-task and organizational task performance. The interaction between IT differentiation and IT integration provides significant benefits at the organizational level as individuals utilize alternative technologies for their specific task assignments and the subsequent IT integration is required to allow individuals to collaborate successfully. However, this moderating effect is non-significant when examining individuals working on their own sub-tasks indicating that IT integration itself does not provide increased performance for individuals when they are not utilizing the optimal technology for their tasks to begin with (Goodhue and Thompson 1995). For example, if an employee is consistently selecting a technology that is inadequate to perform their assigned task, simply increasing the integration will not offset the poor quality output generated by the individual.

In addition to the general impacts of IT differentiation and IT integration on performance, this essay examined the effects of the organizational task portfolio to provide deeper insights into the configuration of the IT portfolio the organizations should seek to achieve high levels of performance.

To return to the initial hypothetical question presented in the introduction: does a single $6 million dollar technology provide the same benefits as three technologies for $2 million dollars each? The answer is: it depends. If the variety of tasks across the organization for which these ITs will be implemented are limited, such as a large call center operation, a standardized technology may be more efficient and effective than three alternatives. However, if the variety of tasks is high, such as in creative environments like R&D or marketing, then a single technology may aid some employees but hinder others in completing their individual and organizational tasks. It is in these varied organizational environments that IT differentiation becomes beneficial to helping individuals meet the demands of their tasks.

Further, if a group in the organization is working independently of the rest of the organization, such as Ecom at GlobalRetailer, then the unique technologies required for these groups may have limited impact on the rest of the organization's ability to complete their tasks. However, for technologies that are used in interdependent tasks, such as meetings and collaborations, an IT portfolio with increased IT integration is needed. If two individuals are using different technologies that work well for their own sub-tasks but their outputs cannot be integrated together for their organizational task then their IT differentiation provides no organizational benefits.

Thus, while enforcing a standardized IT system across the organization may not provide the intended benefits in a dynamic organizational environment due to the inefficient use of technologies for some employees, allowing everyone to utilize alternative technologies in a simpler environment may cause more issues than it solves. These results provide further insights into the contradictory findings of the impacts of IT on organizational performance (Mithas et al.

2012) and the lack of benefits that some organizations have achieved through standardized enterprise systems (Gattiker and Goodhue 2005).

Limitations and future research.

While this study provides an important perspective for managing the organizational IT portfolio, it is not without its limitations. First, this essay does not use actual IT investment and implementation data from organizations. Instead, detailed data an agent-based simulation was utilized which allows for the development and examination of theory when data, especially longitudinal data, is difficult to attain in a field study (Eisenhardt 1989; Kane and Alavi 2007). However, with the advancements of IT infrastructure monitoring technologies in the organization, future research should attempt to utilize computer logs and install databases to validate this research model with real-world data. The monitoring of the IT portfolio is critical for organizations to ensure their configuration of IT differentiation and IT integration is consistent over time with the demands of their task portfolio and their changing environments. GlobalRetailer and its vendor are working to implement a new monitoring technology specifically for this issue.

> They're [GlobalRetailer] actually implementing [Monitoring Technology], which is identity services right now, which provides the solution for doing profiling. It will tell what type of device is hitting the network. Right now, they're initially just going to do MAC address detection so that they can see when something gets added. Then next year, they'll expand that a little bit more so that they derive a little bit more intelligence about it and a little more visibility. – V2

Second, this study only examined a single form of task interdependency, sequential, which was modeled to allow individuals to work independently and combine their outputs at a final stage. Additional forms of interdependency, such as reciprocal or pooled (Saavedra et al. 1993), should be examined in future research to determine the impact that these configurations of the organizational structure and processes have on the benefits and abilities of the IT portfolio.

Further, this essay only utilized three task characteristics that should be expanded in future research to provide clear directives to organizations in analyzing their environments.

Third, the behaviors of the individuals in this simulation were based on a the foundations of the task-technology fit literature (Goodhue 1998) which indicate that individuals who attempt to select the best technology to meet their task demands will have increased performance. However, IS literature is filled with a variety of drivers of adoption and technology selections such as perceived usefulness and ease of use (Davis 1989), satisfaction with IT (Bhatterchejee 2001), and inertia from continued use (Polites and Karahana 2012). Future research should examine these additional individual adoption and usage behaviors, which may impact the organizational IT portfolio in very different ways as employees attempt to select their technologies for the task.

Conclusion.

This essay provided further insights into how the organization can configure its organizational IT portfolio to increase both organizational and individual performance. This research also examined the impacts of the portfolio of organizational tasks, specifically in terms of three attributes (task variety, complexity, and interdependency), to provide insights into the optimal organizational IT portfolio configurations for differing task portfolios. The insights from this research provide important directives for organizations which are looking to more efficiently manage their IT portfolio to ensure efficient and effective technology usage. Additionally, this research provides a detailed examination of ***specific*** IT asset configurations and their impact on organizational performance. Prior literature has focused primarily on the use of IT investment dollars to examine the impact of IT on the organization and indicated this as a potential reason for inconsistent findings (Aral and Weill 2007; Banker et al. 2006; Mithas et al. 2012). By taking a disaggregated perspective of IT investments in the organization, deeper insights into why some organizations fail to see the claimed benefits of large enterprise systems.

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Appendix A. Interview Protocol

The interviewees in this essay had adequate knowledge around the recent changes in the IT management portfolio due to their varied positions in the organization. Each interviewee, described in Table 3.A1 was a key stakeholder in the BYOD policy development.

[See Table 3.A1.]

The following information provides an outline of the interview protocol utilized during each of the interviews throughout the data collection. The survey was designed to allow for a directed interview yet still provide freedom in the conversation as topics evolved during the conversations.

Section 0: Introduction

Thank you [insert name] for taking the time to speak with me today. We are investigating recent changes in organizational IT policies, specifically "Bring-Your-Own-Device" policies. In this interview, I am attempting to get a deeper view of the role that allowing individuals to select their own technologies to use has on those individuals' as well as the organization's performance.

But, before we get started I want to share with you the consent form for this interview and describe to you the general procedure we will follow.

First, I hope that you will allow me to record these interviews so we can transcribe them for analysis at a later date. The responses will be kept in the strictest confidence and the detailed transcripts will only be shared between the researchers. If at any time you feel that you need to me to stop the recording for a specific portion of the interview, please let me know.

Please take a few minutes to read through the consent form and if you feel comfortable with this process sign the bottom and we can begin.

[Share Consent Form]

As I mentioned, this interview is going to focus on how the technologies that you use in the organization are selected, managed, and impact performance at [organization name]. I will get to more detailed questions shortly but I want to start off by getting some background information about yourself and your role in the organization.

Section 1: Job Position

Can you please describe to me your position in [organization name]?

Section 2: BYOD Context

Now I would like to obtain your insights into a more recent initiative that many organizations are taking.

What do you understand by the term "Bring-your-own-device" or BYOD?

Are you aware of any BYOD initiatives at [organization name] that you could tell me about?

What aspects of "BYOD Policy" do you consider important?

Have your daily tasks changed since [organization name] began to initiate a BYOD policy?

What types of technologies does [organization name] allow you to select with this policy for your tasks? For example, laptops, tablets, mobile phones, software, etc.

Can you tell me about any specific restrictions or constraints that [organization name] places on the technologies that you can choose from? Please indicate this for technologies such as laptops, tablets, mobile phones, software, etc.

Section 3: BYOD Impact

Now I want to ask you about how you think these BYOD policies have impacted [organization name] and your own tasks.

How successful do you think BYOD initiatives have been accepted across [organization name]?

What changes do you think would make this more accepted?

Do you think that these BYOD policies are beneficial to the organization?

What specific impacts do you think BYOD has had on [organization name]?

Now how beneficial do you see BYOD for *yourself* and *your own tasks*?

If you could make any changes to the current BYOD policies at [organization name] what would they be?

Section 4: Job Position and Tasks

Next, I would like to learn a little more about your *specific* tasks in the organization.

Can you please tell me a little bit about the different tasks that you complete each week in more detail?

Do you consider these tasks to be significant different from each other or generally related?

Now, for these tasks that you have described I am a little curious about the level of complexity between each of them.

Ok, now for these tasks, can you tell me in a little more detail about the different technologies and skills that are needed to complete these tasks?

Now, for these tasks that you complete each week, how often are you required to work closely with people from other business functions/departments in the organization?

Can you describe some of these interactions with other individuals and how they impact your own tasks?

Section 5: Switching and Selection Behaviors

Now with BYOD allowing employees to select their own technologies, we are curious about the thought process that employees take to pick a specific technology.

When you are trying to determine which technology to adopt for *your own* use in the organization, what factors influence your decision of which to use?

Can you describe to me a time when you decided to stop using one technology and switch to an alternative?

Now, when you are selecting between which technology to use, how many options are there out there?

Now, thinking about the technologies that you have to select from how similar are the abilities to complete each task between these technologies?

Thinking about your own technology, is there a time that you can recall that you had to select between two or more technologies that did very similar tasks? For example, in my field of work I typically can use 3 to 4 different applications to do the same statistical analysis but have to take into account who I am working and sharing the information with beforehand.

Section 6: IT Portfolio Information

We are also interested in understanding the effect BYOD policy can have on the *variety* in technologies in the organization.

When thinking about the technologies that you specifically use, how different are they from the technologies that other individuals in the organization use?

What about those individuals that are in a similar position as you?

Can you describe what some of the biggest differences between your own and other employees' technologies that you see?

What are some of the reasons that you think that other employees would need to use different technologies than you for their tasks?

Can you think of a time when the differences in technologies either positively or negatively impacted the performance of a task?

Now that we have talked about the differences lets focus more on the similarities.

How integrated would you say the different technologies used across the organization are?

Does your organization do anything specific to ensure that the technologies that employees select are able to work together seamlessly?

In your opinion, what impact does having many different technologies in the organization that employees use have on the organizational performance?

What about the impact it has on your own performance when interacting with other individuals?

Are there any specific things that you think could be done to improve the set of technologies available in the organization?

Section 7: Closing

Before we wrap up, I want to share with you a short survey that focuses on different aspects related to BYOD. If you can take a look at these aspects and rate them based on how important you feel they are to you from “unimportant” to “very important”. This will be used to gather a broad view of what aspects that employees see as key to a BYOD implementation in the organization.

[Share 1 page Survey]

Thank you for taking the time to speak with me today, before we end is there anything that we forgot, or is there anything else that you would like to talk about?

Could I get back in touch with you if I have some clarification or follow-up questions after our analysis of these interviews?

Section 8: Recap Survey

The following questions will provide a recap of our discussion and be used as a reference point for comparisons between individuals. Please circle your answer each questions on the five point scales below.

1. BYOD has been accepted successfully across the organization.

Strongly Disagree Strongly Agree

1 2 3 4 5

2. The BYOD policies allowing individuals to select their own technology is very beneficial to the organization.

Strongly Disagree Strongly Agree

1 2 3 4 5

3. My job has a lot of variety which requires me to do many different things.

Strongly Disagree Strongly Agree

1 2 3 4 5

4. My position requires me to use many different areas of knowledge and skills to complete my tasks.

Strongly Disagree Strongly Agree

1 2 3 4 5

5. How often do your tasks require you to work with people from other business functions in the organization?

Never Always

1 2 3 4 5

6. There are many different technologies to select from when deciding which technology to use for my tasks.

Strongly Disagree Strongly Agree

1 2 3 4 5

7. The technologies that I use in the organization are different from those used by other individuals in the company.

Strongly Disagree Strongly Agree

1 2 3 4 5

8. The technologies utilized across the organization are highly integrated.

Strongly Disagree Strongly Agree

1 2 3 4 5

Appendix B. Agent Based Simulation Measure Development

In this appendix, the development and evolution of the measures used to examine IT differentiation and IT integration are discussed. To begin, the initial measure of integration at time T, presented in the formula below, is at the environmental level. $EnvironmentalIntegration_T$ examines the average $TechTechRatio$ between all technologies, K, such that i is the technology sending the output, j is the technology receiving the input.

$$\text{EnvironmentalIntegration}_T = \frac{(\sum_i^1 \sum_j^1 TechTechRatio_{ij})}{K}$$

While $EnvironmentalIntegration_T$ is an estimate of the integration for all **possible** technologies in the environment, this estimation does not take into account the **actual** technologies that exist in a specific organization. To address this issue, $OrganizationalIntegration_T$ is utilized which estimates the level of integration of only the **actual** technologies in the organization. The following formula presents the estimation of $OrganizationalIntegration_T$ as the average $TechTechRatio$ between the technologies utilized in the organization only, k, such that i is the technology sending the output, j is the technology receiving the input.

$$\text{OrganizationalIntegration}_T = \frac{(\sum_i^1 \sum_j^1 TechTechRatio_{ij})}{k}$$

This measure of $OrganizationalIntegration_T$ provides insights into the organizational IT portfolio to some extent, however, it does not take into account the differences between an organization consisting of 9 individuals with technology A and 1 individual with technology B and an organization with 5 individuals with technology A and 5 individuals with technology B. To address this issue a *weighted* version of the $OrganizationalIntegration_T$ measure is estimated, $ITIntegration_T$, and used for the primary analysis. This measure of IT integration takes into account the number of individuals actually owning each specific technology. In the following formula $ITIntegration_T$ is estimated such that each $TechTechRatio_{ij}$ is weighted by O, the number of individuals in the organization owning technology *i*. This summation of conversion ratios is then divided by the number of organizational technologies, *k*, the number of individuals in the organization, *N*, and the number of technologies an individual is allowed to own in their personal IT portfolio, *owned*, to create a standardized value.

$$\text{ITIntegration}_{\text{T}} = \frac{(\sum_{i}^{1}\sum_{j}^{1} TechTechRatio_{ij} \times O)}{k \times N \times owned}$$

To examine the level of IT Differentiation across all individuals in the organization a measure of heterogeneity between groups based on a variation in Euclidean Distances (O'Reilly et al. 1989) is used which is similar to the approach utilized by Lawrence and Lorsch (1967a). In the formula below $OrganizationalDifferentiation_t$ is calculated as the square root of the averaged squared differences between the personal IT portfolio of individual *n1*, Z_{n1}, and the personal IT portfolio of individual *n2*, Z_{n2}, across all individuals, *n*. Thus, $\sum_{n1}^{1}(\sum_{n2}^{1}\frac{(Z_{n1} - Z_{n2})^2}{N})$ examines the sum of ***unique*** systems that are ***not*** shared between individuals *n1* and *n2* such that the difference are the number of unique systems.

$$\text{OrganizationalDifferentiation}_{\text{T}} = \sqrt{\sum_{n1}^{1}(\sum_{n2}^{1}\frac{(Z_{n1} - Z_{n2})^2}{N})}$$

While this provides a level of difference across all individuals in the organization it is a function of the number of environmental technologies in the organization such that the interpretation of each value of IT differentiation is not interpretable without the context of the number of environmental technologies. To standardize this estimation of IT Differentiation an estimation which divides the $OrganizationalDifferentiation_T$ by the theoretical maximum level of IT differentiation, $MaxDifferentiation_T$, is used. The standardized version of this estimation, $OrganizationalDifferentiationStandardized_T$, is presented in the following formula such that *n1* is the focal individual, *n2* is the comparison individual, and *N* is the number of individuals in the organization. *MaxDifferentiation* is the theoretical maximum value of differentiation between all individual IT portfolios in the organization.

$$\text{OrganizationalDifferentiationStandardized}_{\text{T}} = \frac{\sqrt{\sum_{n1}^{1}(\sum_{n2}^{1}\frac{(Z_{n1} - Z_{n2})}{N}^{2})}}{MaxDifferentiation}$$

To estimate the maximum theoretical differentiation between individuals in the organization we utilize an approach which estimates the maximum difference based upon the number of technologies an individual is allowed to own in their personal IT portfolio, *owned*, and the number of individuals in the organization, *N*, as presented in the following formula.

$$\text{MaxDifferentiation}_{\text{T}} = \left(\frac{(owned \times 2)^{2}}{N}\right) \times \ (N^{2} - N)$$

While prior literature has used variations of Euclidean distances (O'Reilly et al. 1989) to measure group heterogeneity (e.g.. Lawrence and Lorsch 1967a) the estimates are computationally taxing in large networks with many attributes. To address this issue an alternative approach was examined. This approach utilizes a comparison of each individual's personal IT portfolio to the average IT portfolio ownership for a specific technology in the organization. The formula below for $OrganizationalDifferentiationMeanDifference_T$ specifically compares individual *n's* technology portfolio, $Z_{n,i}$, to the mean technology ownership of all other individuals, μ_N, such that *n* is the focal individual, *i* is the specific technology in individual *n's* technology portfolio, *owned* is the number of technologies individual *n1* possesses, and *N* is the number of individuals in the organization.

$$\text{OrganizationalDifferentiationMeanDifference}_{\text{T}} = \frac{\left[\frac{\sum_{N}^{1}(\sum_{K}^{1}(z_{n,i} - \mu_{N,i})^{2})}{N}\right]}{owned}$$

This estimation of $OrganizationalDifferentiationMeanDifference_T$ is conceptually similar to the Euclidean Distance measure. To compare the validity and similarity of these alternative measures of organizational IT differentiation an initial test was conducted utilizing the agent-based simulation by estimating the standardized version of IT Differentiation, *OrganizationalDifferentiationStandardized$_t$*, and the mean difference version of IT Differentiation, *OrganizationalDifferentiationMeanDifference$_t$*. This was conducted by examining the estimations of each measure with an increasing number of individual actors (i.e. 5, 10, 15….100). Figure 3.B1 depicts the estimates from this analysis.

[See Figure 3.B1.]

The results indicate that the pattern of results, while differing in magnitude, remains consistent in its variance. Additionally, the correlation between these two measures is 0.96. Therefore, due to the high level of similarity and the exponential magnitude of differences in estimation speed, the primary estimation for IT differentiation, *ITDifferentiation$_T$,* will utilize the mean difference equation, *OrganizationalDifferentiationMeanDifference$_t$,* for simplicity and efficiency.

Chapter 3. Tables and Figures

Figure 3.1. Initial Research Model

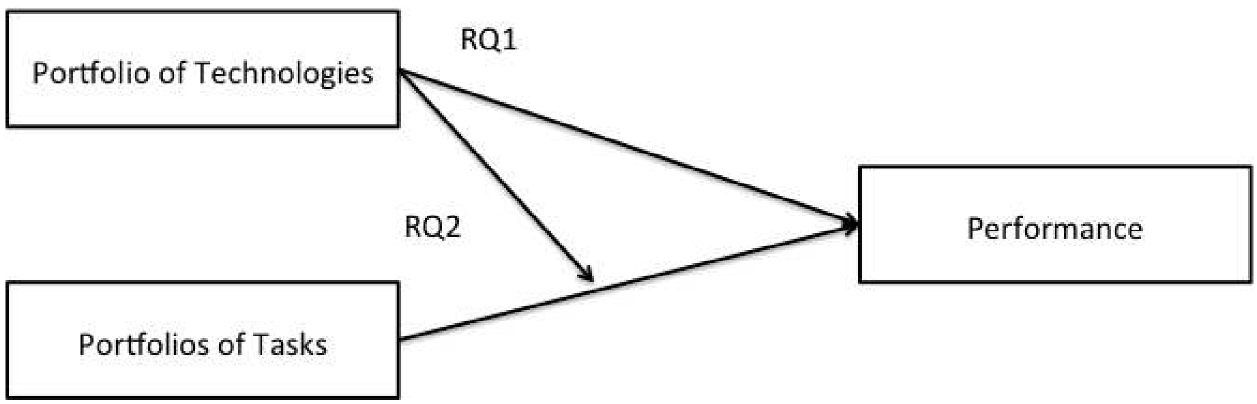


Figure 3.2. Theory Development Process

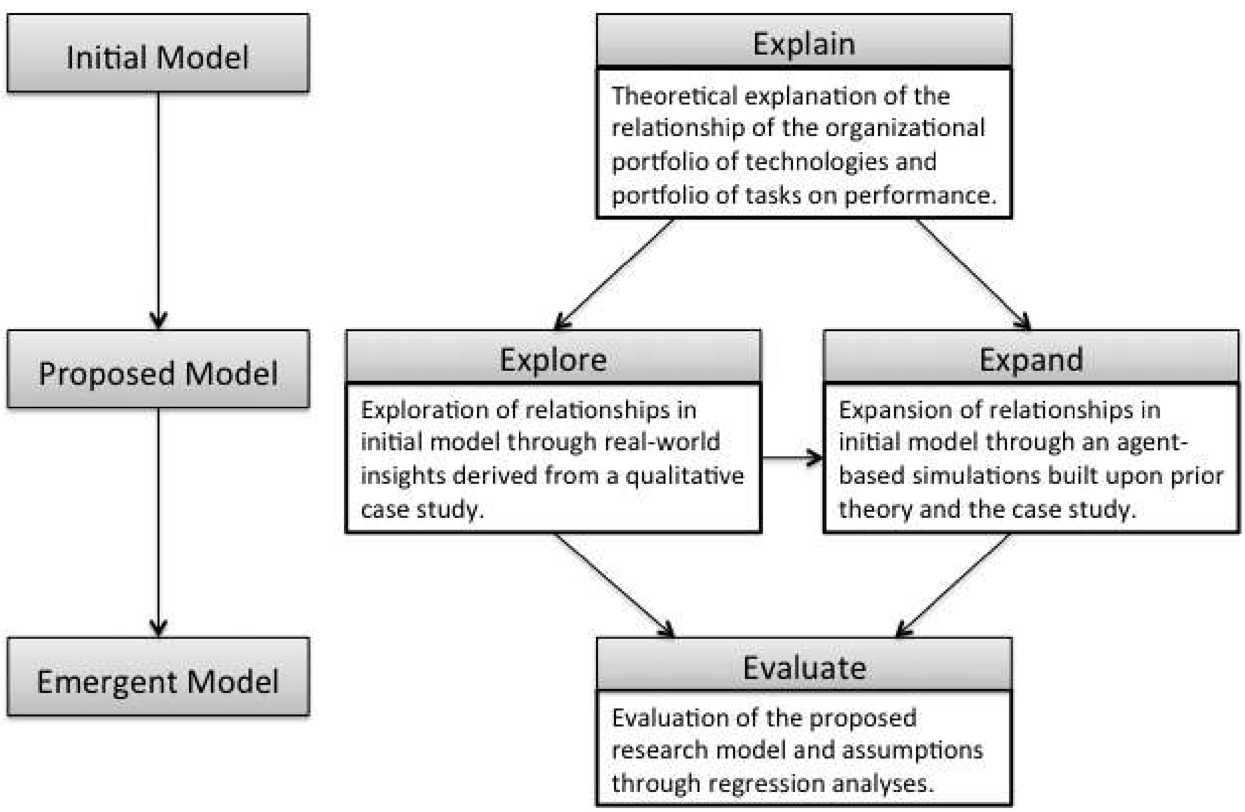
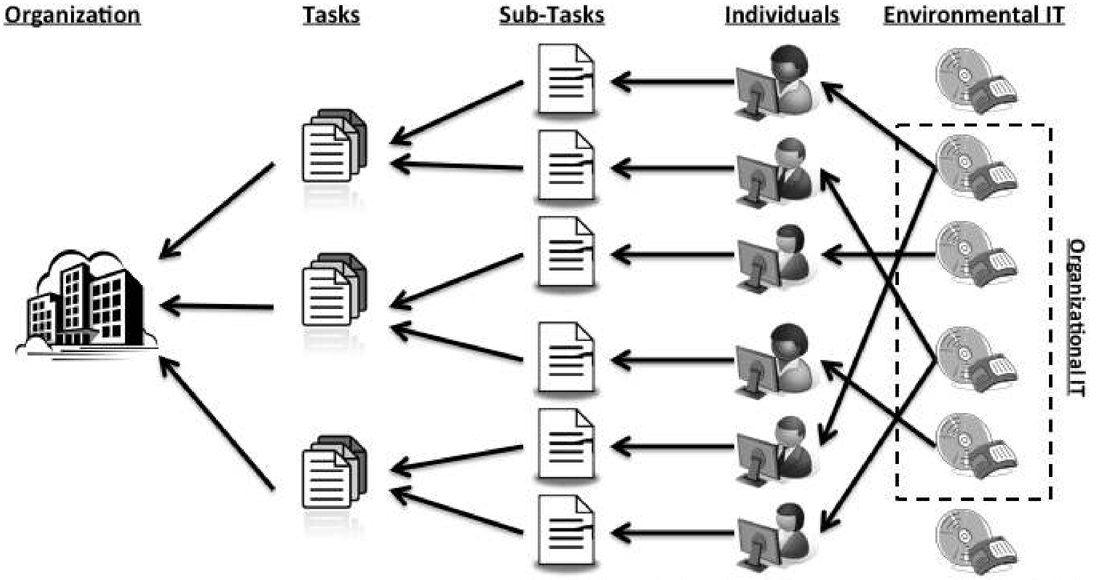


Figure 3.3. Simulation Environment Diagram



Technology-Task Ratios

Environmental IT \ Task				
	.7	.5	.8	.7
	.6	.2	.2	.1
	.8	.8	.3	.1
	.5	.3	.9	.2

Conversion Ratios

Sending IT \ Receiving IT				
	1	0.2	0.1	0.9
	0.3	1	0.3	0.7
	0.1	0.1	1	0.6
	0.3	0.6	0.8	1

Figure 3.4. Simulation Procedure

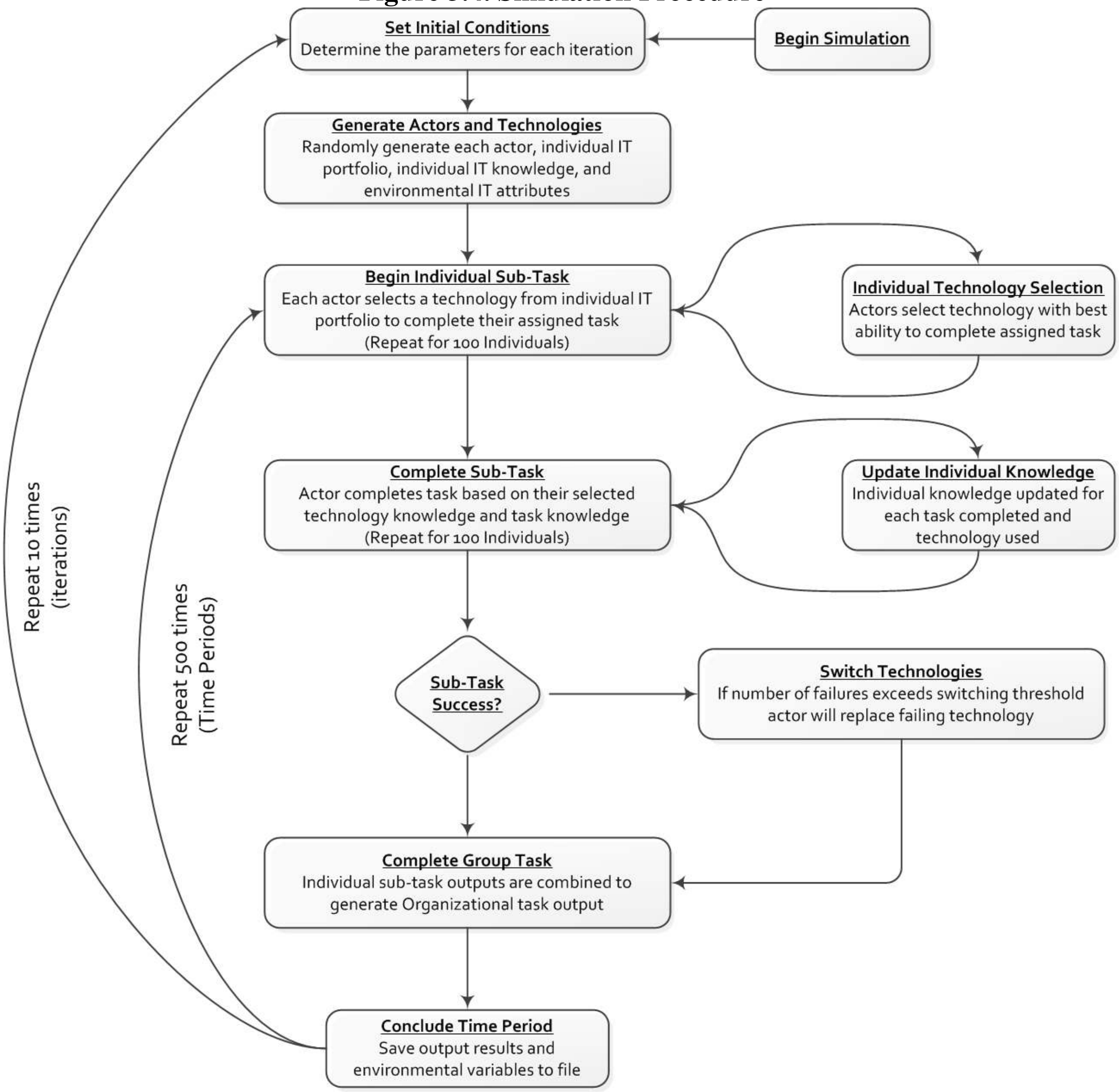


Figure 3.5. IT Differentiation Graphs[a]

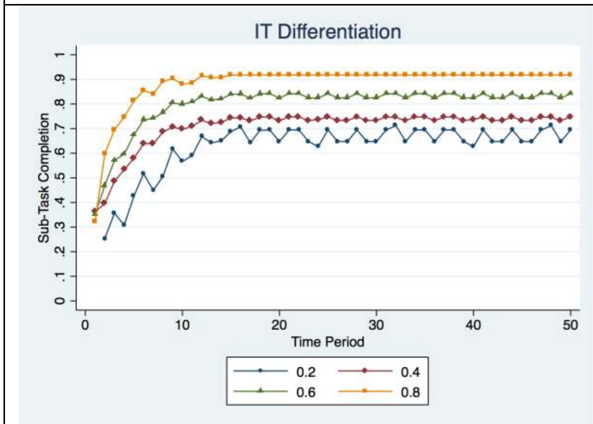
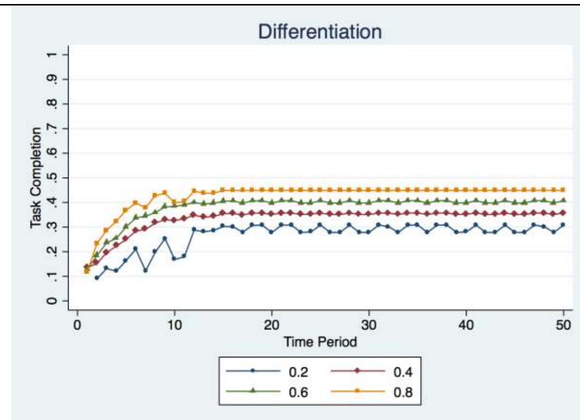
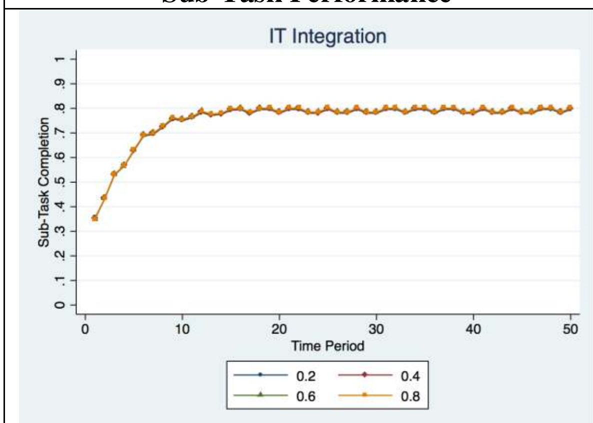
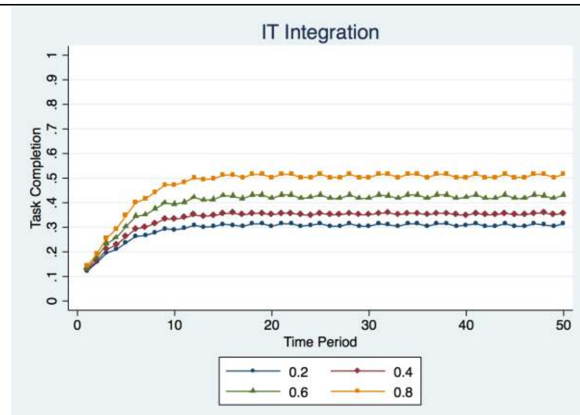
Sub-Task Performance	Task Performance
	

Figure 3.6. IT Integration Graphs[b]

Sub-Task Performance	Task Performance
	

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[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT differentiation across 500 time periods.

[b] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT integration across 500 time periods.

Figure 3.7. IT Differentiation and IT Integration Graphs

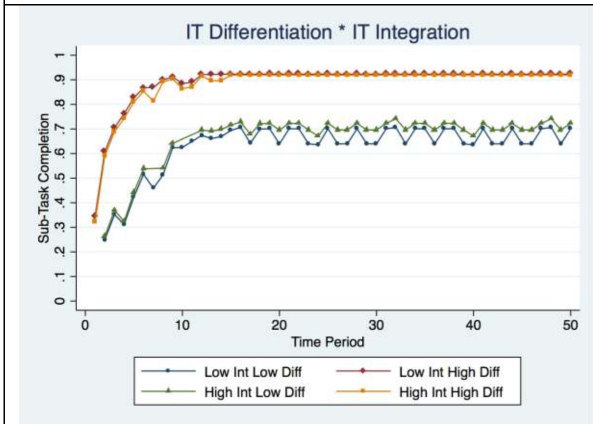
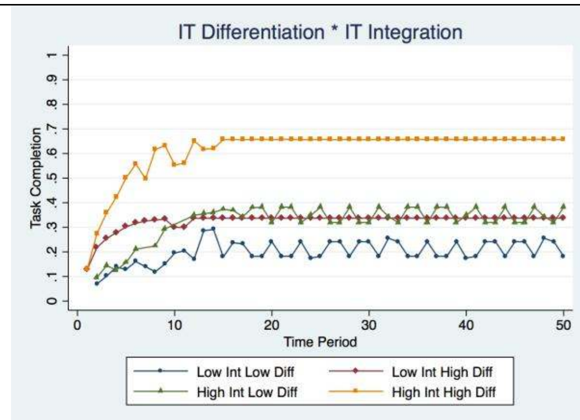
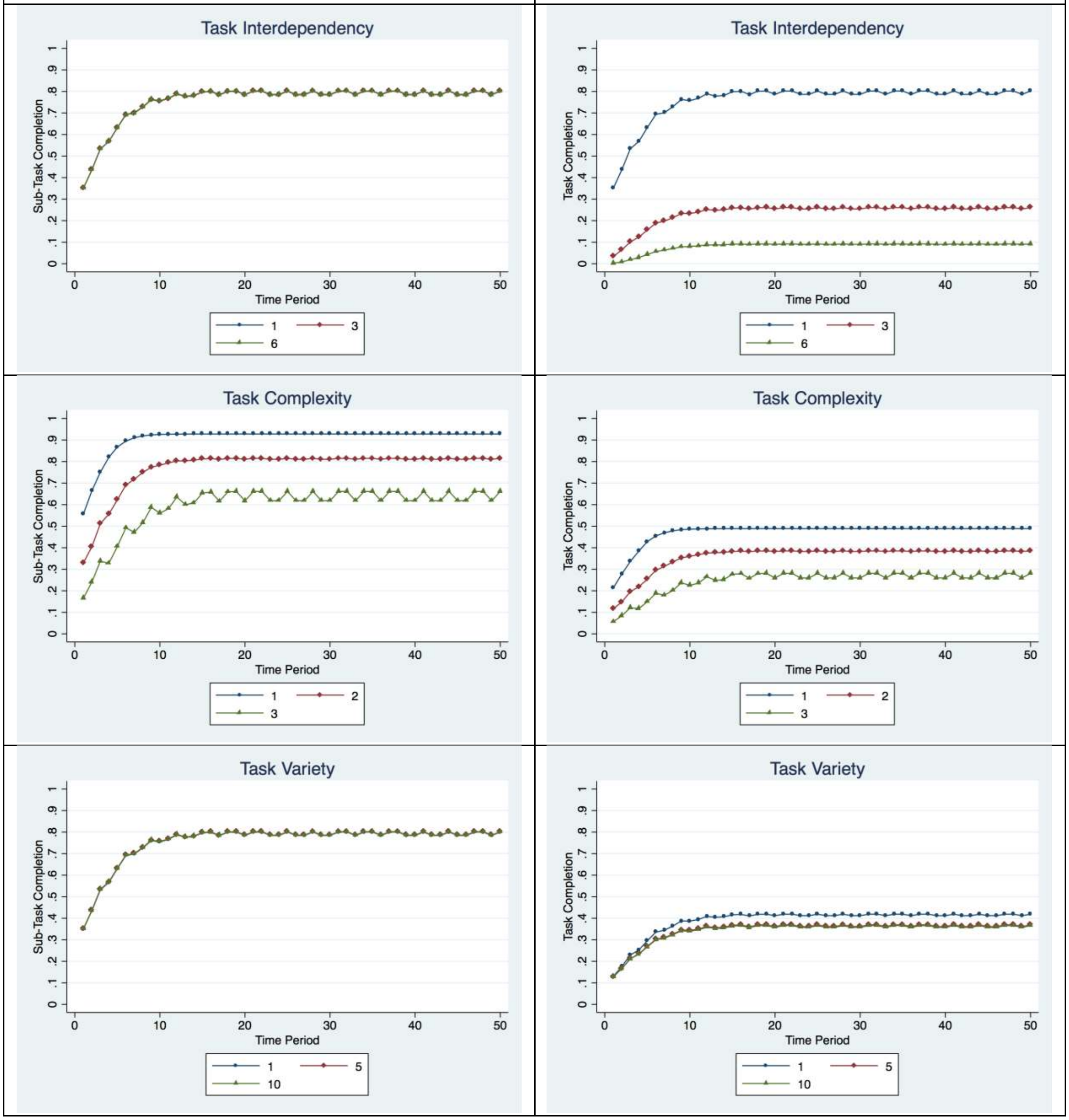
Sub-Task Performance	Task Performance
	

Figure 3.8. Task Characteristics Graphs[a]

Sub-Task Performance	Task Performance



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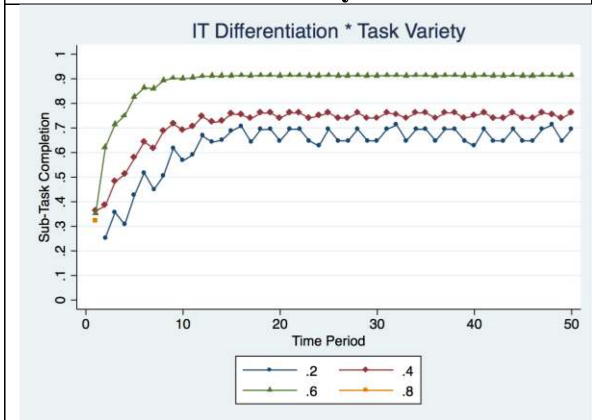
[a] Each graph depicts low interdependency (one person in a group), medium interdependency (three people in a group), and high interdependency (six people in a group), low complexity (one technology), medium complexity (two technologies), and high complexity (three technologies), or low variety (one sub-task), medium variety (five sub-tasks), and high variety (ten sub-tasks).

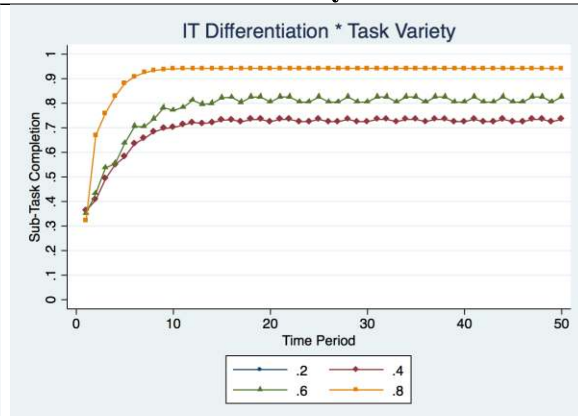
Figure 3.9. IT Differentiation and Task Variety Graphs[a]

Sub-Task Performance

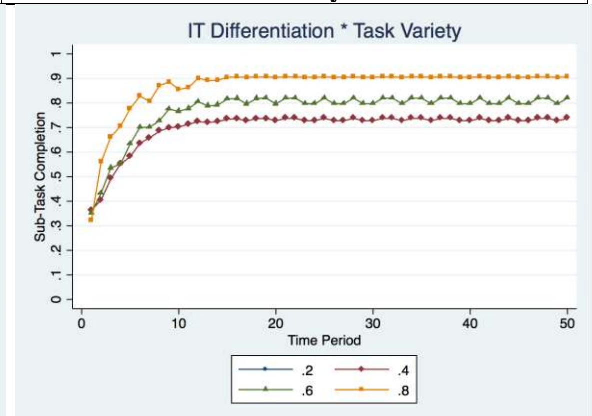
Task Variety = 1



Task Variety = 5

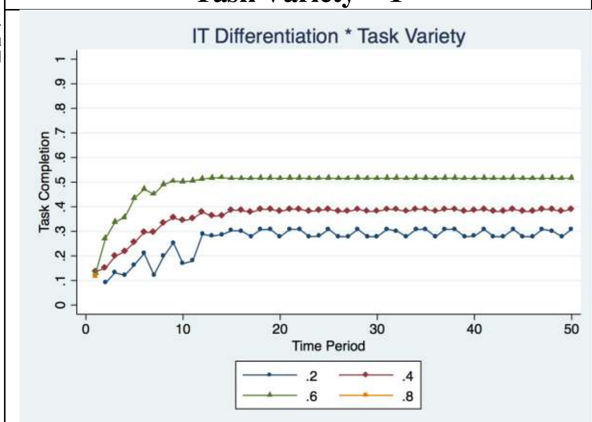


Task Variety = 10

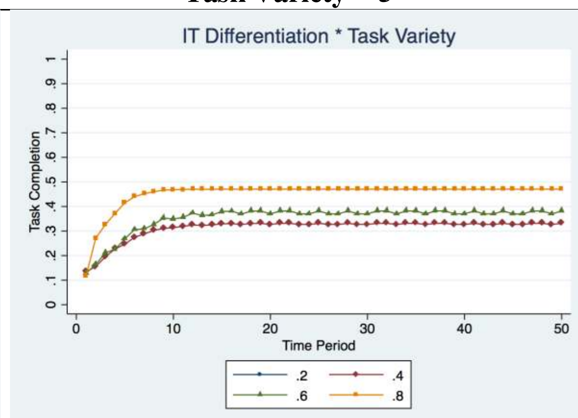


Task Performance

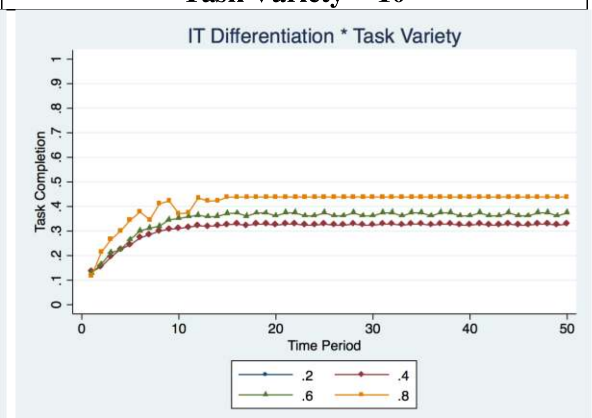
Task Variety = 1



Task Variety = 5

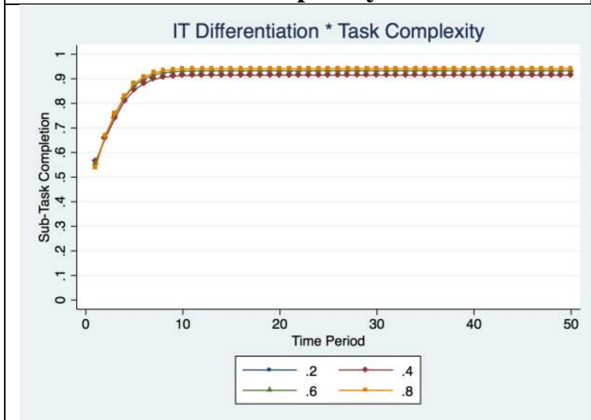
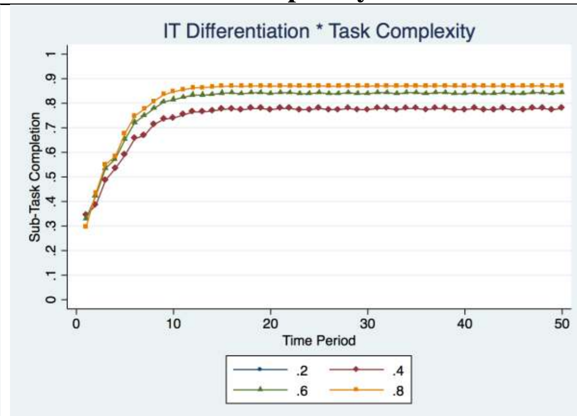
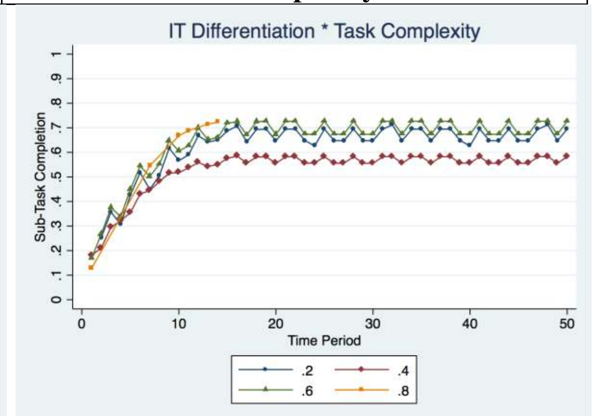


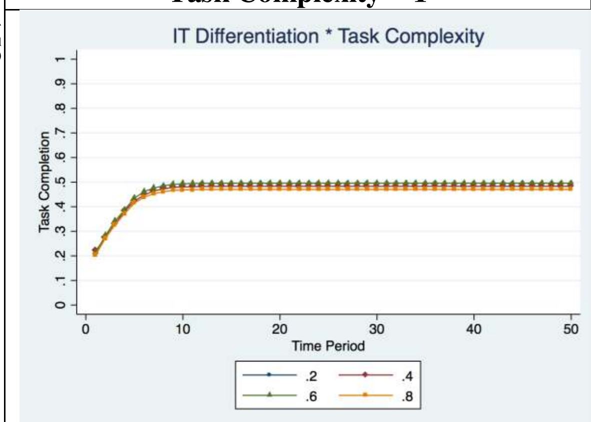
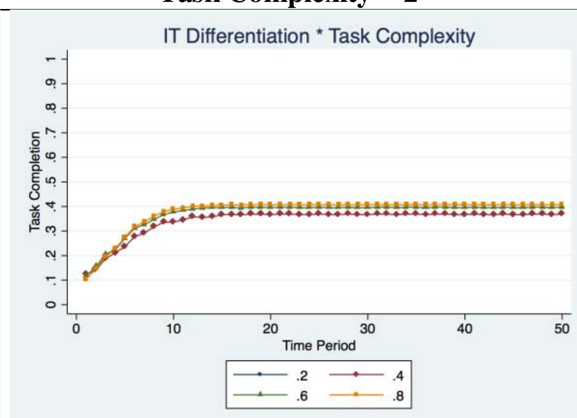
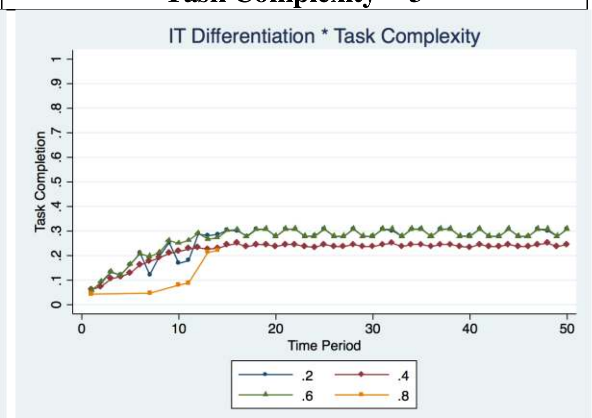
Task Variety = 10



[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT differentiation across 500 time periods.

Figure 3.10. IT Differentiation and Task Complexity Graphs[a]

Sub-Task Performance		
Task Complexity = 1	**Task Complexity = 2**	**Task Complexity = 3**
		

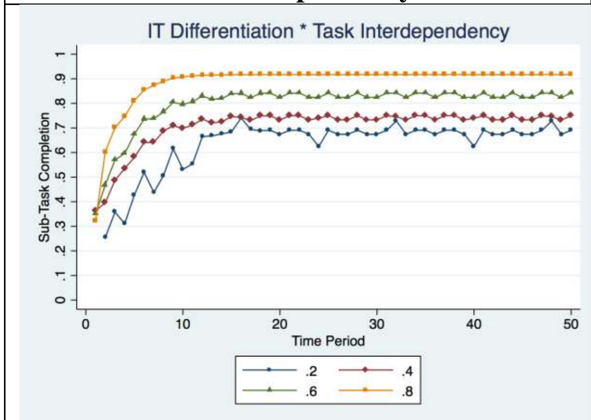
Task Performance		
Task Complexity = 1	**Task Complexity = 2**	**Task Complexity = 3**
		

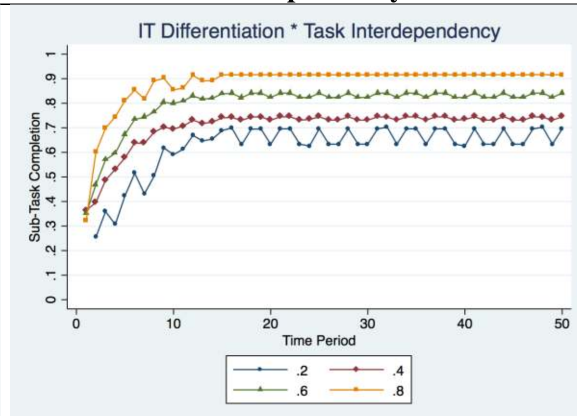
[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT differentiation across 500 time periods.

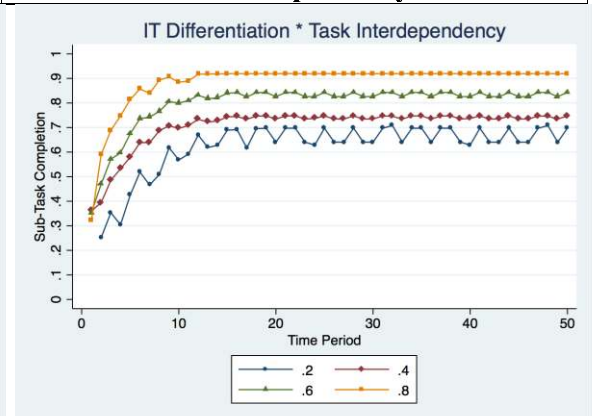
Figure 3.11. IT Differentiation and Task Interdependency Graphs[a]

Sub-Task Performance

Task Interdependency = 1	Task Interdependency = 3	Task Interdependency = 6

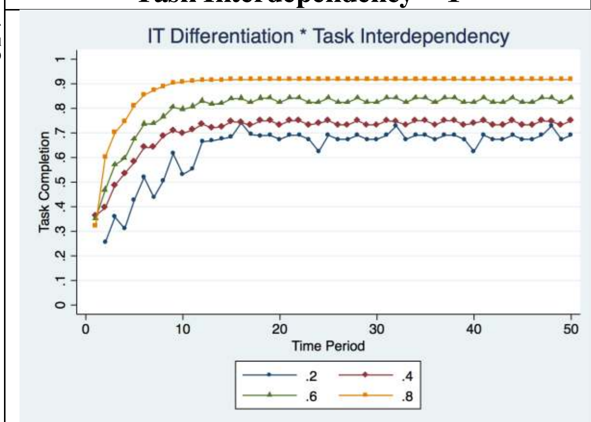


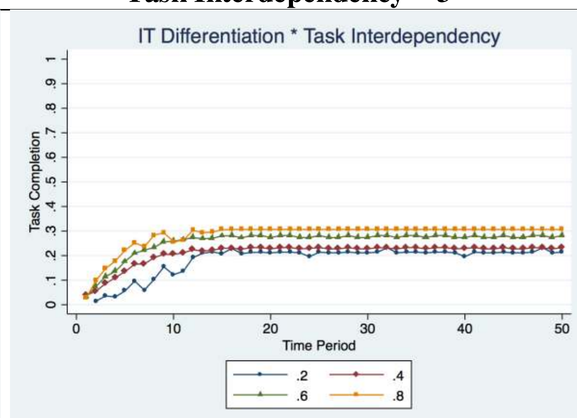


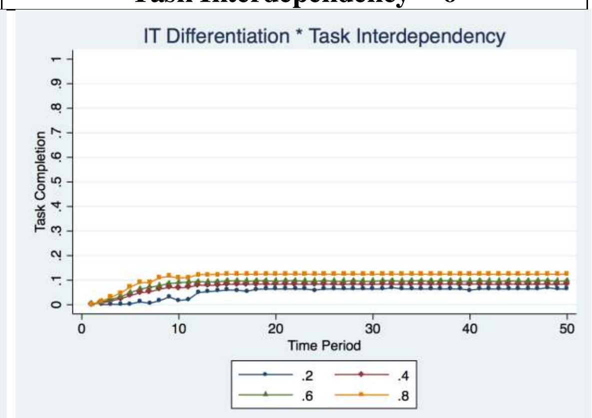


Task Performance

Task Interdependency = 1	Task Interdependency = 3	Task Interdependency = 6





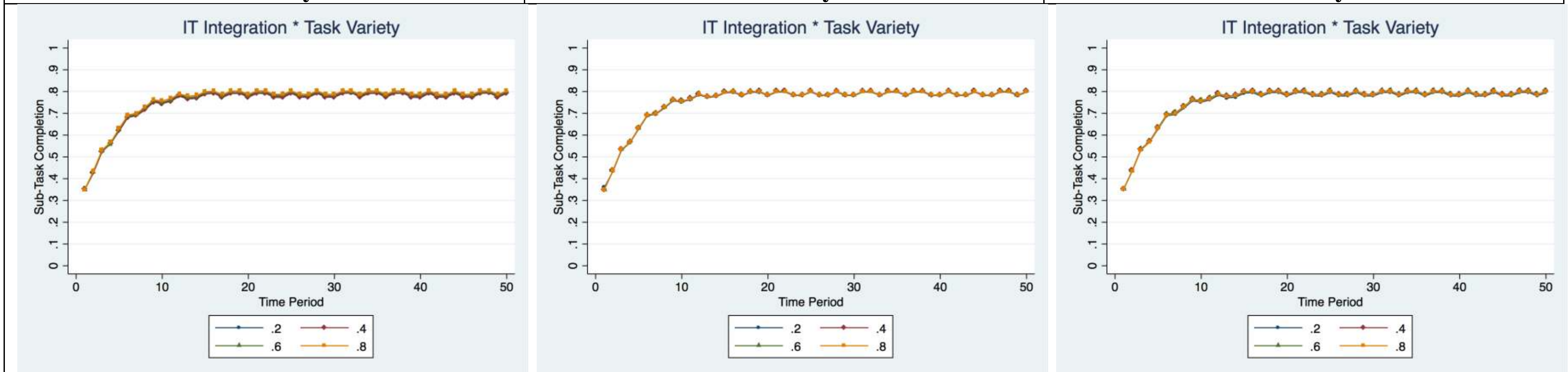


[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT differentiation across 500 time periods.

Figure 3.12. IT Integration and Task Variety Graphs[a]

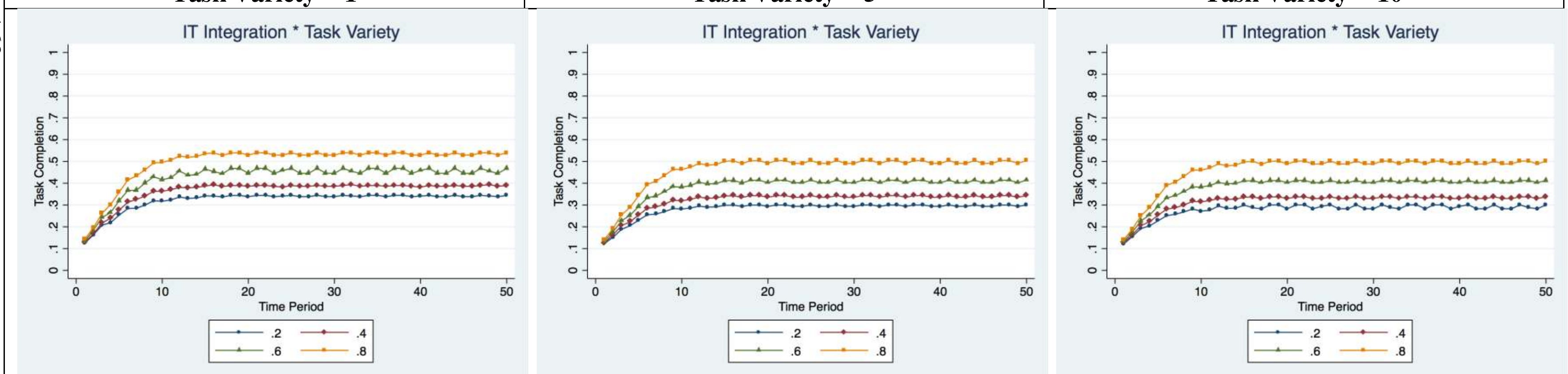
Sub-Task Performance

Task Variety = 1	Task Variety = 5	Task Variety = 10



Task Performance

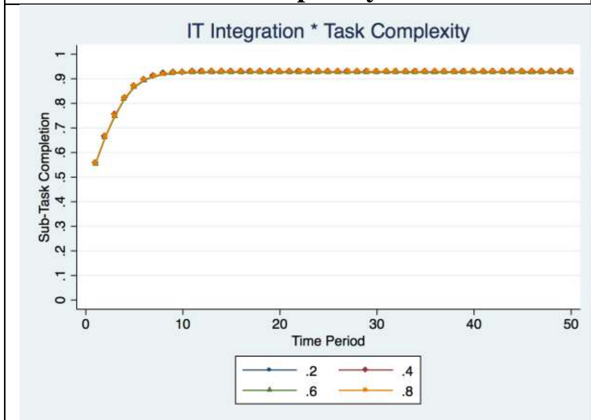
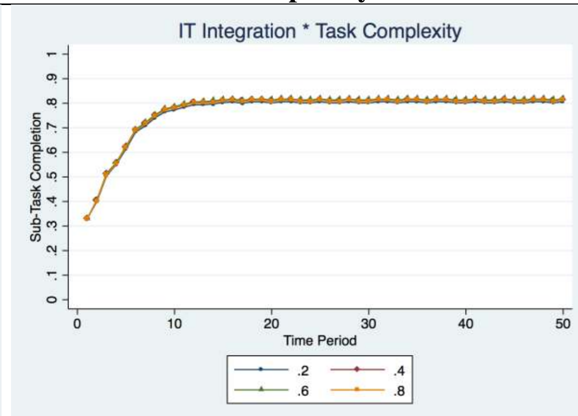
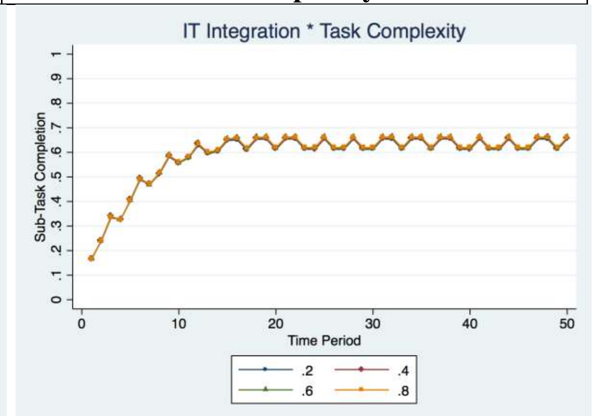
Task Variety = 1	Task Variety = 5	Task Variety = 10



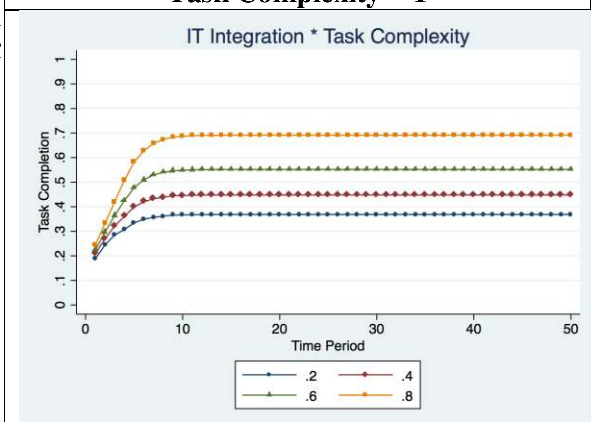
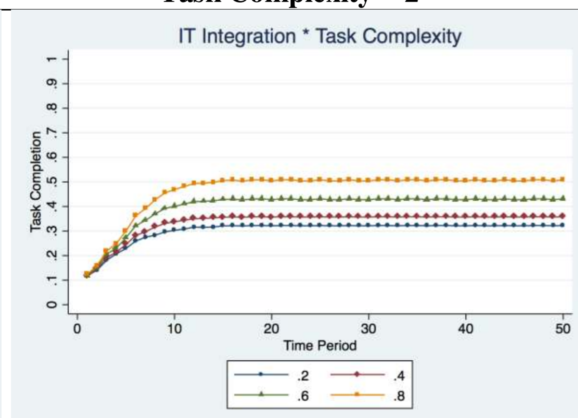
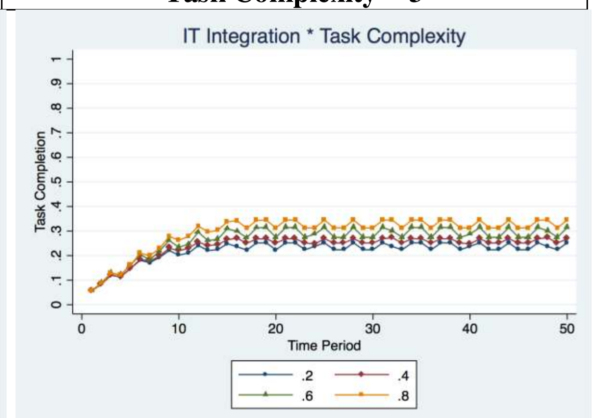
[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT integration across 500 time periods.

Figure 3.13. IT Integration and Task Complexity Graphs[a]

Sub-Task Performance

Task Complexity = 1	Task Complexity = 2	Task Complexity = 3
		

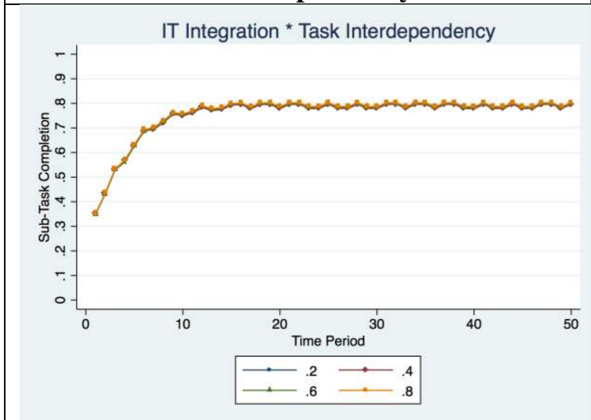
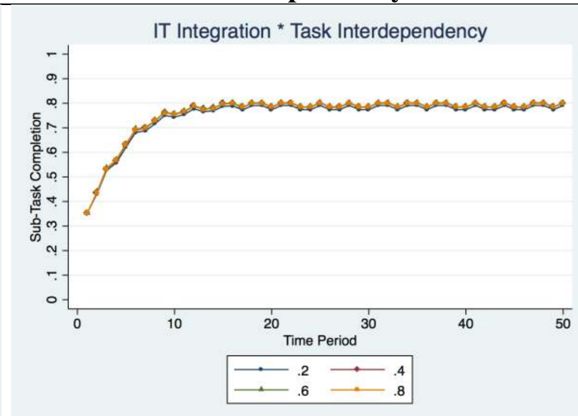
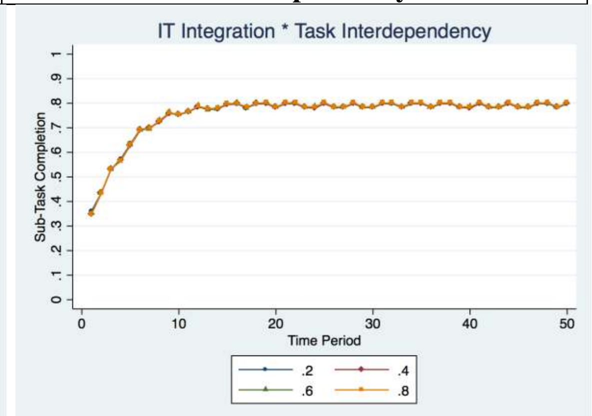
Task Performance

Task Complexity = 1	Task Complexity = 2	Task Complexity = 3
		

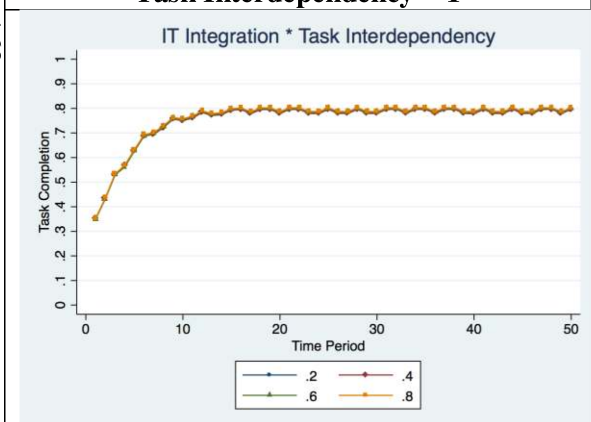
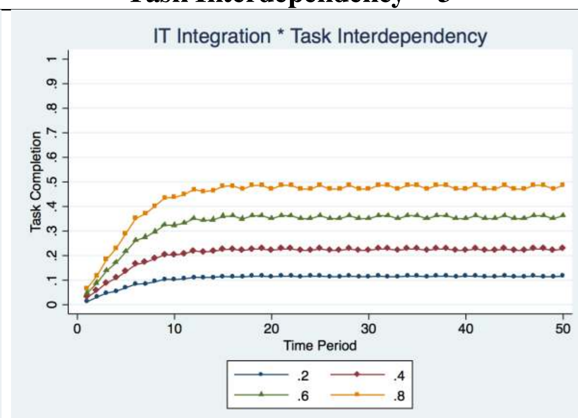
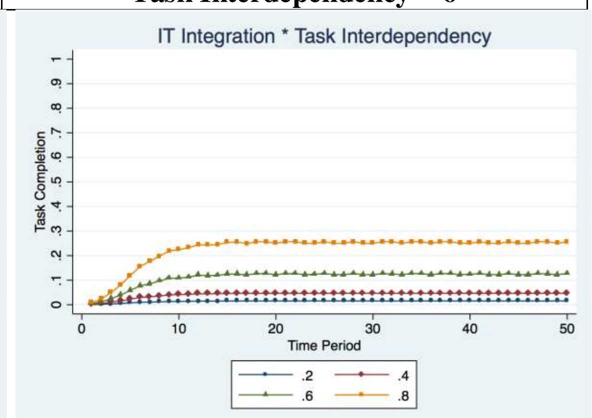
[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT integration across 500 time periods.

Figure 3.14. IT Integration and Task Interdependency Graphs[a]

Sub-Task Performance

Task Interdependency = 1	Task Interdependency = 3	Task Interdependency = 6
		

Task Performance

Task Interdependency = 1	Task Interdependency = 3	Task Interdependency = 6
		

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[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT integration across 500 time periods.

Figure 3.15. Initial Research Model

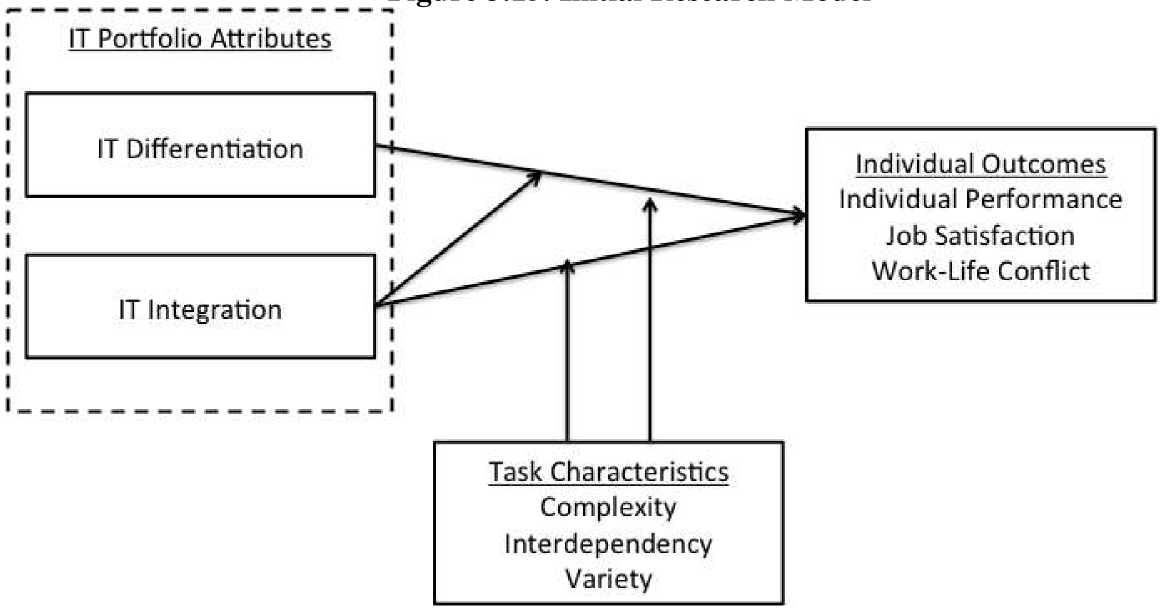


Figure 3.16. Emergent Research Model

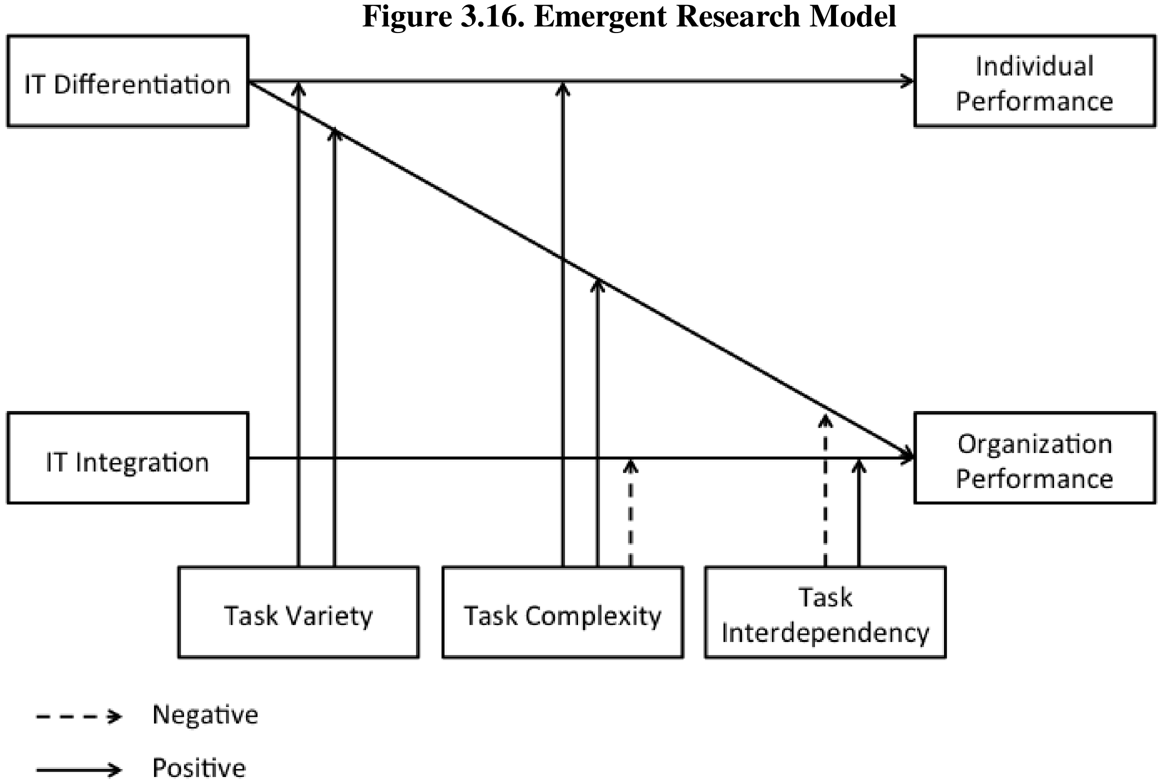
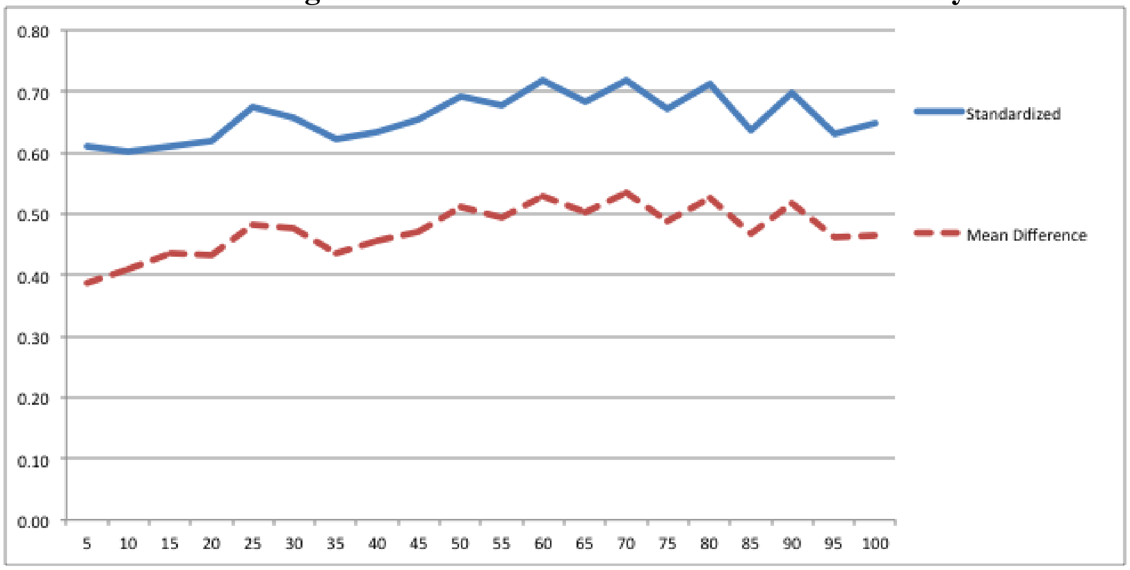


Figure 3.B1. IT Differentiation Measure Similarity[a]



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[a] To compare the different IT differentiation measures this graph depicts the similarities between the Euclidean Distances and mean-difference estimations from 5 to 100 actors in the network.

Table 3.1. Interviewee Description

#	Organization	Interviewee	Job Description
1	GlobalRetailer	GR1	Infrastructure development focusing on new innovations and project planning for new technology roll-outs.
2	GlobalRetailer	GR2	Infrastructure deployment focusing on the large scale roll-out across the organization.
3	GlobalRetailer	GR3	Vendor relationships and management with suppliers.
4	GlobalRetailer	GR4	Legal counsel specializing on security and licensing management.
5	GlobalRetailer	GR5	Operations management for entire organization.
6	GlobalRetailer	GR6	Infrastructure leadership across development, deployment, and support.
7	Vendor	V1	Sales management focusing on customer contact at a retail customer location.
8	Vendor	V2	Project management for customer support at a retail customer location.
9	Vendor	V3	Senior leadership for operations, sales, and support at a retail customer location.
10	Vendor	V4	Networking infrastructure support for a retail customer connected via remote technologies.

Table 3.2. Simulation Stochastic Estimations[a]

Variable	Equation	Description	Range
Individual Sub-task Performance	$SubTaskCompletion_n = TechnologyKnowledge_{n,i} \times SubTaskKnowledge_{n,t} \times TaskTechRatio_{it}$	The measurement of individual sub-task performance is a function of the knowledge an individual has with both technology *i* and the assigned task *t* as well as the ability of technology *i* to successfully complete task *t*.	0 – 1
Organizational Task Performance	$TaskCompletion_p = \left(\prod_{n=1}^{g} SubTaskCompletion_n\right) \times \left(\prod_{n=1}^{g-1} TechTechRatio_{(i,n1),(j,n2)}\right)$	The measurement of organizational task performance is a function of each individual's sub-task performance within the group and the ability to convert and share the sub-task outputs between individual *n1* and *n2* using technologies *i* and *j*.	0 – 1
IT Integration	$ITIntegration = \frac{(\sum_i^1 \sum_j^1 TechTechRatio_{ij} \times O)}{k \times N \times owned}$	The level of IT integration within the organization is measured as the summation of each conversion ability between technologies i and j within organization weighted by *O* the number of individuals who actually own each technology. This value is then standardized based upon the number of technologies in the organization, *k*, the number of employees, *N*, and the size of each employee IT portfolio.	0 – 1
IT Differentiation	$ITDifferentiation = \frac{\left[\frac{\sum_N^1 (\sum_K^1 (Z_{n,i} - \mu_{N,i})^2)}{N}\right]}{owned}$	The level of IT differentiation within the organization is measured as the average difference between each individual's employee IT portfolio, $Z_{n,i}$, and the average employee IT portfolio, $\mu_{N,i}$. This measure examines on average how different the employees are across the organization.	0 - 1

[a] n = individual; *i* = technology; *t* = assigned task; *p* = group of individuals; $TechTechRatio_{ij}$ = the conversion ability between technology *i* and *j*; *O* = number of individuals owning a specific technology; *k* = number of unique technologies within the organization; *N* = number of individuals; *owned* = number of technologies employees are allowed to own at one time; *K* = number of technologies in the environment; $Z_{n,i}$ = set of technologies in individual IT portfolio; $\mu_{N,i}$ = average set of technologies owned by individuals in organization

Table 3.3. Simulation Parameter Values and Sensitivity Analysis

Parameter	Description	Values used in final model	Additional values used for robustness analysis
Number of Environmental Technologies	The number of potential technologies to select from within the environment.	10, 20	5, 15, 30
Number of Technologies Owned by Individuals	The number of technologies an individual owns within their Personal IT portfolios.	3, 4, 5	1, 2
Successful Task Completion Threshold	The threshold at which an individual considers their task completed successfully.	0.75	0.5, 0.90
Task Interdependency	The number of individuals who must work together to complete and combine sub-tasks.	1, 3, 6	10, 15
Task Variety	The number of task types for individual assignment within the organization.	1, 5, 10	20, 30
Task Complexity	The number of skills and technologies that each sub-task requires for completion by an individual.	1, 2, 3	4, 5
Number of Actors	The number of individuals within the organization.	100	50
Failed Attempts Threshold	The threshold at which an individual decides to switch from one technology to an alternative based on failed attempts.	15	30, 50
Average Technology-Technology Ratio	The average level of technology-to-technology conversion ratio that exists for each technology within the environment.	0.1, 0.25, 0.5, 0.75, 1	-
Average Task Knowledge	The average level of task knowledge an individual holds for all potential environmental tasks.	0.75	0.5, 0.90
Average Technology Knowledge	The average level of technology knowledge an individual holds for all environmental technologies.	0.75	0.5, 0.90
Average Task-Technology Ratio	The average level of ability for each technology to complete each task successfully.	0.75	0.5, 0.90

Table 3.4. Main Analysis Results[a]

Variables	Organizational Task Performance (1)	(2)	(3)	(4)	Individual Sub-Task Performance (5)	(6)	(7)	(8)
Constant	0.079***	0.081***	0.083***	0.073***	0.253***	0.258***	0.257***	0.228***
Task Complexity	-0.254***	-0.229***	-0.229***	-0.240***	-0.620***	-0.544***	-0.544***	-0.583***
Task Interdependency	-0.832***	-0.832***	-0.832***	-0.833***	-0.001	-0.001	-0.001	-0.001
Task Variety	-0.062***	-0.095***	-0.095***	-0.099***	0.003	-0.090***	-0.090***	-0.104***
IT Differentiation		0.081***	0.080***	0.082***		0.220***	0.220***	0.225***
IT Integration		0.228***	0.227***	0.227***		-0.007	-0.007	-0.006
IT Differentiation * IT Integration			0.046**	0.016			-0.009	-0.014
IT Differentiation * Task Variety				0.049**				0.161***
IT Differentiation * Task Interdependency				-0.053***				0.003
IT Differentiation * Task Complexity				0.033*				0.114***
IT Integration * Task Variety				0.003				0.008
IT Integration * Task Interdependency				0.090***				0.001
IT Integration * Task Complexity				-0.090***				-0.011
adj. R^2	0.7338	0.7870	0.7888	0.8078	0.6906	0.7542	0.7541	0.7996

[a] N = 810

Table 3.5. Longitudinal Analysis Results

	Organizational Task Performance				Individual Sub-Task Performance			
Variables	**(1)[a]**	**(2)[b]**	**(3)[c]**	**(4)[d]**	**(5)[a]**	**(6)[b]**	**(7)[c]**	**(8)[d]**
Constant	0.073***	0.050**	0.051**	0.009***	0.228***	0.144***	0.148***	0.468***
Task Complexity	-0.240***	-0.267***	-0.267***	-0.018***	-0.583***	-0.682***	-0.680***	-0.095***
Task Interdependency	-0.833***	-0.817***	-0.817***	-0.052***	-0.001	-0.001	-0.002	-0.000
Task Variety	-0.099***	-0.099***	-0.100***	-0.005***	-0.104***	-0.104***	-0.107***	-0.010***
IT Differentiation	0.082***	0.077***	0.079***	0.003***	0.225***	0.219***	0.227***	0.023***
IT Integration	0.227***	0.218***	0.218***	0.013***	-0.006	-0.009	-0.009	-0.001*
IT Differentiation * IT Integration	0.016	0.014	0.017	0.000	-0.014	-0.017	-0.014	-0.001**
IT Differentiation * Task Variety	0.049**	0.046**	0.044**	0.004***	0.161***	0.148***	0.142***	0.021***
IT Differentiation * Task Interdependency	-0.053***	-0.059***	-0.059***	-0.002***	0.003	0.006	0.006	0.000
IT Differentiation * Task Complexity	0.033*	0.031*	0.033*	0.001**	0.114***	0.116***	0.123***	0.012***
IT Integration * Task Variety	0.003	0.004	0.004	0.001	0.008	0.011	0.010	0.001*
IT Integration * Task Interdependency	0.090***	0.088***	0.088***	0.005***	0.001	0.001	0.001	0.000
IT Integration * Task Complexity	-0.090***	-0.100***	-0.099***	-0.006***	-0.011	-0.014	-0.013	-0.001**
Organizational Task Performance (t-1)				0.802***				
Individual Sub-Task Performance (t-1)								0.244***
Time Period				0.002***				0.004***
adj. R^2	0.808	0.805	0.805	0.928[e]	0.800	0.800	0.804	0.705[c]

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[a] Time period = 500 with N = 810
[b] Time period = 400 with N = 810
[c] Time period = 300 with N = 810
[d] Analysis conducted through fixed effect longitudinal analysis via XTREG with N = 39690
[e] Overall R^2

Table 3.6. Robustness Analysis Results[a]

	Second Dataset		3-way Interactions	
Variables	**Organization**	**Individual**	**Organization**	**Individual**
Constant	0.493***	1.018***	0.073***	0.228***
Task Complexity	-0.269***	-0.448***	-0.240***	-0.583***
Task Interdependency	-0.977***	0.001	-0.832***	-0.001
Task Variety	-0.103***	-0.059***	-0.099***	-0.104***
IT Differentiation	0.101***	0.197***	0.082***	0.226***
IT Integration	0.268***	-0.005	0.217***	-0.014
IT Differentiation * IT Integration	0.027	-0.013	0.018	-0.012
IT Differentiation * Task Variety	0.064**	0.144***	0.049**	0.160***
IT Differentiation * Task Interdependency	-0.071***	-0.007	-0.053***	0.003
IT Differentiation * Task Complexity	0.044*	0.101***	0.033*	0.114***
IT Integration * Task Variety	0.001	0.007	0.004	0.010
IT Integration * Task Interdependency	0.103***	0.002	0.090***	0.001
IT Integration * Task Complexity	-0.101***	-0.006	-0.096***	-0.013
IT Differentiation * IT Integration * Task Variety			0.025	0.013
IT Differentiation * IT Integration * Task Interdependency			0.022	-0.002
IT Differentiation * IT Integration * Task Complexity			0.000	-0.007
adj. R^2	0.8095	0.7990	0.8081	0.7993

[a] N = 810

Chapter 4. Organizational IT Portfolio Configuration: The Impact of Individual Decision-Making Models and Organizational IT Policies

Introduction

"Those who cannot remember the past are condemned to repeat it." — (Santayana 1905)

Decisions on the number and type of information technologies (ITs) utilized within an organization, and their distribution and adoption, have been an important topic for research as well as practice. Organizations typically adopt one of three approaches: centralized IT management with the information systems (IS) department deciding on which ITs to implement; a decentralized approach allowing the focal departments to determine the most relevant ITs for own tasks; or a variety of hybrids (Brown 1997; Sambamurthy and Zmud 1999). Although the locus of control varies across these approaches, they all involve specific technologies being selected and adopted by a *group or department* representing the organization and then implemented at an organizational level for the individual employees.

The advent and acceleration of adoption of mobile phones and tablets has transformed the situation, as organizations increasingly allow employees to use their personal devices at work for a variety of tasks. This concept of allowing individuals to utilize their ***own*** devices and technologies to access, use, and complete tasks within their organization is typically referred to as "Bring-Your-Own-Device" initiatives (BYOD; CIO Council 2012a, 2012b; Willis 2012). This emergence of the BYOD phenomenon is driven by the consumerization of IT, which has led to individuals adopting new ITs at a pace that matches or exceeds that of organizational adoption of IT. Moreover, consumer ITs are now much closer to ITs utilized by organizations (Willis 2012). Many individuals believe, often rightly, that they possess better IT at home than at their organizations (Forrester 2012), which is a marked shift from prior generations. Recognizing this shift, organizations are increasingly developing policies to manage BYOD: whereas most organizations had no BYOD policy five years ago, 60 percent of the organizations had BYOD policies in 2011 and to 76 percent[r] in 2012 (Good 2012, 2013). A driving motivation for these policies for many organizations is the belief that employees can solve problems that executives cannot see, and allowing individuals to select their own ITs for work will increase their productivity (Saran 2012).

The defining notion of organizational BYOD policies is that employees are now allowed to select, purchase, and maintain their own ITs within the organization with the goals of reduced costs, increased satisfaction, and higher productivity (Unisys 2012; Willis 2012). Even in organizations that lack a formal BYOD policy, many employees use their personal mobile phones to communicate with work contacts or install their own applications on corporate computers to aide in their tasks without the knowledge of IT departments (Unisys 2012). The current focus of BYOD has been on physical devices, however, the ability to bring your own applications, collaboration systems, and support is increasing as well (Delacour 2012). A recent survey found that 75 percent of firms prohibit employee-installed applications and list them as grounds for termination but 38 percent of employees admit to using them (Forrester 2012). As a shift from prior organization-driven initiatives, BYOD is typically an employee-driven process, and thus employees are likely to purchase technology with own money, use own computer, and convince their boss or company to purchase technology to help in their organizational tasks (Unisys 2012).

Organizations have begun to utilize a variety of BYOD policies which have ranged from complete organizational control of IT, in essence a BYOD avoidance policy, to completely open

[r] Sample organizations range from 500 to 20,000 employees across 13 industries (Good 2013).

policies which allow any IT to be adopted and utilized within the organization. One important aspect of these BYOD policies is that while an organizational IT management policy may be in place regarding the extent of BYOD adoption and capabilities, the individual employees must still make the decision to select, adopt, and use the specific IT on their own. This has created a unique decision-making environment encompassing mandatory BYOD policy compliance while simultaneously providing a sense of voluntariness in the selection of a specific technology. For example, an organizational BYOD policy may state that an employee can select and purchase a single laptop for their own use within the organization, however the decision on ***which*** laptop to adopt for their task is left up to the employee to allow for the adoption of the most effective and satisfactory technology for each individual.

With the decision-making process of IT selection and adoption being driven by the employees within the organization, the evolution and diffusion of specific technologies across the organization has the potential to provide significant variability. With previous organizational driven IT implementations the technologies are selected and diffused across the organization in a predictable manner as outlined by the organizational IT strategy. However, with these decisions now being made at a much granular level the prediction of which technologies will be adopted and emerge within the organization is highly uncertain.

The investigation of this phenomenon requires the exploration of both organizational directives (e.g., BYOD policies) in conjunction with individual adoption and usage behaviors to provide insights into the potential effects these policies and behaviors may have on the organizational IT portfolio. For example, by shifting the adoption decisions to the employees the number of decisions being made has become exponential. This increase in decisions additionally provides the potential for a significant increase in the variety, or differentiation, of IT utilized by individuals within the organization.

Alternatively, as each individual in the organization is now making adoption decisions that are aimed at increasing his or her ***own*** performance and productivity, the organizational foresight to predict issues regarding the compatibility of these ITs with others in the organization is reduced. Decisions made at the department or organizational level typically take into account how the introduction of a specific IT will affect not only those using the IT but also those who interact with the outputs of each IT. Individuals may place reduced weight to this aspect, creating significant IT integration issues in the organization when sharing their task outputs with others.

Despite the growing presence of these policies (Good 2013) and the issues and opportunities that practitioners have claimed from these policies, there has been a lack of academic research exploring this phenomenon. In an attempt to explore this novel and interesting phenomenon this essay utilizes a mixed-method approach through agent-based simulations (ABS), qualitative online interviews, and survey questionnaires to address the following research questions, which are also depicted in Figure 4.1:

[See Figure 4.1.]

(RQ1) How does the organization's IT portfolio influence organizational performance?
(RQ2) How do individuals' IT decision-making behaviors influence the organization's IT portfolio?
(RQ3) How do organizational IT management policies influence the organization's IT portfolio?
(RQ4) How do organizational IT management policies moderate the influence of the organization's IT portfolio on organizational performance?

This essay approaches the above research questions through a multi-phase research design. The theoretical development is conducted through a mixed-method approach (Venkatesh et al. 2013; Taskakkori and Teddlie 2003) with the *development* of the theoretical arguments through individual qualitative responses and the *exploration* and *comparison* of the theoretical model over time through ABS and through employee perceptions via a survey questionnaire. The rest of the essay proceeds as follows. The next section develops the theoretical foundations for the essay. It is followed by the development and explanation of the ABS used to explore the theoretical model. Subsequently, the methods and results associated with a survey of individual employee perceptions are presented. Finally, the essay's contributions, findings, and implications are discussed.

Theoretical Development

IT is critical in providing the organization and its employees the ability to complete their tasks efficiently and effectively. Despite a series of research studies focusing on the benefits of IT investments as a whole (Bharadwaj 2000), limited attention has been given to the specific ***configuration*** of the IT portfolio to drive this increased performance. This research attempts to developed an IT contextualized theory which provides insights into the effect and interplay of individual decision-making models, organizational IT policies, organizational IT portfolios, and the impact on organization performance.

Prior research has provided significant efforts in examining what configuration of organizational assets lead to increased performance. One foundational theory in this area is Lawrence and Lorsch's (1967) theory of differentiation and integration, which focuses on the configuration of organizational assets and structure to lead to optimal performance. This theory posits that two complementary configuration attributes, differentiation and integration, lead to optimal performance when configured appropriately to meet varying environmental conditions (Lawrence and Lorsch 1967; Lawrence and Dyer 1983).

Differentiation within the organization is the configuration and separation of organizational assets such as teams, groups, or departments into separate components or sub-units to handle specific tasks within the organization (Lawrence and Lorsch 1967; Blanton et al. 1992). This separation is put in place to allow the separated sub-units to increase their efficiency and effectiveness with *unique* tasks while reducing the need to have knowledge and experience with all of the tasks within the organization (Doughtery 2001; Jansen et al 2009). However, while these sub-units can now focus their efforts on increasing the effectiveness of their unique tasks, their work must also be integrated with other sub-units to complete larger, organizational goals (Lawrence and Dyer 1983).

This process of combining the sub-units' tasks together to perform organizational goals is enabled through adequate integration across the organization. Integration is defined as the process of combining the unique outputs of specialized sub-units or groups in order to complete larger, organizational tasks (Lawrence and Lorsch 1967; Blanton et al. 1992). Therefore, organizations are able to achieve higher levels of performance by differentiating their assets to respond to unique environmental demands but must also ensure adequate levels of integration across the organization to ensure interdependent tasks are completed efficiently and effectively. However, an inverse relationship exists between differentiation and the ease or effectiveness of integration within the organization (Lawrence and Lorsch 1967). As the level of differentiated units increase, the ability to integrate across them reduces due to differences in needs, goals, and interpretation of requirements. Thus, it is critical to ensure adequate levels of integration when differentiating the organization to ensure superior performance (Raisch et al. 2009).

Building on the insights from this theoretical foundation, two specific configuration attributes of the organization's IT portfolio are proposed: IT differentiation and IT integration. IT differentiation is defined as the *organization's* level of IT variety between the *individuals'* IT portfolios, or in other words, the differences between the technologies employees use across the entire organization. IT integration is defined as the level of coordination of effort among the *individuals'* IT portfolios within an *organization's* IT portfolio, or the ability of ITs to work together to complete larger tasks.

This IT contextualization suggests that an increased level of IT differentiation within the organization allows for individuals to meet their specific tasks demands that vary across the organization. Individuals within the organization perform differing tasks, with differing technological needs that lead to a need for variations in the organizational IT portfolio to allow for efficient and effective performance of the tasks. As the level of IT differentiation increases, the organization must develop an adequate level of IT integration between the technologies, especially in those instances where individuals must work closely together. Therefore, those organizations that can develop a high level of IT differentiation to allow for individuals to utilize the "best" technology for their specific needs and the subsequent integration between these differentiated technologies will see a boost in organizational performance.

The organization's IT portfolio.

The previous research has examined how the organization's IT portfolio can influence the performance of the organization but insights into how organizations can specifically develop and configure the levels of IT differentiation and IT integration within the organization have seen less examination. Organizations can drive the adoption and disbursement of technologies within their organization through traditional IT policies and structures (Sabherwal and Chan 2001); yet, proponents of BYOD policies claim that the individual employees are those that know the true needs of the specific organizational tasks (Saran 2012).

The emergence of BYOD policies within the organization is an attempt to leverage this claim and allow front-line employees to determine what IT best fits their specific tasks. The initial IT contextualization of Lawrence and Lorsch's (1967) theory assumes that individuals will attempt to select the "best" IT for their specific tasks. However, recent literature in economics (e.g., Rubenstein 1998), marketing (e.g., Shiv and Fedorikhin 1999), and ISs (e.g., Polites and Karahanna 2012) has indicated that this trust in the individual decision-making (IDM) process may not be as stable as expected.

In the following section, this essay discusses how varying behaviors related to IDM, which is a driving force in the adoption of ITs, influence the configuration of IT differentiation and IT integration that the organization is attempting to develop. Further, organizational IT policies encourage and/or constrain these IDM behaviors. To expand on this IT contextualized theory and explore the antecedents of both IT differentiation and IT integration, the following section describes the role of the organizational IT policies and IDM behaviors, which drive the configuration of the organizational IT portfolio.

Individual decision-making models.

The introduction of BYOD policies has created a scenario in which employees are now making individual decisions regarding their IT usage, thus vastly increasing the number of IT decisions made in each organization (Willis 2002). The study of IDM behavior has progressed for decades in a variety of fields. This stream of research accelerated in the economics literature when researchers explored the potential for "rational" decision making for economical benefits (Simon 1955). These rational models examine IDM behavior under the assumption that individuals will attempt to make decisions based on maximizing their utility function, or the most benefit with the least amount of costs (Simon 1959; Edwards 1954). While the literature has found that organizations as a whole tend to behave in a rational manner (Simon 1979), the behaviors of individuals have provided variations from this assumption (Simon 1991).

After years of examinations of classical economics theory using the rational models, the evidence of "less than perfect" decisions led to development of the theory of bounded rationality (Simon 1991). Bounded rationality indicates that while individuals attempt to make rational decisions, the constraints on time and effort lead to the use of various cut-off points in the requirements to meet conditions that *satisfy* the needs of the individual. This satisficing nature of individuals during their decision-making process can lead to decisions that may not be the "best" for each scenario, but meet each individual needs as they perceive them (Simon 1991). This satisficing based on individual needs is also one of the leading forces behind individual differences in their decision-making despite clear options for the "best" decision.

The assumptions of rationality and bounded rationality have been utilized in the theory development across many fields. A variety of theoretical models and constructs in the IS field have built upon these assumptions, especially in the area of IS pre- and post-adoption research. TAM (Davis 1989) and UTAUT (Venkatesh et al. 2003) each provide evidence that individuals attempt to make rational decisions as indicated by the significant impact of both perceived usefulness and performance expectancy on the behavioral intention to adopt a technology. While these theories have played a strong role in the growth of the IS field, there are many examples of alternative forces that impact behavioral intentions to adoption a technology other than the utility of the technology. For example, prior experience and perceived ease of use with a technology play an important role in predicting IDM behaviors (Polites and Karahanna 2012; Venkatesh et al. 2003; Davis 1989); the satisfaction that individuals receive from utilizing a specific technology is a driving force in IS continuance (Bhattacherjee 2001; Bhattacherjee and Barfar 2011), and more recently the influence of an individuals social network and norms may sway individual adoption behaviors (Fang et al. 2013).

A qualitative data collection was conducted to gather further real-world evidence and determine the IDM behaviors that employees currently exhibit specifically related to IT adoption. An online survey questionnaire consisting of systematic vignettes regarding various technology adoption decisions was collected from 159 individuals via an online crowdsourcing market (Steelman et al. 2014) and seniors from a college of business at a Midwest university. The qualitative insights gathered from these individuals were then coded and categorized based upon the decision-making heuristics each respondent indicated. Appendix A provides the details of this data collection. Based on the initial examples of IS theories using rational and bounded rational assumptions, and the insights from the vignette data collection (described later), four specific IDM models emerged[s], as shown in Table 4.1.

[See Table 4.1.]

- ***Rational IDM*** *- Individuals will attempt to determine the best technology to use for their specific tasks based on the unique abilities and functionalities of each technology.*
- ***Experience IDM*** *- Individuals will attempt to select a technology to use for their specific tasks based on their prior experience and knowledge with each technology.*
- ***Satisfaction IDM*** *- Individuals will attempt to select a technology to use for their specific tasks based upon their prior satisfaction with each technology.*
- ***Network IDM*** *- Individuals will attempt to determine which technology to use for their specific tasks based upon the technologies being used by other individuals in their network.*

Samples of the insights from the vignettes are also provided in Table 4.1 as they relate to each IDM model. The significant variation in decision-making processes described by the respondents further supports the need to examine both rational and bound rationality assumptions in regards to IT adoption.

With individuals now making some IT adoption decisions in the organization on their own, based on their own preferences and decision-making models, the potential for variation in the

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[s] These IDM models and their heuristics are a small sample of the potential drivers for individual adoption behaviors. For brevity, this essay utilized the most discussed models indicated by the individuals. Additional models may provide varying impacts and are discussed in the discussion section regarding future research.

outcomes of these decisions increases. The inherent differences in individual preferences, experience, satisfaction, and perceptions regarding each technology will influence the IDM process. To further investigate these alternative decision-making models and their impact on the organization's IT portfolio each model will be examined in the following phases of analyses through ABS and survey questionnaires.

Managing organizational IS growth.

Prior literature on the management of IS within the organization has focused primarily on *who* should be making the decision such as a centralized IT department or a decentralized authority through each functional department (Sabherwal and Chan 2001; Brown and Grant 2005). This line of research provides theoretical directives to organizations that are employing a traditional IS adoption policy. However, with the introduction of the BYOD policies into the organization the insights provided from prior literature have limited directives on managing IS growth in the face of exponential individual decision makers.

Further, while the practitioner press has debated the opportunities and issues regarding BYOD policies and indicated the lack of clear organizational directives, a large portion of prior IS research which may provide insights into the management of the BYOD phenomenon has been overlooked both by practitioners and researchers. Technologies have evolved over time as IS researchers and practitioners have developed significant management policies that simply transcend technology (Subramanian and Lacity 1997). During the late 1980s and into the early 1990s there was a significant exploration of the phenomenon of **End-user Computing** (EUC) which was claimed to be one of the largest shifts in IS computing practices and research since the start of the field (Bergeron et al. 1993).

End-user computing has seen multiple definitions as the role that users performed with technology evolved but is generally defined as "the development and use activities associated with the employment of computer resources, by one or more non-data processing professionals in functional areas, to perform or facilitate job-related tasks and responsibilities. Individuals are involved in EUC activities if, in employing computer resources, they either directly interact with the computer or are engaged in a task leading to direct interaction with the computer, such as coding (Sipior and Sanders 1989)." End-user computing began in the early years of organizational computing during the age of the mainframe and when shared computing resources were the norm within the organization.

As users begin to increase their computer competency, and the speed of IT capabilities accelerated, the ability for end-users to develop and implement their own technologies to facilitate their own organizational tasks began to expand rapidly (Alavi 1985; Alavi et al. 1987; Rockart and Flannery 1983). EUC was estimated to grow from a nominal 10 percent in 1981 to an estimated 70 percent in 1990 (Rockart and Flannery 1983). This rapid growth rate of end-user computing led many organizations to struggle to understand and manage the phenomenon in a timely fashion. This is similar to the rapid growth of BYOD that we are experience in today's organizational IT environment (Good 2012, 2013). Furthermore, the issues raised during the EUC phenomenon have an uncanny similarity to the opportunities and issues identified in the recent press regarding BYOD.

During the initial growth of EUC, practitioners and researchers alike identified a variety of potential opportunities and issues that end-user computing may bring to the organization. In Table 4.2, several opportunities and issues common to both EUC and BYOD are depicted. Thus, some of the problems that organizations were facing in the 1980s are resurfacing as the end-users' interactions with organizational IT evolve. Despite these similarities, researchers and practitioners alike have potentially disregarded the wealth of literature around EUC and its recommended management policies. If we ignore our historical research in IS around these issues, we risk repeating the earlier mistakes.

[See Table 4.2.]

Despite the large number of similarities between EUC and BYOD discussions in in the opportunities and issues, recent increases in IT capabilities, end-user roles, and the organizational IT environment have caused some new issues and opportunities. As shown in Table 4.2, three general issues are novel to the BYOD context which were not a focus during the end-user computing discussions: organizational IT cost savings, changes in work-life balance of end-users, and potential legal ramifications regarding the ownership of technology and data. During the EUC era, it was primarily the organization that saw budget increases due to purchasing and paying for the technologies and mainframe time shares that end-users were utilizing to perform their tasks more efficiently. In the context of BYOD, it is the end-user who is generally charged with selecting, purchasing, and maintaining the technology they utilize for a variety of both their organizational and personal tasks (Willis 2012). Due to this, it has become a much debated argument that BYOD can save organizations millions of dollars in technology acquisition and support fees by passing the charges onto their users (Ballenstedt 2012; Willis 2012; Ackerman 2013; Rains 2012).

However, with this change in ownership and purchasing of the technology have come multiple legal issues involving the ownership of technology resources, organizational data, and control of the IT utilized within the organization. During the EUC debates, the ownership of all resources and data were firmly located within the organization and the debate about organizational control of an individual’s technology were not an issue, however due to the consumerization of IT, this issue has become the focus of many organizational debates (McGee 2012; Casey 2012; Kaneshige 2012).

An additional issue that has come to the forefront of the BYOD issue is the potential adjustments to an individual's work-life balance due to increased mobility, access, and expectations of connectivity by organizations and employees alike (CIO Council 2012a; Ballenstedt 2012). With a lack of telecommuting and the advancement in mobile phone technology this recent issue was unaddressed during the exploration of end-user computing in the 1980s and 1990s.

While these issues are important differentiators of the BYOD context, and need to be incorporated in research, two potentially significant issues related to the organizational IT portfolio have been pushed aside in many debates – the compatibility and integration of ITs and the selection of ineffective and inappropriate ITs by end-users. During the debates and research regarding EUC policies there was a strong focus on developing ITs that could integrate with other departments, users, and databases across the organization as well as ITs that were developed, selected, and implemented incorrectly by non-IS individuals (Alavi and Weiss 1985; McLean et al. 1993).

In today's context of BYOD this focus of increased performance and production has been potentially limited by making an assumption that individuals (a) know the best technology for their own task and workflow as well as (b) the technologies that work best with the systems already in the organizational IT portfolio. This issue garnered a large deal of investigation during the end-user computing research as end-users were typically thought of to have less computer competency than the IS personnel. With the advancement of technology and increased technological knowledge that many individuals have in today's environment this issue has yet to be examined to the same extent. Thus, despite the similarities and differences between the prior EUC research and the ongoing debates around BYOD, there has been an evolution of the IT environment both within and outside the organization that affects the various management policies selected to address this phenomenon.

EUC was widely believed to provide large improvements in organizational productivity when managed properly but could also have detrimental outcomes to the organization if the EUC policies were improperly managed (Mirani and King 1994). Some of the seminal work by Alavi and her colleagues (Alavi and Weiss 1985; Alavi 1985; Alavi et al. 1987, 1988) explored a variety of EUC management policies within the environment to discover (a) what policies existed, (b) how each policy impacted EUC growth, and (c) which policies provided the best performance under various environmental conditions. While researchers have examined different management strategy typologies regarding end-user computing, many agree that the selection of an EUC policy within the organization varies over time as organizations gain knowledge regarding specific ITs and EUC practices. Table 4.3 defines five organizational EUC strategies as outlined by (Alavi et al. 1988) which vary in three general EUC management attributes: ***direction***, ***support***, and the level of ***control*** on EUC.

[See Table 4.3.]

Each of the management strategies described by (Alavi et al. 1987, 1988) has been utilized to explore a variety of IT innovations during the EUC era and provided important insights into how and when an organization should utilize each management policy to achieve optimal EUC growth and organizational productivity. This essay takes a similar approach by examining the ***direction***, ***support***, and ***control*** attributes of an organizational IT management policy to determine how each attribute can influence the organizational IT portfolio. Table 4.4 describes each attribute, as outlined by Alavi et al. (1988), the IT management implications of each attribute, and the following simulation implementations. The three IT policy attributes examined in this research focus on general aspects the organization can utilize to influence the level of technologies that exist within the organization. The organization can provide direction, control, and support of specific ITs through their IT management policies to either encourage or constrain the variety of ITs that are allowed within the organization.

[See Table 4.4.]

- *Direction - The plan and strategy of the organization's views towards technology management in regards to the number of technologies options and standards for technology adoptions.*
- *Support - The provision of tools, training, and expertise given towards the employees to support the variety of technologies allowed within the organization.*
- *Control - Organizational control of the individual behaviors regarding how often the individual IT portfolio can be changed, modified, and adjusted due to financial constraints and budgeting.*

Supporting the Organization's IT Portfolio through Organizational IT Policies

In addition to the direct influence that specific organizational IT policy attributes may have on the development of the organization's IT portfolio, the ability for the adopted ITs to aid employees in completing their organizational tasks may be influenced by specific attributes of the policies as well (Alavi 1988). The role of the organizational IT policy is to not only provide a vision for the organization's IT portfolio but support its evolution within the organization as technologies flow in and out of the organization. For example, while the ability to choose from multiple ITs (i.e., direction) may lead to an increase in the level of IT differentiation of the organizational IT portfolio itself, it may also lead to more efficient IT differentiation within the organization's IT portfolio. Allowing individuals to select from a larger range of ITs will provide the employees to locate the most optimal technology to increase their performance instead of being constrained by potentially inefficient ITs selected by the organization (Willis 2012;

Kaneshige 2012). To further explore this relationship, the interaction of the organizational IT policy attributes and the organization's IT portfolio attributes are examined.

The research model in Figure 4.2 expands upon the initial research model in Figure 4.1. First, it includes the impacts of the two aspects of the organization's IT portfolio – IT differentiation and IT integration – on organizational performance. This research question further examines the impacts of IT assets on organizational performance through a configuration perspective of the organization's IT portfolio.

[See Figure 4.2.]

Second, the impact of IDMs on the configuration of the organization's IT portfolio is examined. Using an exploratory approach to examine this research question will provide new perspectives due to the lack of clear theoretical insights into how different IDMS will impact these two attributes specifically. Third, the impact of the organization's IT policy attributes on the configuration of the organization's IT portfolio is examined. Again, as the utilization of the organization's IT portfolio attributes, IT differentiation and IT integration, has seen limited examination, this research question is further examined in an exploratory fashion.

Lastly, the ability for the organization's IT policy to moderate the beneficial impacts of the IT portfolio on performance is examined. While the organizational IT policy can direct the evolution of the configuration of the organization's IT portfolio over time, it may also influence the benefits that the adopted ITs may have on organizational performance.

Examining the various IDMs individuals adopt and the configuration of the IT management policies that organizations are taking towards BYOD initiatives through these general attributes provide insights into: (a) what impacts IDMs have on the organization's IT portfolio (i.e., IT differentiation and IT integration), (b) what impacts organizational IT policy attributes have on the organization's IT portfolio, and (c) how the organizational IT policy attributes moderate the performance benefits provided by the organization's IT portfolio. Following the insights developed through the individual survey vignettes and prior literature, a mixed-method analysis is conducted through a series of ABS and survey questionnaires, which provides a rich environment to explore the research model in Figure 4.2.

Research Methods

The research model in Figure 4.2 is examined utilizing a mixed-method approach (Tashakkori and Teddlie 2003) combining (a) qualitative survey vignette responses, (b) agent-based simulations (ABS), and (c) a survey questionnaire. The qualitative survey vignette responses are utilized to determine the behaviors that individuals exhibit during technology decisions. The ABS provides an evolutionary view into how these IDM models and the organizational IT policy attributes will impact the configuration of the organization's IT portfolio over time as well as the impacts of the organization's IT portfolio and IT policy on organizational performance. Further, the survey provides insights from employee perspectives of the impact of the IT policy, IT portfolio, and their personal IDMs related to IT adoption on the configuration of the organization's IT portfolio and performance.

Qualitative vignettes.

This essay began with the development of the theoretical framework for further exploration through a combination of prior literature and real-world insights of individuals from a series of survey vignette responses. This qualitative data collection utilized an online survey questionnaire composed of systematic vignettes designed to collect individual technology decision-making processes. 159 individuals, recruited through an online crowdsourcing market (Steelman et al. 2014) and students from a Midwest University, provided insights into how individuals make decisions in regards to which technology to use for a specific task and when to switch technologies that fail to meet their needs. These insights were then coded and categorized to identify the focal IDMs within this research model. For brevity, the full details of this data collection and analysis are provided in Appendix A. The use of real-world individual decision-making responses provides further validity to the selection of the focal IDM behaviors examined in this essay (Kane and Alavi 2007).

Agent-based simulation method.

The evolution of the organizational IT portfolio, due to the multiple decisions that employees make over time, creates a scenario that is difficult to examine in a traditional field study. First, the examination of individual IT adoption requires a longitudinal research design that captures both individuals first entering into the organization as well as their changes in technology over time. Many traditional organizations' IT switching policies restrict changes to years at a time which would limit the ability to easily examine variations in the control attribute of an IT policy. For example, many organizations have a two to three year period between computer updates for employees and limit their ability to switch during this time period while other organizations, which are supportive of BYOD initiatives, may allow individuals to switch as often as they would like at their own expense.

Second, with BYOD policies creating an exponential growth in the number of decision makers in the organization, the number of individuals required to survey effectively has become problematic. Limiting a field study to a subset of the individuals may bias the findings due to the significant variations in IDM behaviors. Additionally, attempting to locate organizations with the full combination of organizational IT policy attributes and varying IDM models may provide further issues due to the recent nature of the BYOD phenomenon. To address these issues, this essay examines the focal research questions through a series of ABS to complement the other two research methods.

The use of ABS is especially beneficial for the development of innovative theoretical perspectives which include the analysis of both the behaviors of the individuals and evolution of the network (Davis et al. 2007) especially in cases where the outcomes for the organization cannot be easily understood without a bottom-up evolutionary approach to individual behaviors and relationships (Macy and Willer 2002). The use of ABS models for the theoretical development of the impacts of individual behaviors on IT differentiation and IT integration will provide insights not only on typical behaviors but on extremes as well (Kane and Alavi 2007). Additionally, this examination captures the emergent nature of the organizational IT portfolio as individuals switch between ITs to meet their needs (Epstein and Axtell 1996). Thus, the use of the ABS in this essay provides the basis for the expected outcomes in a real-world environment while simplifying the environmental variables (Railsback and Grimm 2012).

To provide increased evidence and validity of the insights developed in this essay, the qualitative survey vignettes were used as the basis for the modeling of the specific IDM behaviors in the ABS. Basing the individual behaviors in the ABS on the insights derived from actual employees provide increased validity and depth to the findings (Rudolph and Repenning 2002).

Simulation model.

This phase in the analysis examines the impact of IDM behaviors and organizational IT policy attributes on the organization's IT portfolio (i.e., IT differentiation and IT integration) through a series of computational models. Additionally, the impact of the organization's IT portfolio on performance is examined to provide further exploration of the IT contextualized theory. The following section provides a brief overview of the implementations of the ABS utilized to examine the model in Figure 4.2 with the expanded details provided in Appendix B.

The ABS used in this stage of analysis consists of an organization with multiple employees who must complete an assigned sub-task during each time period. These employees must work in groups with other individuals to complete larger, organizational tasks, which are a combination of the individual outputs from their sub-tasks. Employees within the organization must use a technology from their personal IT portfolio to complete each sub-task assigned during the time period. The selection of *which* technology to utilize is driven by differences in the IDM models discussed above.

After completing their individual sub-task each time period, the employees will evaluate their performance on the sub-task based on an organizational standard for success (i.e., 75 percent complete). If the individuals' performance falls short of this goal multiple times, the individual will attempt to *switch* and adopt a new technology, which may perform more successfully. The frequency of this switching behavior is driven by the organizational IT policy attribute, control, discussed in the following sections. The employees will continue to perform their sub-tasks, evaluate their performance, and adjust their individual IT portfolios until their individual performance meets the organization's standards.

One goal of an ABS is to allow a researcher to closely model reality while simultaneously ensuring simplicity within the model (Gilbert 2008; Railsback and Grimm 2012). Accordingly, the simulation model utilizes simple behaviors and assumptions of individuals within the organization to examine how variations in the IDM models and organizational IT policy attributes influence the organizational IT portfolio at an abstract level (Gilbert 2008; Davis et al. 2007). Appendix B provides further details regarding the assumptions, behaviors, and development of the ABS.

To begin, the focal constructs within this IT contextualized theory, IT differentiation and IT integration, are attributes of the organizational IT portfolio at a point in time. As individuals add and remove technologies from their IT portfolio, the specific configuration of the organizational IT portfolio is adjusted as well. Therefore, to specifically capture the stochastic nature of both IT differentiation and IT integration the ABS tracks the variations in their configuration during each time period to allow for the examination of the evolutionary nature of IT adoptions (Railsback and Grimm 2012).

For the sake of brevity, the equations for calculating each of these measures are provided in Appendix B, with their interpretation and development discussed here. IT differentiation is defined as the variation in *individual* IT portfolios within the *organizational* IT portfolio. Prior literature has utilized an adaptation of euclidean distances (O'Reilly et al. 1989) to measure group heterogeneity (Lawrence and Lorsch 1967). However, due to the computation demands of this method with a simulation of this size an alternative approach was taken. An examination of the average ownership across the entire organization was compared to each individual's IT portfolio to collect a mean-difference view of each actor from the collective[t]. By developing an aggregate measure of the IT differentiation within the organization this measure allows for values of 0 to indicate no differentiation, or all individuals owning and using the exact same technology, to 1 which indicates complete differentiation, or all individuals owning and using different technologies. Therefore, as the measure IT differentiation increases it indicates more individuals are selecting different technologies than those of their colleagues.

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[t] A series of tests comparing both methods were conducted with consistent patterns emerging and a correlation of 0.96 with varying levels of organizational size. See Appendix B for details.

IT integration is defined as the level of coordination of effort among the *individuals'* IT portfolios within an *organization's* IT portfolio. In other words, how well can each of the technologies that individuals own within the organization communication and convert the inputs/outputs of the other technologies in the organizational IT portfolio. Each technology within the environment has a natural ability to convert the inputs/outputs of each other technology within the environment. IT integration captures the average level of conversion ability between these technologies for those technologies that individuals own within the organization[u]. Additionally, a weighted measure is utilized to differentiate between an organization that has 99 individuals with technology A and 1 individual with technology B from an organization with 50 individuals with technology A and 50 individuals with technology B. Therefore, as the level of IT integration increases, it indicates that the average conversion ability between the technologies in the organizational IT portfolio is increasing as well.

During each time period, the individuals perform two behaviors – (a) *selecting* an IT to use for their sub-task and (b) deciding which IT to adopt if they are *switching*. Each of these IDM behaviors are modeled based upon the four IDM models described above – rational, experience, satisfaction, and network. When individuals decide based on a rational decision-making model they will attempt to find the "best" IT to utilize for their task. Each IT in the environment has a natural ability to complete each sub-task ranging from 0 (no ability) to 1 (complete ability) to successfully accomplish the sub-task. Therefore, a rational individual will select the IT with the highest ability to complete his or her sub-task successfully.

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[u] This measure only examines the technologies owned by individuals within the organization, not all possible technologies in the environment.

The alternative IDM models drive individual behaviors through varying heuristics in selecting an IT and switching to a new IT. Each individual within the organization has (a) a general preference for each IT based on their satisfaction with the technology, and (b) a level of prior experience with each IT based on their education and use of an IT. These levels of satisfaction and experience are randomly generated for each individual during the start of the simulation. During each time period, individuals adjust their level of satisfaction for the IT they used based upon their successfulness of completing their sub-task and their experience with the IT each time it is used. When selecting based upon either a satisfaction or experience IDM model, individuals will attempt to utilize an IT that is either their most preferred or experienced, respectively.

The last IDM model, network, is based purely upon the social influences each individual faces within the organization. Each individual is assigned a group to work in during the beginning of the simulation, similar to an employee being assigned to a specific department. When individuals are attempting to determine which IT to use for a specific task, or switch to when their current IT is failing, the search process can take a significant amount of time and resources to find an adequate IT. Many individuals will attempt to reduce their time spent making these decisions by asking their relevant social network of individuals to determine what is working for them. In this simulation, individuals will ask their immediate network (i.e., their group), and determine which IT is the most adopted to drive their own decision.

These four IDM models are each based upon (a) qualitative vignette response from actual employees and (b) prior literature examining drivers of individual IT adoption (Venkatesh et al. 2003; Davis 1989; Polites and Karahanna 2012; Bhattacherjee 2001). In this essay, individuals within the organization utilize a single type of IDM model when selecting their technologies. In reality, individuals may utilize a combination of IDM models before selecting a technology for their specific tasks. However, in an attempt to determine the unique impact of each IDM model this essay examines the methods as separate IDMs. The limitations of this approach are elaborated further in the discussion section.

The organizational IT policy attributes examined in this essay – direction, control, and support – are modeled around the ability to manage and adjust the IT adoption within the organization. Direction, or the strategy an organization takes towards variety or standardization, is modeled through the potential alternative technologies that the organization allows individuals to select from in the environment. By constraining or encouraging different technologies the organization can provide direction to their IT configurations. The direction of the organizational IT policy is varied as 10, 20, and 30 alternative ITs for individuals to select from for their individual tasks.

Despite the fact that under BYOD initiatives individuals typically purchase the specific ITs they adopt, the organization still must support these ITs to some extent. An organization cannot simply deny support to their employees or they will risk significant task flow problems and failures. To limit the level of support that an organization must face, the number of ITs that each individual may own can be adjusted. For example, many organizations only allow their employees to have a single organizational computer for their tasks and anything above that is not supported by the organization. To model the potential support an organization will provide the number of ITs each individual can own in their individual IT portfolio is varied as 3, 4, or 5.

The last attribute examined in this analysis is the control that the organization places on individuals making adoption decisions. Switching and adopting new ITs within the organization can cause significant implementation costs to the organization and cause unnecessary demands on the IT department to setup each technology. Organizations can limit this behavior by controlling how often an individual is able to update or switch their technology, similar to the 3-year refresh period on organizational computers. To model this within the ABS short periods (i.e., 15 time periods), long periods (i.e., 75 time periods), and prohibited switching (i.e., > 500 time periods) are implemented within the organization.

The ABS described thus far provides a general organizational environment of employees, the varying IDM behaviors they exhibit, and the IT policy attributes implemented within the organization. The following section describes the analysis of these simulation models and their interpretation.

Analysis.

NetLogo (Wilensky 1999) was used as the programming environment to develop the ABS. This software is widely used in a variety of academic fields for ABS and is supported with considerable documentation and online communities through Northwestern University (Railsback and Grimm 2012). Netlogo allows for the development of the ABS, the related documentation, the simulation interface, and the required data collection for each simulation run (Gilbert 2008). Each simulation was ran for 500 time periods and replicated for 10 iterations for each set of parameters (Railsback and Grimm 2012). Appendix B provides the detailed parameter descriptions, settings, and sensitivity analyses used within this study.

The empirical examination of the results of the ABS utilizes an exploratory, interpretive approach. One benefit of ABS is the ability to determine how effects emerge over time (Macy and Willer 2002). A set of time-series graphs were created to visually represent the changing levels of IT differentiation and IT integration over time. First, the organizational IT portfolio attributes, IT policy attributes, and IDM models depicted in the research model are examined for their direct effects on either the organization's IT portfolio or performance. Next, the interaction of the organizational IT policy attributes and the organization's IT portfolio is examined to determine how organizations can more effectively support their specific IT configurations.

Results.

The effects of the organization's IT portfolio on organizational performance.

To begin, the effects of the organization's IT portfolio on organizational performance are examined across the entire simulation time frame of 500 time periods to view the evolutionary nature of the organization's IT portfolio. In Figure 4.3, the impact of varying levels of IT differentiation and their impact on organizational performance are depicted with the mean level of organizational performance mapped across the 500 time periods of the simulation[v]. In each graph four categories of IT differentiation are plotted[w]: very low (0.2), low (0.4), high (0.6), very high (0.8).

[See Figure 4.3.]

In Figure 4.3, it appears that as the level of IT differentiation increases from very low to very high, the level of organizational performance decreases. Prior theory indicates that an increase in differentiation should enhance performance as the assets (e.g., ITs) are selected based on their benefits towards specific tasks (Lawrence and Lorsch 1967). However, this analysis finds a negative relationship of IT differentiation on organizational performance, which may be driven by the variations in IDMs during the IT adoption procedure. The implications of this are explored in the discussion section below.

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v Due to file size constraints in Netlogo and the analysis software used, the simulation time periods are captured every 10 periods such that 50 in the figures is equal time period 500 in the simulation.

w Categories of extremely low (i.e., 0) and extremely high (1) IT differentiation were not plotted due to their limited presence in the models over time as individuals converged on specific technologies.

In Figure 4.4, the effects of various levels of IT integration within the organization's IT portfolio on organizational performance are depicted. In Figure 4.4, the mean level of organizational performance is mapped across the 500 time periods of the simulation with each graph depicting four categories of IT integration[x]: very low (0.2), low (0.4), high (0.6), very high (0.8).

[See Figure 4.4.]

The results of this analysis indicate a significant positive relationship between IT integration and organizational performance. As the level of IT integration increases from very low to very high within the organization's IT portfolio, the individuals are able to work more efficiently and effectively together when sharing their sub-task outputs together to complete larger, organizational tasks. This relationship is consistent with prior theory which indicates that significant benefits of integration on organizational performance (Lawrence and Lorsch 1967).

Next, the effect of IT differentiation in moderating the impact of IT integration on organizational performance is examined. The increased IT differentiation within the organization's IT portfolio and the simultaneous management of the IT integration across the organization is depicted in Figure 4.5, which indicates the interaction of IT differentiation and IT integration on performance across the 500 time periods of the simulation. In this figure, low and high levels of IT differentiation and IT integration were separated utilizing one standard deviation above and below the mean (Cohen et al. 2003) to provide four organizational IT portfolio configurations: Low Integration/High Differentiation, Low Integration/Low

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[x] Categories of extremely low (i.e.. 0) and extremely high (1) IT integration were not plotted due to their limited presence in the models over time as individuals converged on specific technologies.

Differentiation, High Integration/High Differentiation, and High Integration/High Differentiation.

[See Figure 4.5.]

In this figure, it becomes apparent that IT differentiation significantly moderates the effect of IT integration on organizational performance. Providing a high level of IT integration within the organization is critical to allow employees to work together and complete their organizational tasks successfully. Additionally, a high level of IT integration allows the organization to have a high level of IT differentiation and still provide a higher level of performance than those without adequate IT integration. While prior literature would indicate that a high level of IT differentiation and subsequent high level of IT integration would provide the optimal organizational performance (Lawrence and Lorsch 1967), this configuration falls short of the high IT integration, low IT differentiation configuration. This could be driven by a variety of effects such as inadequate technologies within the organization's IT portfolio due to differences in IDMs or simply the increased conversion and integration issues created when dealing with a large number of technologies compared to a smaller sub-set of technologies. The implications of this relationship are explored further in the discussion.

The effects of individual decision-making models on the organization's IT portfolio.

Next, the examination of the four IDM models (rational, satisfaction, experience, and network) are examined for their impact on both IT differentiation and IT integration. Further, these impacts are examined for both individuals initially adopting or *switching* to a new technology in their individual IT portfolio as well as *selecting* which technology to use from their existing individual IT portfolio. Figure 4.6 shows the impacts of the four IDM models on both IT differentiation and IT integration when individuals are making *switching and adoption* decisions. The figure displays the level of IT differentiation and IT integration across all 500 time periods to display the evolutionary nature of organizational IT portfolio.

[See Figure 4.6.]

In Figure 4.6, the IDM models have a significant impact on the level of IT differentiation in the organization over time. Both the rational and network models tend to reduce the level of differentiation over time while the satisfaction and experience models remain consistent across time. These results provide evidence that when individuals in the organization are behaving rationally and searching for the "best" technology to perform their task they each tend to converge onto a smaller subset of technologies to utilize across the organization. For example, while there may be many alternative technologies in the marketplace, only one technology is the "best" for a specific task and each individual performing that task will migrate towards that technology over time as they evaluate their performance.

The network IDM model provides a similar reduction in the differentiation as the rational model but to a lesser degree as individuals are not necessarily selecting the "best" technology but the one that "simply works" for others in the organization. Individuals will ask those individuals in their immediate network and determine what is working best for them on their task before adopting and switching to a new technology. This groupthink behavior, while not quite as efficient as the rational model, still provides important consensus of useful technologies within the organization (Simon 1991).

The experience and satisfaction models, however, do not appear to reduce their differentiation over time as individuals each have a strong variation in their personal preferences. As each individual has a different level of prior experience with ITs and satisfaction with those ITs, the potential difference across individuals becomes exponential. Therefore, when individuals reevaluate their ITs and need to switch and adopt a new IT, there is no consensus to base their decisions off of in the environment. Thus, when individuals are switching and adopting new ITs, both the rational and network IDM models reduce level of differentiation as compared to the experience and satisfaction IDM models within the organization.

When examining the impact that these IDM models have on integration a different pattern of results emerges. It appears in Figure 4.6 that the IDM models have no impact on the level IT integration within the organization. This seems to follow similar arguments that individuals focus on their own performance and may place less weight on the rest of the organization when making decisions. Therefore, based on these results it appears that the IDM models used during *switching and adopting* have no impact on the level of IT integration within the organization.

The second behavior that individuals perform when determining their performance within the organization is *selecting* which technology from their personal IT portfolio to utilize for their specific sub-tasks. Many of us have multiple applications and technologies available that perform similar tasks, yet must make a decision of which to utilize based on some decision-making model. For example, as researchers many of us have access to multiple statistical tools that can be used to perform our analyses. When working on a project each of us must make a specific decision of which tool to utilize over another based on its performance abilities (i.e., rational), our prior experience (i.e., experience), individual preferences (i.e., satisfaction), or whom we may be working with (i.e., network).

Figure 4.7 depicts the impacts of the four IDM models during selection decisions on both IT differentiation and IT integration. In both graphs, the selection behaviors that individuals use in their decisions do not impact either IT differentiation or IT integration. This may not be directly counter-intuitive as the estimations of both IT differentiation and IT integration are based upon the ITs *owned,* not necessarily the ITs *used* in each step. Therefore, while each individual may use a different IT to perform their specific task, everyone in the organization may have access to the same resources and therefore not change the organizational IT portfolio. Based on these insights, it appears that the selecting behaviors that individuals perform have no impact on either IT differentiation or IT integration.

[See Figure 4.7.]

The effects of the organizational IT policy on the organization's IT portfolio.

The examination of the impact of the organizational IT policy attributes on both IT differentiation and IT integration proceeded in a similar fashion as above. Each attribute was examined separately to determine their individual impacts on the organizational IT portfolio. In Figure 4.8, the impacts of each of the policy attributes on IT differentiation and IT integration are depicted for each parameter setting.

[See Figure 4.8.]

Examining the impact of direction on IT differentiation in Figure 4.8 is conducted by examining the varying levels of technology options available to the employees via 10, 20, or 30 alternative technologies for adoption[y]. It is evident from Figure 4.8 that as the level of direction, or the number of alternative technologies, increases there is a significant impact on the level of IT differentiation within the organization. As the number of technologies available for individuals to decide between increases, the potential for differences across individual IT portfolios and the subsequent organizational IT portfolio increases. The inverse relationship is found for the impact of direction on integration within the organization such that an increase in alternatives reduces the potential IT integration within the organization. This is in line with prior theory that indicates as the level of differentiation increases within the organization, the ability to integrate the differences becomes more problematic (Lawrence and Lorsch 1967). Therefore, based on these results, it appears that direction has a significant impact on both IT differentiation and IT integration by increasing the potential differentiation and reducing the potential integration in the organizational IT portfolio.

To examine the impact of organizational support on both IT differentiation and IT integration the number of ITs an individual is allowed to own in the individual IT portfolio is varied as 3, 4 or 5. The number of ITs organizations allow individuals to own is an indication of the level of support resources the organization expects to conduct to meet individual needs. In Figure 4.8, the impact of support on IT differentiation indicates that as the level of support increases the level of differentiation across individuals decreases. This impact may be due more to the increase in the potential overlap between technologies that individuals own instead of simply selecting different technologies for their individual tasks. Therefore, based on these results, it appears that the level of support within the organization will reduce the level of IT differentiation within the organization.

Alternatively, it appears that there is no significant impact of support on the level of IT integration within the organization. Simply providing the ability for individuals to own multiple ITs does not necessarily mean that they are going to select those ITs that work best with others within the organization and are still going to make their decisions based on their own benefits.

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[y] These parameter settings were tested for their sensitivity to the initial settings (see Appendix B) and a similar pattern of results was found. For brevity, these analyses are not provided but available from the author upon request.

Based upon these results, it appears that support has no impact on the level of IT integration within the organizational IT portfolio.

Lastly, the impact of the control of the organizational IT portfolio on IT differentiation and IT integration is examined. In Figure 4.8, control, specifically the frequency by which individuals can switch to a new technology, is varied from a short period (i.e., 15 time periods), long period (i.e., 75 time periods), and never (i.e., 520 time periods[z]). These results indicate that the level of control within the organization can have a significant impact on the level of IT differentiation within the organization. Allowing individuals to switch technologies over time provides the ability to evaluate their current performance and adjust their technology needs to increase performance over time.

It also appears that both short and long time periods between switching provide benefits to the organization as seen by the significant drop in IT differentiation over time. While short time periods allow individuals to meet their needs quicker, it may come with increased costs to the organization and individual adopting new technologies. Organizations that employ excessively long periods before changing technologies or never allow individuals to adopt new technologies may be hindering their employees from increasing their own productivity. Based upon these results, it appears that providing flexible control, regarding individual's switching ability, within the organizational IT policy will reduce the level of differentiation within the organization as individuals adjust their technologies to select better technologies. Additionally, these individuals will eventually converge on similar technologies over time on average.

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[z] An arbitrary 520th time period was used but any value over 501 would keep the individuals to be able to switch within the simulation examination.

When examining the impact of control on IT integration it appears that there is no significant effect. Similarly to the support impact on integration, simply allowing individuals to switch technologies more often than others does not mean that those individuals making the decision are going to focus on integrated technology but will instead focus on their own benefits. Based on these results, it appears that control has no impact on the level of IT integration within the organizational IT portfolio.

The interaction of the organizational IT policy and IT portfolio on performance.

While these impacts of the organizational IT policy attributes provided insights into how they may impact the configuration of the organization's IT portfolio over time, this section examines how the IT policy may moderate the performance benefits of the IT portfolio itself. The organization's IT policy not only encourages or constrains the evolution of the organization's IT portfolio through increased options, ownership, and switching abilities but also may influence the impact of the subsequent effects of the organizational IT portfolio due to the limits or options put in place during adoption.

In Figure 4.9, the moderating effects of direction on the impact of both IT differentiation and IT integration on organizational performance are depicted. When examining the moderating effect of direction on IT differentiation, it becomes apparent that as the number of technology options increase (i.e., direction) the performance impacts of IT differentiation not only shift, but scenarios of very low and low IT differentiation are eliminated due to an increased variety of technologies selected by individuals. Alternatively, it appears that direction has no significant moderating effect on the relationship between IT integration and organizational performance as the benefits fail to shift across different levels of direction.

[See Figure 4.9.]

Next, the moderating effects of support on the impact of IT differentiation and IT integration on organizational performance are depicted in Figure 4.10. It appears in this analysis that as the number of ITs an individual can own (i.e., support) increases the negative relationship of IT differentiation diminishes, indicating a negative moderating effect. As individuals are allowed to own more ITs, having everyone owning the same ITs may reduce the ability to meet specific organizational demands despite being easier to integrate. Alternatively, there appears to be no moderating effect of support on IT integration, as the beneficial effects of IT integration remain constant across varying levels of support.

[See Figure 4.10.]

Lastly, Figure 4.11 depicts the moderating effects of control on IT differentiation and IT integration on organizational performance. It appears that as the time required before individuals can adjust their personal IT portfolio (i.e., control) increases, or the organization restricts the employee decision behaviors, there are significant effects on both IT differentiation and IT integration. Increasing the time between switching for individuals significant reduces the negative relationship of IT differentiation on organizational performance such that prohibiting individuals from switching (Control = 520 Time Periods) limits the employees ability to select alternative technologies which could be both beneficial or detrimental to organizational performance. Alternatively, allowing individuals to switch frequently will generate configurations under which a lower level of IT differentiation is more beneficial in increasing organizational performance.

[See Figure 4.11.]

This negative moderating effect of control is also found for IT integration such that increasing the time before individuals can adjust their personal IT portfolio will reduce level of organizational performance over time. Allowing individuals to switch frequently will provide employees to select technologies that may be more beneficial for their specific tasks as well as converge on common technologies that are easier to integrate. Forcing employees to retain an inadequate technology over time prohibits the development of organizational performance over time.

Summary of insights from the agent-based simulation.

From these current insights it appears that the IDM models that employees utilize to *switch* and adopt their technologies for their organizational tasks have a strong impact on IT differentiation but little to no impact on the level of IT integration with the organization's IT portfolio. Additionally, the decisions that individuals make regarding *selecting* which technology to utilize from their individual IT portfolios for their tasks have no impact on the configuration organization's IT portfolio as the technologies have already been adopted. Further, if an organization is attempting to develop a specific configuration of IT differentiation and IT integration within the organization it appears that it can utilize specific organizational IT policy attributes to drive these demands. Evidence seems to indicate that direction, support, and control each have important roles in driving the level of IT differentiation within the organization while only direction plays a role in influencing IT integration.

While these initial impacts provide insights into how either the IDM models or the organizational IT policy attributes impact the organizational IT portfolio, organizations are further interested in learning how the configuration of their IT portfolio can increase performance. The ABS results indicate that IT differentiation may actually reduce the level of organizational performance, contrary to prior theory (Lawrence and Lorsch 1967). IT integration, on the other hand, has a strong positive impact on performance by allowing individuals to work more efficiently and effectively together through the variety of ITs. Furthermore, an increased level of IT integration moderates the impacts of IT differentiation by making the increased variety of ITs more beneficial for the organization. Lastly, it appears that the direction, support, and control all have significant moderating effects on the impact of IT differentiation on performance while only control moderates the impact of IT integration on performance.

In summary, it appears that both IDM models and organizational IT policy attributes affect the organizational IT portfolio. Understanding these impacts on both IT differentiation and IT integration can allow for an organizations to design their IT policies based on their perceptions of their employee adoption processes to develop specific configurations of their IT portfolio. Additionally, the specific configuration of the organization's IT portfolio has significant implications for organization performance and these implications can be either constrained or encouraged through the use of specific IT policies.

While these findings provide important insights into the role that IDMs, IT policy, and the organization's IT portfolio interact over time through the use of ABS, the results are based upon a simplified view of reality. In an attempt address this potential limitation a survey questionnaire is used in the following phase of analysis in an attempt to provide real-world perspectives on these relationships.

Survey methods.

The proposed relationships that emerged during the ABS provide a series of expectations that *may* occur during a real-world scenario when organizations utilize specific IT policies and individuals make various decisions (Gilbert 2008). However, one limitation to the use of ABS for theory development and refinement is the reduction of real-world phenomena to simplified relationships to explore theoretical impacts. To further explore these findings a complementary mixed-method approach utilizing a collection of real-world data is recommended to provide increased validity, generalizability, and reliability (Venkatesh et al. 2013). The last phase of this essay utilizes survey responses regarding individual perceptions from employed individuals working in a variety of job roles.

The sample for this phase consisted of 497 employed individuals recruited from an online crowdsourcing market (Steelman et al. 2014) that has been found to be a promising emergent data collection environment, used in a variety of fields, to elicit responses of a general population. The participants have a mean of five years in their organization, were 23 years old, 53.8 percent were male, and 48.5 percent had a bachelor's degree or higher. They are employed in a variety of industries and job roles, not only IT-intensive positions, providing a broad perspective of organizational employees. BYOD policies are not only in place for IS employees but throughout the entire organization (Willis 2012); the use of this broad sample should be similar to what would be found across a typical organization.

The focal constructs in this analysis, IT differentiation and IT integration, have not been previously utilized in academic literature and required a rigorous scale development procedure. A systematic survey instrument development of IT differentiation and IT integration was conducted to provide increased validity and reliability of the results (MacKenzie et al. 2011). During this process a series of seven pilot tests were conducted utilizing faculty, PhD Students, and organizational employees to ensure the validity and reliability of the survey instruments. After an initial survey instrument was developed seven pilots of approximately 1127 individuals were conducted through an online crowdsourcing market (Steelman et al. 2014) to examine the stability of the instruments in the presence of prior research instruments. Appendix C provides details of the survey items, including controls and instructions to respondents.

To capture an individual's decision-making models, a series of scales were used based on previously validated scales when available. The rational model was adapted from the

Performance Expectancy scale in UTAUT (Venkatesh et al. 2012). The experience model was adapted from the Effort Expectancy scale in UTAUT (Venkatesh et al. 2012). The network model was adapted from the Social Influence scale in UTAUT (Venkatesh et al. 2012). Lastly, the satisfaction model was adapted from similar measures of Hedonic Motivation from Venkatesh et al. (2012) and Satisfaction from Bhattacherjee (2001). The utilization of these measures tied closely to their alignment with each IDM model as described in Table 4.1.

The evaluation of the organizational IT policy attributes – direction, control, and support – were captured utilizing a combination of scales to examine (a) the number of technology alternatives, (b) ability to possess multiple technologies, and (c) the time between technologies updates within the organization. As there were no previously validated scales that directly measured these aspects, in alignment with this conceptualization, a similar approach was utilized as that of the development of IT differentiation and IT integration.

Analysis.

The analysis for this study was conducted through the use of component-based structural equation modeling techniques, specifically partial least squares (PLS) using SMARTPLS 2.0 (Ringle et al. 2005), which is well suited for theory development projects (Chin 1998). PLS has recently seen an increase in the post-hoc robustness analysis techniques to increase validity such as common method bias (Liang et al. 2007; Bagozzi 2011), multi-group analyses (Sarstedet et al. 2011; Chin 2000) and unobserved heterogeneity (Becker et al. 2013). Additionally, because of the significant number of interactions to be examined within the research model, alternative methods such as covariance-based structural equation modeling (CB-SEM) were not utilized due to the complexity in estimating a large number of interactions in a single CB-SEM model compared to PLS (Cortina et al. 2001). Therefore, the use of PLS is well suited for this study and is generally accepted within the mainstream IS literature.

Before examining the results of this analysis the reliability, convergent validity, and discriminant validity of the instruments were examined. Table 4.5 provides the correlations, means, standard deviations, reliabilities, and average variance extracted (AVE) for each of the constructs in the model. Each of the constructs provide evidence of reliability, convergent validity, and discriminant validity as each construct had a composite reliability > 0.80, Cronbach's alpha > 0.70, AVEs > 0.50, and the off-diagonal correlations exceeding the square root of the AVEs in all cases (Hair et al. 2006). Further, the loadings and cross-loadings for each of the individual items load primarily on their focal construct and less so on other constructs with a minimum difference[aa] of 0.32 indicating further evidence of convergent and discriminant validity (Gefen and Straub 2005). Based on these analyses the instruments used have adequate reliability and validity to provide confidence in the following estimations.

[See Table 4.5.]

Before examining the final estimation of the research model a series of tests were conducted to determine if common method bias (CMB) was a problem in the study. First, to determine if a common latent factor was influencing the results within the model a Harmon's one factor test (Podsakoff and Organ 1986) was conducted. The results from this analysis indicated 7 factors with eigenvalues > 1 and the first factor only accounting for 31.6 percent of the estimated variance, indicating that CMB did not provide a significant threat in this analysis (Sanchez et al. 1995).

Next, the correlations between each construct were re-examined to determine if there were any excessively high correlations (i.e., $r^2 > 0.90$), which may indicate CMB (Pavlou et al. 2007).

[aa] Full PLS loadings and cross-loadings are available from author upon request.

Table 4.5 does not provide any correlations with exceedingly high values to generate concern within this analysis.

Lastly, a more recent approach developed to work within PLS was utilized to test for CMB within a structural equation model (SEM). The Liang et al. (2007) method has seen increased utilization in the past few years within the IS field, specifically due to its simplicity and ability to test for CMB utilizing a single method factor within component-based SEM such as PLS (Chin et al. 2012). When estimating the model including the single method factor to capture CMB, (a) the loadings of the method factor on each indicator item are low and only 4 of 38 items were significant, (b) the loadings of the substantive indicator items on their focal construct are all significant in magnitudes much greater than the method factor, and (c) none of the original results change in direction or significance. Further, when examining the squared factor loadings of the method factor and the substantive construct factors the results indicated that the focal constructs estimated 78.60 percent of the average variance explained while the common method factor accounted for only 0.12 percent of the average variance explained. Thus, based on the results of these three analyses, there is evidence that CMB may not be a significant concern in this study.

After determining adequate measurement validity within this study the complete structural equation model was estimated using SmartPLS 2.0 (Ringle et al. 2005). This estimation was complete utilizing the full sample of 497 responses with a bootstrapping estimation of 1,000 resamples to ensure robust coefficient estimation and significant levels for the complete model (Chin 2010).

The analysis of this model is conducted using a two-step procedure (Goodhue et al. 2007) that examines the measurement model, controls, and direct effects within PLS with the interaction analyses being conducted in STATA 12 (Statacorp 2011) due to computation and multi-collinearity issues. In SmartPLS, the estimation of moderating effects is calculated through a product indicator technique (Hensler and Fassot 2010) generated by the software. This method within PLS provides potential estimation concerns due to the increased power needs and multi-collinearity possibilities. To reduce multi-collinearity due to multiple moderating latent variables needed in SmartPLS for this analysis, the moderation analysis was moved to STATA 12 utilizing OLS regression of latent variables, similar to the second stage estimation in PLS (Chin 1998). Table 4.6 presents the results.

[See Table 4.6.]

Results.

Before examining the PLS estimations in Table 4.6, the correlations between the latent variables were examined to determine consistency with prior theory and expectations. As shown in Table 4.5, the correlation between IT differentiation and IT integration is significant and negative (r = -0.22) which is consistent with the expectation of an inverse relationship. Prior literature indicates that as the level of differentiation increases, the ability to integrate the assets becomes more difficult (Lawrence and Lorsch 1967). Additionally, IT integration is positively correlated with organizational performance (r = 0.30) while IT differentiation appears to be negatively related to organizational performance (r = -0.12). While this relationship of IT differentiation and organizational performance is inconsistent with the prior theoretical insights, it is consistent with the ABS findings.

To begin the examination of the research model, the impact of IDMs and the organizational IT policy attributes are examined on both IT differentiation and IT integration in Models 1 and 2 in Table 4.6.

When examining the effect of IDMs on IT differentiation in Model 1, which includes the controls, IT policy attributes, and the IDMs, it appears that both the Rational IDM (β = -0.102, $p<.05$) and the Network IDM (β = 0.075, $p<.05$) have a significant impact on the level of IT differentiation. However, while the Rational IDM has a consistent negative relationship with that of the ABS results, the Network IDM has a positive relationship compared to the negative impacts found in the ABS. Additionally, both the Experience IDM (β = 0.005, n.s.) and Satisfaction IDM (β = -0.015, n.s.) remain to have non-significant impacts on IT differentiation, similar to the ABS results.

When examining the impact of the IDMs on IT integration in Model 2, none of the IDMs have a significant impact, similar to that of the ABS. This provides increased consistency between the ABS and survey insights in regards to the impact of IDMs on the configuration of the organization's IT portfolio.

Next, the organizational IT policy attributes, specifically support (β = 0.42, $p < .001$) and control (β = -0.15, $p < .01$), have a significant impact on IT differentiation in Model 1. Interestingly, direction (β = -0.06, n.s.) has no impact on IT differentiation as anticipated. While support was anticipated to reduce the level of differentiation in the simulation, the positive results from the PLS analysis may not necessarily be misleading. While in the simulation the level of technology alternatives (direction) was limited to 10, 20, or 30 options, the options in the real world are near limitless. Allowing individuals to own more ITs (support), while leading to more potential overlap in the simulation analysis, can lead to even further differences in the real world when the probability of overlap is reduced due to excessive options.

The increase in switching potential (i.e., control) within the organization allows individuals to switch away from their standardized, corporate issue technologies and towards their specialized technologies. This finding is in line with that of the simulation analysis, which indicates that as individuals are allowed to switch more often can adjust their level of IT differentiation to meet the needs of their own tasks.

When examining the impact of the organizational IT policy attributes on IT integration in Model 2, a similar pattern is found. Both support ($\beta = 0.161$, $p < .01$) and control ($\beta = -0.145$, $p < .01$) have significant impacts while direction ($\beta = 0.043$, n.s.) remains non-significant. These results are inconsistent with that of the ABS results, which indicated that direction had a negative impact on the level of IT integration while support and control had no significant impact. The discussion of the consistent and inconsistent findings is described in more detail below.

Next, the impact of the organization's IT portfolio, the IT policy attributes, and their interaction on organizational performance is examined in Model 3. In this analysis the results indicate that IT differentiation ($\beta = -0.060$, n.s.) has a negative, yet non-significant, impact on organizational performance while IT integration ($\beta = 0.293$, $p < .001$) has a significant positive impact. Additionally, the interaction between IT differentiation and IT integration ($\beta = -0.239$, $p < .001$) is significant as well, similar to that of the ABS. This interaction is depicted in Figure 4.12 utilizing one standard deviation above and below the mean of each variable (Cohen et al. 2003).

[See Figure 4.12.]

This interaction plot in Figure 4.12 indicates that at low levels of IT differentiation, an increase in IT integration results in significant performance benefits. This high level of IT integration is also the optimal configuration option when a high level of IT differentiation exists within the organization. These results provide a similar relationship as those discovered in the ABS within Figure 4.5 which also indicated that high IT integration and low IT differentiation were the optimal configurations. While this relationship is consistent with that of the ABS, it is somewhat contradictory to that of prior theory (Lawrence and Lorsch 1967) and is explored further in the discussion section.

In addition to the direct effects of the organization's IT portfolio, the ability for the organizational IT policy attributes to influence the impact of organization's IT portfolio on organization performance are examined. In this analysis, the three organizational IT portfolio attributes (control, support, and direction) are examined for their ability to moderate the relationship of both IT differentiation and IT integration. In this analysis only support moderates the impact of IT differentiation ($\beta = 0.177$, $p < .001$) and IT integration ($\beta = 0.171$, $p < .01$) while control and direction have no significant moderating effects. To provide a depiction of these moderating effects, interaction plots were generated utilizing one standard deviation above and below the mean of each interacting variable (Cohen et al. 2003).

In Figure 4.13, the interaction between support and IT differentiation on organizational performance is depicted. In this analysis, it appears that when there is a high level of support (i.e., the number of ITs an individual can own) that a high level of IT differentiation is more beneficial. This scenario indicates that individuals would own more ITs and each of those would be more varied between individuals to meet their specific goals. When there is a low level of IT differentiation, having everyone own the same set of ITs in larger personal IT portfolios does not provide increased performance. Alternatively, when there is a low level of support in the organization's IT policy, a low level of IT differentiation is more beneficial as it allows people to work together more easily with those ITs. Further, greater IT differentiation under low support provides the lowest organizational performance, as individuals must spend significant time attempting to integrate the separate ITs.

[See Figure 4.13.]

The interaction between support and IT integration on organizational performance is depicted in Figure 4.14. In this figure, a high level of IT integration and increased individual IT portfolio sizes (i.e., support) provide significant benefits to the organization while a smaller individual IT portfolio is more beneficial in scenarios when IT integration is limited within the organization. This could be due to the ability to mitigate conversion and quality losses that occur when sharing task outputs between ITs that have limited integration abilities through a reduction in the potential ITs working together.

[See Figure 4.14.]

In summary, this analysis finds that Rational and Network IDMs have significant impacts on the level of IT differentiation within the organization's IT portfolio while the Experience and Satisfaction IDMs have no significant impacts. Additionally, none of the IDMs have any impact on the level of IT integration within the organization, providing further support for the fact that individuals may not select their ITs based on the level of integration ability when making individual decisions. Organizational IT policy attributes, specifically support and control, both have significant impacts on the level IT differentiation and IT integration within the organization's IT portfolio while direction has no significant impact on either. Further, IT differentiation has no significant impact on organizational performance while IT integration has a significant positive impact as well as a moderating effect on the ability for IT differentiation to provide increased benefits. In addition, the support attribute within the organizational IT policy provides a significant moderating effect on the IT differentiation and IT integration relationship on organizational performance while control and direction have no significant moderating effects.

Discussion

This essay has explored the unique scenario of IT decision making within the organization driven by the emergence of BYOD policies. In these IT decision-making scenarios, individual employees are now identifying, selecting, and utilizing their *own* ITs for their organizational tasks. With the increase in the number of IT decisions being made inside the organization, the examination of the various IDMs is crucial to determine how different heuristics may influence the organization's IT portfolio configuration.

Building on the prior literature on individual decision-making (Simon 1959; Edwards 1954) and the prior IS literature on organizational IT policies (Alavi et al. 1987; Rockart and Flannery 1983), this essay explores the role of both individual behaviors and organizational factors in influencing the organization's IT portfolio and eventual performance. Utilizing a multi-phase, mixed-method design (Venkatesh et al. 2013), consisting of qualitative individual interview vignettes to *develop* initial expectations, an agent-based simulation to *explore* the theoretical insights over time, and a survey questionnaire to *compare and explore* the insights through real-world employee perspectives provided increased validity and reliability to the emergent insights (Kane and Alavi 2007; Rudolph and Repenning 2002).

The summarization of these insights from both the ABS and the questionnaire survey are provided in Table 4.7. This table indicates that while there are a series of relationships that were inconsistent across the ABS and survey questionnaire, due potentially to individual strengths and weaknesses of each method, there are also a series of consistent results. In both the ABS and the survey, the relationship of both IT integration and the interaction of IT integration and IT differentiation were significant and consistent. Additionally, the role of the Rational IDM on IT differentiation remained consistent in both the modeled simulation environment and through employee perceptions. The non-significant impacts of both the Experience and Satisfaction

IDMs remained consistent in both the ABS and survey as well, indicating the lack of significant role these IDMs play in influencing specific configurations of IT differentiation and IT integration. Further, the Network IDM has a consistent non-significant role in both the ABS and survey. Lastly, the control attribute of the organizational IT policy has a significant negative relationship with IT differentiation indicating its ability to reduce the level of IT differentiation within the organization.

[See Table 4.7.]

This research contributes to the extant IS literature by exploring the recent IS phenomenon of "Bring-Your-Own-Device" initiatives within the organization. Despite the significant discussion within the popular press, academic research has yet to deeply examine this emerging phenomenon that has been considered to be one of the largest changes in organizational IT management in decades (Willis 2012; Unisys 2012). The adoption of ITs by individuals, instead of organizations, is a dramatic shift from prior IT management policies, which were driven only by organizational objectives. Exploring this phenomenon through both individual behaviors and organizational policies provides clearer directives to organizations attempting to configure their IT portfolio characteristics (i.e., IT differentiation and IT integration) in the face of BYOD initiatives.

Additionally, this research examines the organizational IT portfolio in a detailed, asset-specific perspective through the examination of IT differentiation and IT integration. Prior IS literature has examined the organizational IT portfolio through an *aggregate* measure such as IT budget investments (e.g., Bharadwaj 2000; Dewan and Min 1997), which has been claimed as a potential cause for controversial findings regarding the impact of IT (e.g., Aral and Weill 2007; Mithas et al. 2012). Examining the specific *configuration* of organizational IT through IT differentiation and IT integration will provide more direct insights to both research and practitioners in developing the IT portfolio.

Prior research has provided evidence of the performance impacts of both IT differentiation and IT integration for both individuals and organizations. This essay provides further insights into the IT contextualized theory by examining the antecedents of IT differentiation and IT integration to develop directives for organizations attempting to develop a specific IT portfolio configuration. By providing evidence of how the both IDM behaviors and organizational IT policies can impact on the organizational IT portfolio, organizations can now develop their IT policies to meet the demands of their environment and individual desires while building their target IT portfolio configuration.

Additionally, this research further examined the relationship between IT differentiation, IT integration, and organization performance by introducing alternative assumptions regarding IT adoption within the organization. One result that was indicated within this research was the inconsistent impact of IT differentiation on organizational performance in both the ABS and the survey. While prior theory indicates that an increase in IT differentiation will lead to increased organizational performance and a subsequent high level of IT integration will further develop that benefit (Lawrence and Lorsch 1967), in this analysis the insights varied. The IT differentiation within the organization's IT portfolio was not beneficial as expected but instead negative in the simulation and non-significant in the survey. One potential reason for these inconsistent results lies in the assumptions of adoption behaviors utilized in prior research. Lawrence and Lorsch (1967) indicate that the organization will differentiate based on the specific needs of the organization and make the "best" decisions necessary during the differentiation. However, with the introduction of alternative decision-making models in this research, the selection of ITs in the organization's IT portfolio were not driven solely by rational thought.

To test this reasoning, a subsequent analysis was conducted in the ABS utilizing only the Rational IDM model to determine the impact of IT differentiation and IT integration on organizational performance. As depicted in Figure 4.15, it becomes apparent that when individuals are adopting purely the "best" technology for their specific needs the prior theoretical insights do indeed emerge. However, by extending this theoretical model through the use of both rational and bounded rationality decision-making models the benefits that organizations may expect to receive may be constrained. While a high level of IT differentiation can be beneficial, it must be differentiated with a clear purpose and reasoning to provide benefits to the organization. Variety simply for the sake of variety does not provide increased organizational performance based on the analyses in this research.

[See Figure 4.15.]

Limitations and future research.

While the results from this mixed-method approach provide a unique perspective of the impacts of individual decision-making models and the organizational IT policy attributes on the organizational IT portfolio, it is not without its limitations. More specifically, the simulation and survey analyses were conducted on a limited set of both IDMs as well as organizational IT policy attributes. First, as mentioned above the qualitative vignettes indicated that individuals utilize a variety of different heuristics to make their decisions. The most frequently mentioned heuristics were utilized in this analysis, however future research should attempt to examine alternative decision-making models. Further, individuals may utilize a hybrid combination of each IDM to make their decisions, which may provide different impacts on IT differentiation and IT integration.

Second, only a limited set of organizational IT policy attributes were modeled within the ABS and examined in the survey questionnaire. Organizational IT policies are complex entities that have a variety of constraints and limitations; however, to provide clear directives, retain simplicity, and examine the impacts of specific components of the IT policy this essay utilized a small sub-set of IT policy attributes (Gilbert 2008). Future research should examine alternative IT policy attributes to provide further insights into how organizations can ensure their IT portfolio is configured and managed as expected.

Lastly, the exploration of the theoretical model was conducted through two diffing methods, each with their own strengths and weaknesses. Due to the emergent nature of the organization's IT portfolio over time, an ABS was utilized which allowed for the examination of the impacts of both IDMs and organizational IT policy attributes over time in simplified reality. However, despite these insights, the results are limited in their ability to closely model reality due to the simplification of relationships and external influences. To provide a complementary view, a survey questionnaire capturing real-world perspectives of employees regarding the impacts of their personal IDMs, their organization's IT policy, and their organization's IT portfolio were captured. This method provides important insights into how employees within the organization view the impact of the organization's IT portfolio and IT policy while foregoing to longitudinal effects. The combination of these methods to compare and contrast the emergent results provides areas for future research to refine the theoretical model and capture these differences.

As depicted in the ABS figures, the adjustment and impact of various IDMs are emergent in nature and may not be clearly identifiable during a single cross-sectional questionnaire (Shadish et al. 2002). Future research should attempt to develop a longitudinal design to capture the removal and influx of technologies within the organization and the specific IDMs that individuals utilize during *each* decision. These results will provide further insights into how individuals make decisions during IT adoption and potentially identify specific scenarios when different IDMs perform better than others.

Conclusion.

In this essay, the unique decision-making scenario within the organization driven by the adoption of BYOD policies was explored through an IT contextualized view of Lawrence and Lorsch's (1967) theory. Specifically, the antecedents of both IT differentiation and IT integration were explored through the impacts that both individuals and organizations may have on the IT portfolio. Building on the literature on IDM models (Simon 1959; Edwards 1954), and prior IS literature on organizational IT policies (Alavi et al. 1987; Rockart and Flannery 1983), the role of these two drivers were explored.

Utilizing a multi-phase, mixed-method approach (Venkatesh et al. 2013) consisting of qualitative online interview vignettes, agent-based simulations, and a survey questionnaire this essay explores how varying scenarios within the organization can influence the configuration of the organizational IT portfolio through IT differentiation and IT integration and the eventual impact on organizational performance. The results indicate that generally, various individual decision-making (IDM) models have significant impact on the level of IT differentiation in the organization as employees select either the "best," most preferred, most satisfactory, or most recommended technologies in the environment. Alternatively, the IDMs have limited impact on the level of IT integration within the organization, as individuals tend to focus on their own needs and not those of the collective.

Simply providing opportunities and options to an individual does not necessarily lead to expected outcomes. The old adage, "you can lead a horse to water, but you cannot make it drink" encompasses the relationship of organizational IT policies and IDMs. The implementation of the organizational IT policy can either encourage or constrain the development of the organization's IT portfolio, but it cannot directly influence individuals into utilizing specific IDMs to select the "best" technologies for their own tasks

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Appendix A: Details of the Vignette Data Collection

For the development and justification of the assumptions and individual decision-making (IDM) behaviors utilized within the simulations a series of qualitative data collections were conducted to provide real-world insights and behaviors of individuals. Starting with the rationale and constructs developed through an IT contextualization of Lawrence and Lorsch's (1967) theory of differentiation and integration, a set of potential conditions were identified which may influence an individual's behavior for the selection of technologies: the number of technologies available, the level of experience with the technologies, the interdependence with co-workers, and the similarities between technologies. To ensure an effective data collection and consistency in the method and data collection across individuals a systematic quasi-experimental process was developed (Shadish et al. 2002).

The procedure for this data collection required that individuals answer a series of questions regarding how they would select a technology, switch to an alternative technology, and decide which technology to use for their tasks. A specific approach was taken to ensure that each vignette was both systematically varied for each condition and also remain as consistent as possibly in both the length of text and ordering of each sentence (Shadis et al. 2002). In Table 4.A1 below, the specific variations of each potential influence, their associated text, and word length are provided. The potential vignette scenarios provided a 2x2x2x3 factorial design to adequately vary each scenario and ensure the data collection crossed all designs. Each respondent was randomly assigned 2 of the 24 scenarios to answer within the survey. In addition to the technology selection scenarios each respondent was asked a scenario regarding (a) *how many times a technology must fail to meet their expectations before deciding to switch* and (b) *how they select which technology from their existing IT portfolio to use for their works tasks*.

These three areas of behaviors provide the initial data collection utilized for the development of the simulation parameters in the second phase in the essay.

[See Table 4.A1]

> **Sample Selection Vignette**: You have just started a new position at an organization and need to select the set of technologies that you would like to use for your tasks. Your organization will let you select from 2 different technologies. You do not have any prior experience with the technologies available for selection. In this position you typically have to work closely with other individuals in your department for your everyday tasks. The technologies are all very similar and any technology can be used to complete all the required tasks for your position. How would you go about selecting a technology?
> **Sample Switching Vignette**: In addition to your selection process, we are curious about how you determine **when** it is time to switch to a different technology. More specifically, how do you decide when it is time to start looking for a new technology to use for your tasks? For example, how many times do you have to fail at a task before you start looking for an alternative technology?
> **Sample Usage Vignette**: In today's environment, many of the technologies that people own can complete the same tasks with different levels of quality. For example, if your boss asked you to make a report of the current clients you serve, you could make this list on Microsoft Word, Apple's Pages, or even Notepad. We are curious how people select between different technologies that they already have access to for completing a task. Can you please describe an example and the thought process that you had to make for this decision?

Two separate data samples were utilized for the data collection in this phase. First, an online crowdsourcing market (Steelman et al. 2014), which consists of a large population of individuals who conduct various tasks such as surveys, was used to gather a general population. As the behaviors described in the vignettes were general in nature, the set of individuals from this environment fit the requirements for participation. The sampling frame was restricted to U.S. participants to ensure consistency in the interpretation of the vignettes (Steelman et al. 2014). A total of 100 responses were collected within two days. In addition to this method, a more traditional sample of 59 undergraduate college students entering into the job market was collected. As the vignettes depicted provide a scenario in which the participants would be or had recently entered the job market, the use of this sample should provide important insights into individual technology behaviors.

After collecting all the responses from both samples, each response was placed into a qualitative database for future analysis and coding (Sabherwal and Chan 2001). The selection and switching responses were each coded separately as their behaviors would be modeled separately within the simulation. An initial phase of open-coding was utilized to determine themes within the responses. After the initial phase the listing of themes and notes were compiled, categorized into more general aspects, and recoded for the behaviors used in each vignette. Table 4.1 in the manuscript provides examples and a description of the IDM behaviors that emerged during this phase. The use of real-world responses from actual individual behaviors provides robustness and increased validity to the modeling of these behaviors within the simulation (Kane and Alavi 2007; Rudolph and Repenning 2002).

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Appendix B. Details of the Agent Based Simulation

The discussion of the agent-based simulation (ABS) model begins with the basic specifications of the environment, organization, and individuals depicted in Figure 4.B1. The following specifications are used to ensure the ability to maintain a simple, yet insightful ABS. The ABS consists of an organization, its employees, a set of tasks and sub-tasks, and the technologies needed to complete the sub-tasks. Each individual within the ABS has their own set of behaviors and attributes and acts independently to influence the progression of the simulation.

[See Figure 4.B1.]

To begin, the environment has the following basic specifications:

- *A finite set of sub-tasks exists within the environment for individuals to complete.*
- *A finite set of technologies exist within the environment for individuals to utilize in their individual sub-tasks.*
- *Each technology within the environment has a specific ability to complete each sub-task within the environment.*
- *Each technology within the environment has a specific ability to communicate and convert the outputs of each of the other technologies within the environment.*

Therefore, based upon these specifications, one can determine that for each sub-task in the environment, there is an optimal technology to utilize. Additionally, for each technology that is utilized in the environment, there is an optimal technology choice that reduces the loss of information and fidelity during conversions between technologies.

For the specific sub-tasks and tasks within the organization the following specifications apply:

- *An organization is composed of individual actors who complete assigned sub-tasks* ***independently****, which must then be combined with other sub-tasks to complete specific organizational tasks.*

- *The completion quality of the organizational tasks are a function of the individuals' sub-task completion quality and the interactions between individuals combining the output of each individual sub-task through specific technologies.*
- *Each individual shares his or her sub-task output with at most one individual, based upon sequential interdependency.*[bb]

Based upon these specifications, the examination of organizational performance through the completion quality of various interdependent tasks are provided as a function of both individual sub-task completion quality, the specific technology conversion abilities, and the variation of sub-task compositions for organizational tasks. While these provide a basis for the distribution and differentiation of sub-tasks and tasks within the organization the following individual attributes and behaviors outline the variations in individuals completing each sub-task.

- *Each individual within the organization are assigned a random sub-task to complete during each simulation.*
- *Each individual within the organization begins with a random set of technologies in their individual IT portfolio to use for the completion of their sub-task.*
- *Each individual only uses those technologies that they have in their specific IT portfolios at each time period.*
- *In each time period an individual utilizes their task knowledge and technology knowledge with their selected technologies to complete their sub-tasks.*
- *After each sub-task, the individual's level of knowledge of the sub-task and technology utilized increases from experience.*

These individual behaviors provide the basis for the determination of individual sub-task completion quality within the organization. While the organizational performance focuses on the completion quality of tasks, a combination of sub-tasks, the individual performance is developed independently of other individuals in the organization as they complete their sub-tasks independently.

[bb] Additional forms of dependency may be modeled (e.g., reciprocal, pooled, etc.) but has been limited to sequential for this current analysis.

The primary benefit of utilizing a bottom-up approach with ABS is the ability to examine how individuals' behaviors influence the organization over time (Axelrod 1997; Macy and Willer 2002). The specific behaviors an individual exhibits during each time period are discussed in further detail below.

During each time period, *T*, the primary goal of an individual is to complete own assigned sub-task. To do so, a specific technology must be selected from the individual's personal IT portfolio. This selection of which technology to utilize for a sub-task is based upon the individual decision-making (IDM) models discussed within the manuscript. Each individual will make selection and switching decisions based on a rational, satisfaction, experience, or network IDM model.

After using a technology, each individual will evaluate their performance at their sub-task and determine if their technology has worked successfully for them. If an individual has a repeated series of issues completing their sub-task with a specific technology they will begin to search for an alternative and switch technologies in their personal IT portfolio. This evaluation and search behavior will drive the variations and evolution of the configuration of both the personal and organizational IT portfolios through the addition and removal of technologies over time.

The development of the actual ABS model is based upon these initial specifications of the individuals, organization, and environment. The following section describes the computational modeling of the focal constructs within the model – the organizational and individual performance, IT differentiation, IT integration, IDM models, and the organizational IT policy attributes – to provide a basis for the estimation and examination of these constructs within the ABS.

Measurement

In this section, the formal computation calculations are described which estimate the focal constructs within the IT contextualized theory: IT integration, IT differentiation, individual and, organizational performance.

IT Integration and IT Differentiation

To empirically model and examine the impacts of IT differentiation and IT integration – the two focal attributes of the organizational IT portfolio – a variety of alternative measures, reflecting differing perspectives, were compared.

As discussed, each technology has a unique ability to convert inputs and outputs from another technology within the environment. This conversion value, $TechTechRatio_{ij}$, between technology *i* and technology *j* is randomly generated during the beginning of each simulation. The set of conversion ratios between all technologies within the environment generates a *K* by *K* matrix where *K* is the set of all technologies within the environment. Additionally, all technologies have a complete conversion ability between the same technologies such that $TechTechRatio_{ii}$ is equal to 1 in the diagonal of the matrix. The level of IT integration is estimated at each time period, *T*, as a combination of the conversion ratios of technologies within the organization. While the calculation of $TaskCompletion_p$ above utilizes the conversion ratio between two specific technologies that each individual uses for their tasks to compute performance, the following calculation use the combination of all possible technology conversion ratios to estimate the level of IT integration for the organization.

The focal measure of $ITIntegration_T$ utilized in this analysis is derived from the average conversion ratio between each technology, $TechTechRatio_{ii}$, that existings only within the organization, not the entire set of options in the environment. Additionally, this measure is weighted by the number of individuals in the organization who actually own the technology. For example, this measure takes into account the differences between an organization consisting of 9 individuals with technology A and 1 individual with technology B and an organization with 5 individuals with technology A and 5 individuals with technology B.

In the following formula $ITIntegration_T$ is estimated such that each $TechTechRatio_{ij}$ is weighted by O, the number of individuals within the organization owning technology i. This summation of conversion ratios is then divided by the number of organizational technologies, k, the number of individuals within the organization, N, and the number of technologies an individual is allowed to own within their personal IT portfolio, owned, to create a standardized value.

$$ITIntegration_T = \frac{(\sum_i^1 \sum_j^1 TechTechRatio_{ij} \times O)}{k \times N \times owned}$$

The level of IT integration within the organization is influenced by two distinct processes. First, the mean level of IT integration across all technologies in the environment is systematically varied by adjusting the mean level of conversion rates, $TechTechRatio$, from 0.1 to 1. Additionally, the level of IT integration within the organization is driven by the individuals' selection and switching behaviors such that removing technologies that are unsuccessful and replacing them with alternative technologies alters the IT integration of the organization but not that of the environment.

To measure differentiation within the organization prior literature has used variations of Euclidean distances (O'Reilly et al. 1989) to measure group heterogeneity (e.g., Lawrence and Lorsch 1967). However, due to the potentially computationally taxing estimation of Euclidean distances in large networks with many attributes, an alternative approach was taken. This approach utilizes a comparison of each individual's personal IT portfolio to the average IT portfolio ownership across the organization. The formula below for *ITDifferentiation*$_T$ specifically compares individual *n's* technology portfolio, $Z_{n,i}$, to the mean technology ownership of all other individuals, μ_N, such that *n* is the focal individual, *i* is the specific technology in individual *n's* technology portfolio, *owned* is the number of technologies individual *n1* possesses, and *N* is the number of individuals in the organization.

$$\text{ITDifferentiation}_\text{T} = \frac{\left[\frac{\sum_N^1(\sum_K^1(z_{n,i} - \mu_{N,i})^2)}{N}\right]}{owned}$$

This estimation of OrganizationalDifferentiationMeanDifferenceT is conceptually similar to the Euclidean Distance measure. To compare the validity and similarity of these alternative measures of organizational IT differentiation an initial test was conducted utilizing the ABS by estimating the standardized version of IT Differentiation, OrganizationalDifferentiationStandardizedt, and the mean difference version of IT Differentiation, OrganizationalDifferentiationMeanDifferencet. This was conducted by examining the estimations of each measure with an increasing number of individual actors (e.g., 5, 10, 15….100). Figure 4.B2 depicts the estimates from this analysis.

[See Figure 4.B2.]

The results indicate that the pattern of results, while differing in magnitude, remains consistent in its variance. Additionally, the correlation between these two measures is 0.96. Therefore, due to the high level of similarity and the exponential magnitude of differences in estimation speed, the primary estimation for IT differentiation, *ITDifferentiation*$_T$, will utilize the mean difference equation, *OrganizationalDifferentiationMeanDifference*$_t$, for simplicity and efficiency.

Performance

During each time period within the organization, each individual must complete his/her assigned sub-task, t. To complete each sub-task an individual, n, will select one of the technologies, i, from their personal IT portfolio. The individual then attempts to complete his/her assigned sub-task by utilizing the knowledge they have of the task, $SubTaskKnowledge_{n,t}$, and the knowledge they have of the technology they selected, $TechnologyKnowledge_{n,i}$. As described above each technology has a specific ability to complete each task within the environment, $TaskTechRatio_{it}$. The following equation describes the calculation for individual sub-task performance.

$$SubTaskCompletion_n = TechnologyKnowledge_{n,i} \times SubTaskKnowledge_{n,t} \times TaskTechRatio_{it}$$

Within the organization there are multiple tasks that are being completed in parallel by groups of individuals. The completion of a task is contingent upon the completion of individual sub-tasks and the level of sub-task combination between the individuals in the group. For example, individual A utilizes Pages for the development of a report and proceeds to share their output to individual B who utilizes Word for the formatting of the report. During the conversion from Pages to Word there is a potential for loss of fidelity and consistency of the output from Individual A. This conversion between Pages and Word has no impact on the individuals' sub-task completion, performed independent of one another; however, when combining the outputs for and organizational task there is a reduction in the quality of the task completion.

Therefore, the calculation of the completion for each task, $TaskCompletion_p$, for each group of individuals, p, is presented in the following formula such that g is the number of individuals in a group and n is the individual completing an individual-level sub-task. The equation multiples the product of the $SubTaskCompletion_n$ values by the product of the conversion rate, $TechTechRatio_{(i,n1),(j,n2)}$, for each handoff between individual *n1* using technology *i*, *(i, n1)*, and individual *n2* using technology *j*, *(j, n2)* for all *n1,n2* handoffs, with *n1* unequal to *n2*.

$$TaskCompletion_p = \left(\prod_{n=1}^{g} SubTaskCompletion_n\right) \times \left(\prod_{n=1}^{g-1} TechTechRatio_{(i,n1),(j,n2)}\right)$$

For example, if individuals A, B, and C are working on a task and have each completed their individual sub-tasks the calculation would estimate the product of all individual sub-task completion values, $\left(\prod_{n=1}^{g} SubTaskCompletion_n\right)$, and multiply this by the product of the number of conversions between each individual and their technology, equal to g-1 hand-offs. This estimates a task completion value as a function of the individual sub-task completion values and the technologies utilized by the individuals.

In summary, the measure of $SubTaskCompletion_n$is an estimation of an individual's own sub-task, independent of all other individuals within the organization. Alternatively, the $TaskCompletion_p$ is an estimation of the components of individual sub-task performance and the associated technology conversions between individuals. To generate levels of individual and organizational performance at the network levels the average $SubTaskCompletion_n$, for individual performance and the average $TaskCompletion_p$, for organizational performance are estimated.

Individual Decision-Making Models

To model the four IDM models within the ABS the heuristic that each individual uses during their selection and switching behaviors were varied. Those individuals who operate under the rational IDM model base their decisions upon the $TaskTechRatio_{it}$ of each technology for the specific tasks assigned. Those individuals who operate under the experience IDM model base their decisions upon the level of $TechnologyKnowledge_{n,i}$ of each technology within the individual's IT portfolio. Those individuals who operate under the satisfaction IDM model base their decisions upon the level of $TechnologySatisfaction_{n,i}$ of each technology within the individual's IT portfolio. Those individuals who operate under the network IDM model base their decisions based upon the *average IT ownership* of their immediate social network.

Organizational IT Policy Attributes

The modeling of the organizational IT policy attributes – direction, support, and control – is systematically varied within the simulation. Specifically, direction, or the number of technologies available for adoption by individuals within the organization, is varied from 10, 20, and 30 technologies. Support, or the number of technologies and individual is allowed to own within their individual IT portfolio at one point in time, is varied from 3, 4, and 5 technologies. Lastly, control, or the frequency by which an individual can switch technologies in and out of their individual IT portfolio, is varied from 15, 75, and 520 time periods[cc].

For complete details regarding the parameters and sensitivity analyses conducted within this simulation refer to Table 4.B1.

[See Table 4.B1.]

Simulation Analysis

This study utilized the NetLogo (Wilensky 1999) simulation software developed at Northwestern University which has been utilized in a variety of academic fields. NetLogo provides the ability to develop the interface, documentation, and programming of the ABS with a native programming language and development environment (Railsback and Grimm 2012). To provide sufficient power and robustness to the analysis each simulation was conducted for 500 time periods and replicated for a minimum of 10 iterations for each set of parameter settings. The

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[cc] The 520th time period is arbitrary and any value over 501 would keep the individuals to be able to switch within the simulation examination.

parameter settings utilized in each of the models are provided in Table 4.B1 indicating the primary values and those utilized for sensitivity analyses.

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Appendix C. Survey Instrument and Development.

To develop the questionnaire utilized for this research a rigorous development and validation process was conducted (MacKenzie et al. 2011). Through recent arguments regarding the lack of rigorous development and validation of survey instruments within the IS literature, MacKenzie et al. (2011) have developed a series of guidelines and procedures to aid in the development of strong and reliable instruments. These procedures, consisting of conceptualization, development of measures, model specification, scale evaluation and refinement, validation, and norm development, were used to develop the survey instruments for the focal constructs in this research. Below are the details of the methods and data collections used for each step in this procedure.

Step 1 – Conceptualization

To begin, a clear conceptualization of the focal constructs of **IT differentiation** and **IT integration** were described to provide a foundation for the subsequent steps. This initial step required developing clear, simple, and concise definitions of each focal construct. These definitions were derived from the prior literature, theoretical foundations, and similarities and dissimilarities from prior research. In addition to the definition a series of attributes regarding the construct were defined such as the focal entity, the general properties, dimensionality, stability, and required aspects for each construct.

Based upon the foundational differentiation and integration theory (Lawrence and Lorsch, 1967) **IT differentiation** is defined as the *organization's* level of IT variety between the *individuals'* IT Portfolios. The focal entity of this construct is an organization with the focus being on a general property, an organizational attribute. Additionally, the construct is unidimensional in nature as it focuses purely on the number and variety of technologies used within the organization. As the number of technologies an organization uses over time may vary, the level of IT differentiation can change over time and across organizations. A necessary component of the measurement of IT differentiation is the presence of technologies utilized within the organization. An attribute of a high level of IT differentiation is a large variety of technologies within the organization.

As for IT integration, defined as the level of coordination of effort among the *individuals'* IT Portfolios within an *organization's* IT Portfolio, its focal entity is an organization as well with the focus being on a general property, an organizational attribute. Similar to IT differentiation, this construct is unidimensional as it focuses only on a measure of the integration of technologies. As the number and variety of technologies change within the organization the level of IT Integration can vary over time and across organizations as well. An attribute of a high level of IT Integration is the presence of high levels of conversion rates between the technologies within the organization.

Step 2 – Generate Items to Represent these Constructs

The second step was to acquire a set of representative items that capture the nature of the construct to be utilized in the subsequent analyses. The following items were generated based upon the focal definitions and dimensionality to capture the attributes of the construct. Ten items per construct were selected to provide the potential for removal in following cleansing steps.

IT Differentiation Items.

1. *I use many different technologies for my organizational tasks.*
2. *The number of technologies I use is different than those of other employees*
3. *The technologies we use within my organizational are all the same*
4. *Employees within the organization all tend to use different technologies.*
5. *The employees within my organization all tend to use the same technology.*
6. *I use unique technologies for my tasks compared to others within my organization.*
7. *Other individuals within the organization use unique technologies for their tasks.*
8. *The technologies used within the organization are very different between individuals.*
9. *Employees tend to select different types of technologies for their tasks.*
10. *There is a large differentiation in technologies between employees.*

IT Integration Items.

1. The technologies within my organization work together seamlessly
2. It is easy to share information and tasks from my technology to others within the organization.
3. The technologies I use within the organization are integrated with the others in the organization.
4. Files are not transferred easily between the different technologies in the organization.
5. It is for me to share task outputs from my technology with other individuals.
6. The technologies within the organization all interact with easy other easily.
7. There is little to no loss in quality sharing my task outputs to others will different technologies.
8. The technologies I use for my tasks all work flawlessly with the other technologies used in the organization.
9. The technologies used by individuals within my group are integrated well.
10. Technologies used in the organization can convert and open files from other technologies easily.

Step 3 – Assess the Content Validity of the Items

The third step was to access the content validity of each item to ensure that it is conceptually more related to its focal construct than the others within the model. MacKenzie et al. (2011) indicate that the development of clear content validity, "the degree to which items in an instrument reflect the content universe to which the instrument will be generalized", is crucial to ensuring a valid and reliable construct to be used in future research. The recommendation is to utilize a variation of a card sorting procedure, displayed in Table 4.C1 below, which lists all items on the left column, the focal constructs and definitions in the header rows, and ask each individual to rate each item in how well it relates to various constructs on a 1 – "Very Low" to 5 – "Very High". In addition to the focal constructs it is recommended to include additional constructs that are both similar and dissimilar to ensure discriminant and convergent validity. The results from these responses were then comparing the mean ranks of each item-construct relationship similar to a factor loading.

[See Table 4.C1.]

To collect data for this procedure it is recommended to find participants that (1) have the intellectual ability to rate the constructs and (2) be representative of the intended population. As the focus of these constructs is on an organization's number of technologies utilized by individuals a representative sample was collected from employed US participants through an online crowdsourcing market (Steelman et al. 2014) to allow for both a large sample and valid participants. Each participant was paid $0.50 to rate the items in this task.

A series of data collections were repeated in this phase to arrive upon a consistent set of items that reflected the constructs of interest. In each data collection, individuals rated the items against IT differentiation, IT integration, and a similar construct IT variety[dd]. The first sample of 109 responses provided multiple items that either cross-loaded significantly, loaded on the wrong construct, or did not load onto any construct. In each survey, an open-ended question was provided to gather feedback from the participants in reference to problems with the survey, definitions, and items. Within the first data collection it was noted that the definitions between IT differentiation and IT variety were very similar and required further clarification. After adjusting the definitions for clarity a second data collection was gathered consisting of 100 responses. In analyzing the loadings for this data collection specific items were identified that had poor loadings. The items were then ranked in descending order of loadings for their respective constructs to identify the top five items for IT differentiation, IT integration, and IT variety. The final data collection in this step consisted of 51 responses and provided loadings that were as expected and no cross loadings between constructs.[ee]

[dd] IT variety was defined as the number of ITs available in the market to complete a specific task.
[ee] The specific items that were retained are discussed below during the full data collection step.

Step 4: Formally Specify the Measurement Model

After the set of items were analyzed to determine their relative loadings on the constructs' definitions the formal measurement model was specified. In this instance IT differentiation, IT integration, and IT variety were modeled as reflective measures as each item was expected to be highly inter-correlated and a reflection of the constructs' items and not a formation of the construct (Hair et al. 2006).

Step 5: Collect Data to Conduct Pretest

After the intended items were selected and a formal measurement model determined, the collection of pretest data was conducted to empirically validate the results through traditional statistical methods. A recommended threshold for the number of sample individuals include a range from 100-500 respondents (Comrey and Lee 2013) for the initial testing of the psychometric properties.

Step 6: Scale Purification and Refinement

Once the initial set of pretest data was collected, the empirical validation and refinement of the instrument began. Utilizing the formal model as specified in Step 4, an exploratory factor analysis was conducted to ensure similar construct loadings as prior steps. After dropping some items, which were problematic in their loadings, a confirmatory factor analysis was conducted utilizing structural equation modeling to validate the results (Bollen 1998).

This began by ensuring a proper solution was modeled that (a) converges and (b) none of the variance estimates were negative. Following a proper solution, the model can be examined through the significance of the individual relationships between constructs via z-tests at the appropriate significance level, the chi-square statistic, a series of goodness-of-fit indices (RMSEA, CFI, TLI, chi-square/d.f. ratio), the average variance extracted, the Cronbach's alpha and composite reliabilities, and the significant lambda values of each item. For any items that do not meet these requirements an elimination procedure was conducted to drop those with low validity, reliability, or strong and significant measurement error (Bollen 1998). Utilizing an iterative procedure of dropping items, which were problematic, and adjusting model based upon the modification indices, a sufficient model was found.

Step 7: Gather Data from New Sample and Reexamine Scale Properties

After the initial scale was refined and purified with a single data collection, an additional data collection was gathered to validate the refinements. Utilizing a reduced survey questionnaire, a sample of 200 employed U.S. participants were collected through the online crowdsourcing market (Steelman et al. 2014). This data collection was utilized for the following steps to assess the scale validity and reliability for future research usage.

Step 8: Assess Scale Validity

After a consistent and valid survey instrument was found the empirical results were validated a final time with this sample. Additional tests are recommended to experimentally manipulate the levels of each construct through vignettes or experimental designs. An alternative approach is to utilize known-group comparisons to compare known differences across groups. As this is (a) an initial development of the focal constructs, (b) known groups of individuals were not accessible at this point, and (c) the inability to experimentally manipulate an organization's level of IT differentiation and IT integration is not possible, this step was conducted in an alternative manner. This process was conducted by examining the expected correlations and relationships between constructs as predicted by prior theory. Additionally, the expected relationships within the nomological network were examined.

The scale assessment conducted in this phase consisted of the entire survey questionnaire in addition to the constructs developed through this procedure. A confirmatory factor analysis utilizing structural equation modeling provided a sufficient model (Bollen 1998) with a chi-square = 902.911, RMSEA = 0.055, CFI = 0.933, TLI = 0.924, and SRMR = 0.054.

Step 9: Cross-Validate the Scale

This step focused on cross-validating the scale across different groups, cultures, or demographics. This was conducted by collecting two additional samples of individuals through an online crowdsourcing market sample, restricting responses to only U.S. respondents and those who had not participated in any prior surveys (Steelman et al. 2014). The survey instruments were then compared to prior findings in this procedure to identify any significant problems that may have arose during an alternative sample. Each of the models provided consistent findings and loadings with the prior estimations.

Step 10: Develop Norms for the Scale

The final procedure for this validation process was to create norms and expected behaviors of the survey instrument for future empirical research. Based upon the scale anchors utilized and the item lead-in information a survey instrument and the participant instructions are provided below.

Full Survey Instrument and Instructions

The focal items utilized in this essay are provided below. Each item was measured on a 5-point scale from 1 = "Strongly Disagree" and 5 = "Strongly Agree".

Introduction to IT Integration and IT Differentiation questions:

For the following questions keep in mind all of the technologies that are utilized by individuals in your company for the completion of your organizational tasks.

IT Integration (Author developed)

1. *The technologies within my organization work together seamlessly.*
2. *The technologies used by individuals within my group are integrated well.*

3. *It is easy to share information and tasks from my technology to others within the organization.*
4. *The technologies I use within the organization are integrated with the others in the organization.*
5. *The technologies within the organization all interact with each other easily*

IT Differentiation (Author developed)

1. *There is a large differentiation in technologies between employees.*
2. *The types of technologies I use is different than those of other employees.*
3. *Employees within the organization all tend to use different technologies.*
4. *The technologies used within the organization are very different between individuals.*
5. *Employees tend to select different types of technologies for their tasks.*

Organization Performance (Author developed)

1. *The technologies I use for completion of my tasks increase the organizational performance.*
2. *The tasks completed by individuals within the organization benefit from these technologies.*
3. *These technologies improve the overall performance of the organization.*
4. *These technologies are frequently used to increase the performance of the organization.*
5. *The overall effectiveness of the organization is improved from these technologies.*

Introduction to the following questions:

For the following questions keep in mind the technologies that you specifically utilize for the completion of your organizational tasks.

Rational Decision Making Model (Based on Performance Expectancy (Venkatesh et al. 2012))

1. *I select technologies that are useful in my daily life.*
2. *I select technologies that increase my chances of achieving things that are important to me.*
3. *I select technologies that help me accomplish things more quickly.*
4. *I select technologies that increase my productivity.*

Experience Decision Making Model (Based on Effort Expectancy (Venkatesh et al. 2012))

1. *I select technologies that are easy for me to learn.*
2. *I select technologies that are clear and understandable.*
3. *I select technologies that are easy to use.*
4. *I select technologies that are easy for me to become skillful at using.*

Network Decision Making Model (Based on Social Influence (Venkatesh et al. 2012))

1. *I select technologies that people who are important to me think that I should use.*
2. *I select technologies that people who influence my behavior think that I should use.*
3. *I select technologies that people whose opinions that I value prefer that I use.*

Satisfaction Decision Making Model (Author developed)

1. *I select technologies that I am satisfied with using.*
2. *I select technologies that I am happy using.*
3. *I select technologies that are pleasing to use.*
4. *I select technologies that are gratifying to use.*

Direction (Author developed)

1. *The market has a large number of alternative technologies available for my tasks.*
2. *Many different vendors sell technologies that could be used for my tasks.*

3. *There is a large variety of technologies to potentially use for my tasks.*
4. *A large assortment of technologies are available on the market to complete the tasks.*
5. *The variety of technologies that could be used is large.*

Support (Author developed)

1. *I have many different technology options available to complete my tasks.*
2. *My organization provides me with multiple technologies to choose from for the same tasks.*
3. *There are multiple technologies options that can be used to finish my tasks. (Dropped)*

Control (Author developed; Reverse Coded)

1. *My organization allows me to switch technologies as often as I want. (Dropped)*
2. *My organization lets me change technologies quickly.*
3. *My organization lets me update the technologies that I use for my tasks often.*

Controls

1. *Job Position: Please give us a short description of your current job position. (Qualitative)*
2. *Tenure: How long have you been in your current position (in years)*
3. *Gender: Please indicate your gender:*
4. *Education: What is the highest level of education you have completed?*
5. *Age: What year were you born?*

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Shadish, William R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Wadsworth Cengage learning.

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Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, *36*(1), 157-178.

Chapter 4. Tables and Figures

Figure 4.1. Initial Research Model

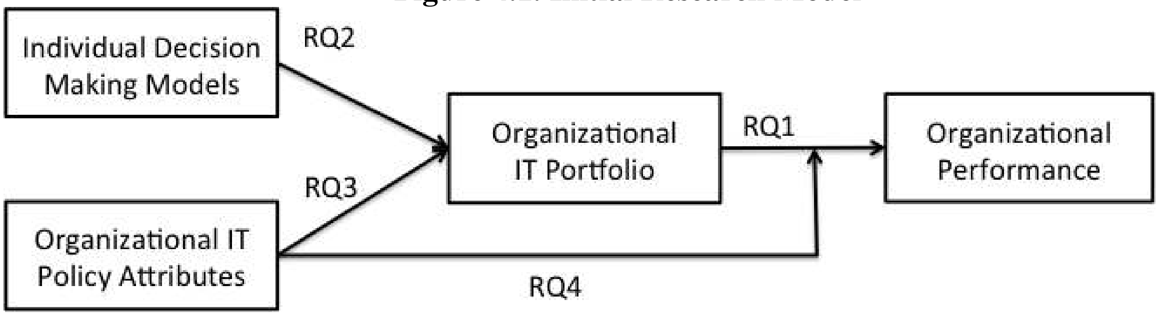


Figure 4.2. Theoretical Research Model

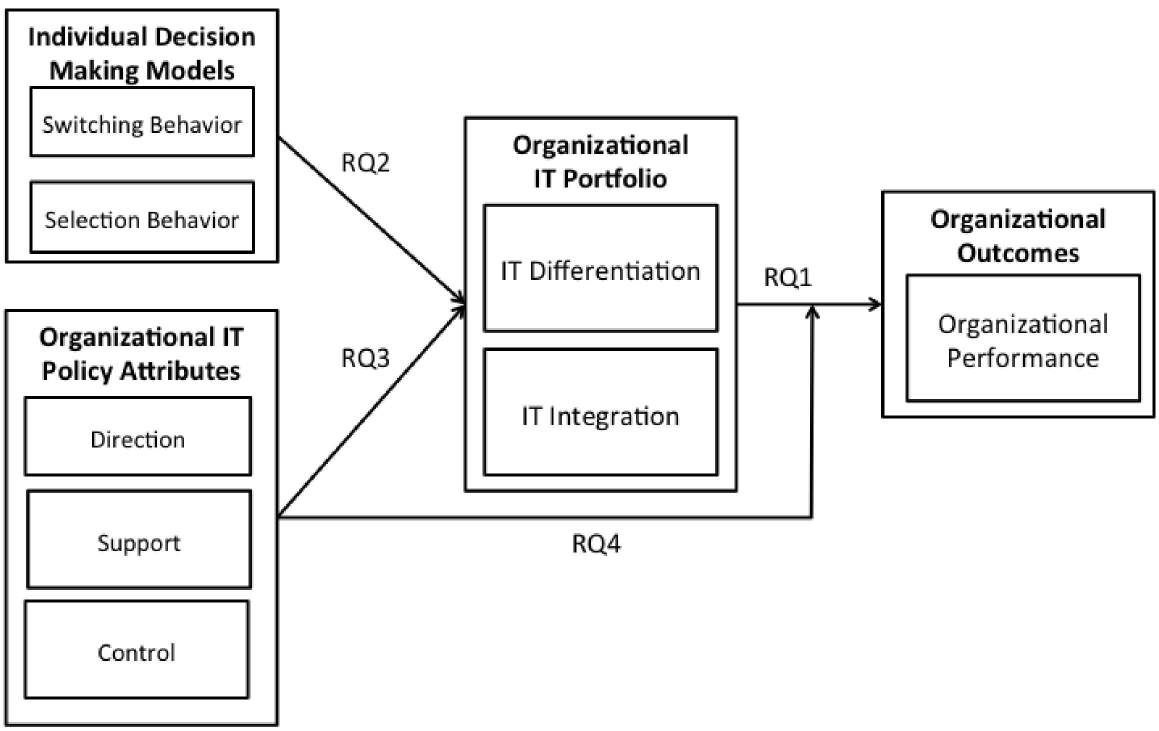


Figure 4.3. IT Differentiation on Organization Performance[a]

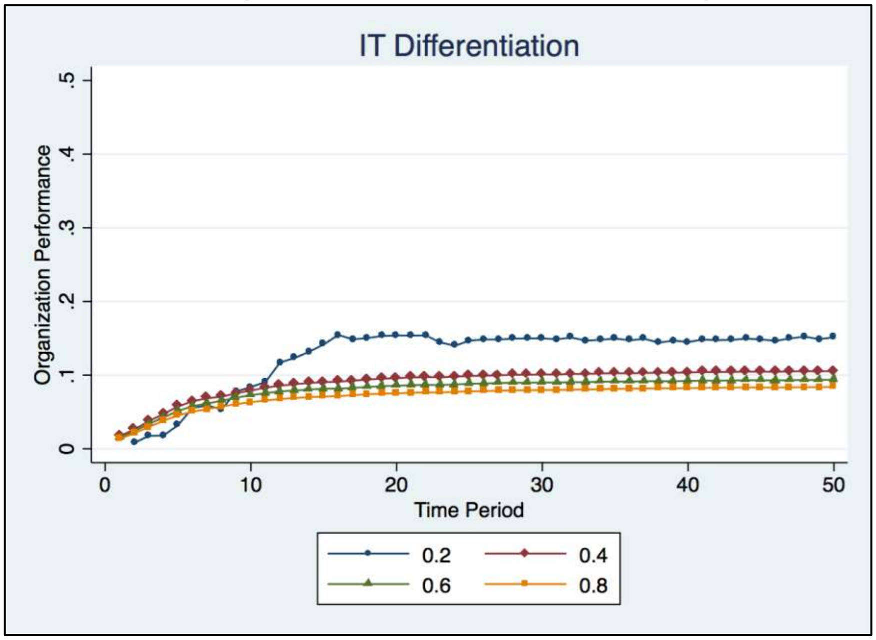
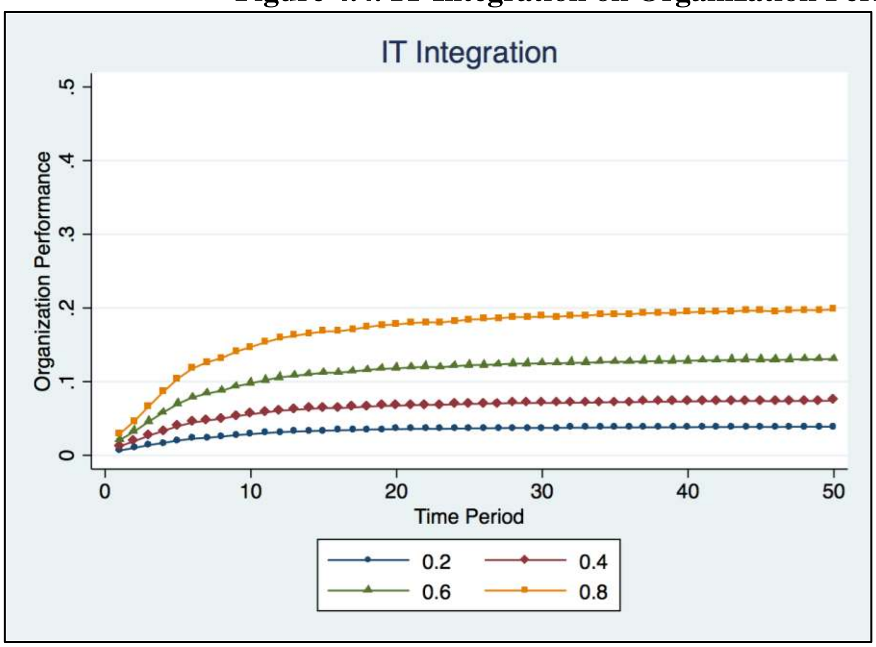


Figure 4.4. IT Integration on Organization Performance[b]



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[a] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT differentiation across 500 time periods.

[b] Each figure graphs very low (0.2), low (0.4), high (0.6), and very high (0.8) levels of IT integration across 500 time periods.

Figure 4.5. IT Integration and IT Differentiation on Organization Performance

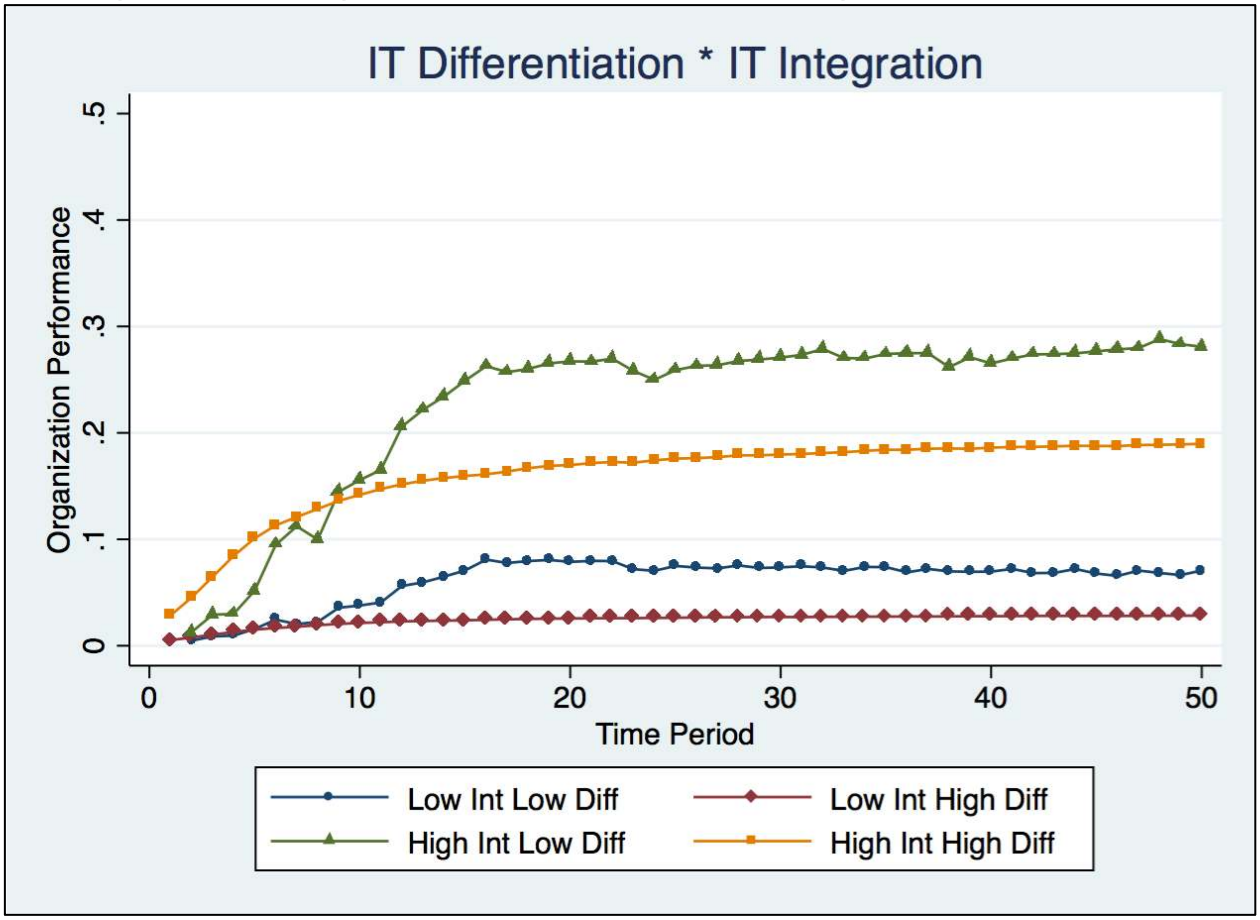
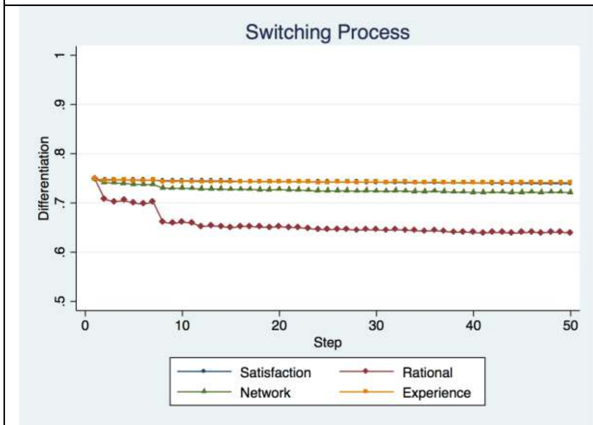


Figure 4.6. Individual Decision Making Models for Switching Technologies

Differentiation



Integration

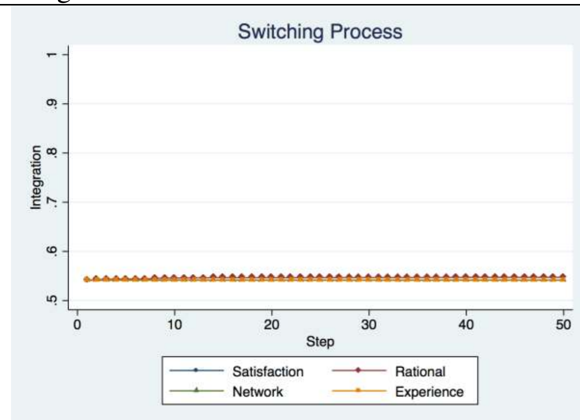
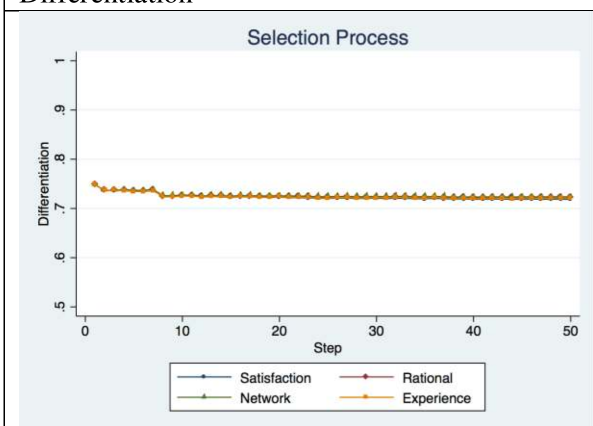


Figure 4.7. Individual Decision Making Models for Selecting Technologies

Differentiation



Integration

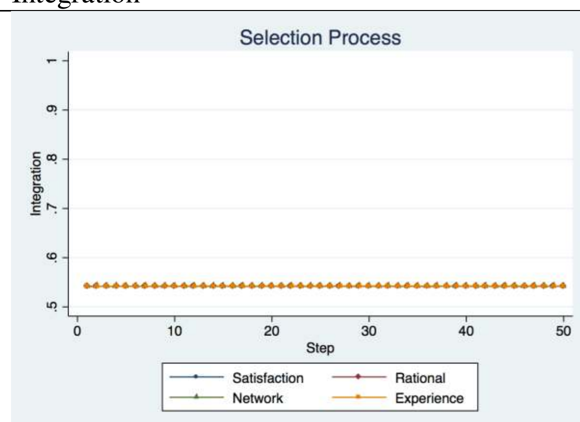
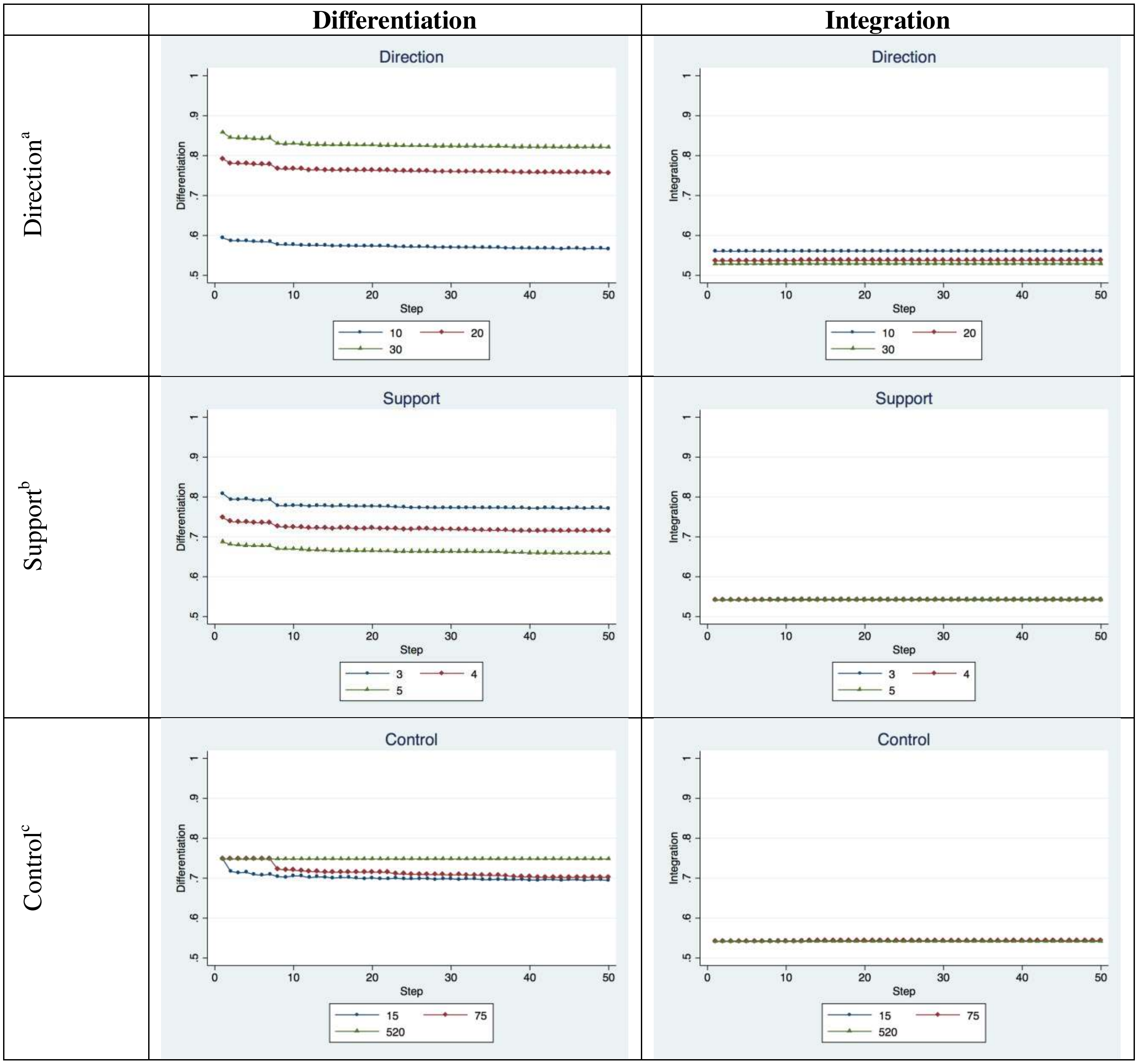


Figure 4.8. Organizational IT Policy Attributes



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[a] Each figure denotes the impact of 10, 20, or 30 technologies in the environment across 500 time periods.

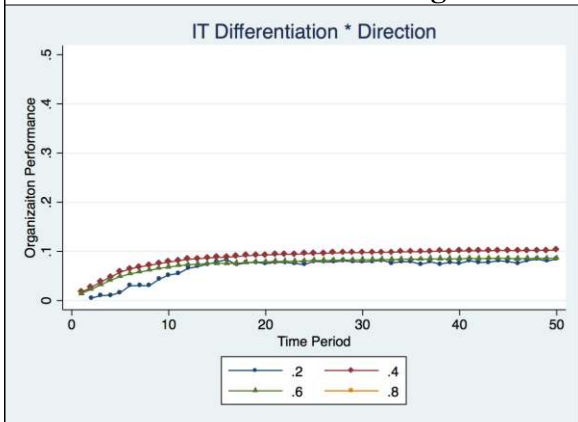
[b] Each figure denotes the impact of 3, 4, or 5 technologies in the individual's IT portfolio across 500 time periods.

[c] Each figure denotes the impact of switching every 15, 75, or 520 time during the 500 time periods.

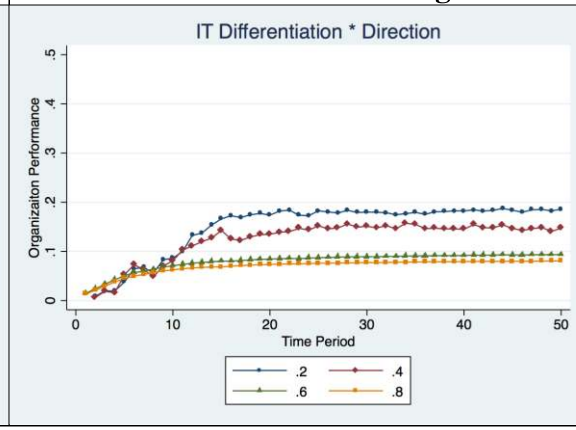
Figure 4.9. Interaction of Direction on the Impact of IT Differentiation and Integration on Organization Performance

Moderation of IT Differentiation on Organization Performance

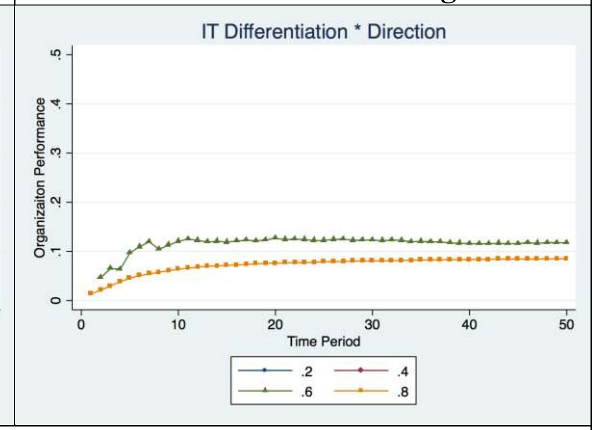
Direction = 10 Technologies



Direction = 20 Technologies

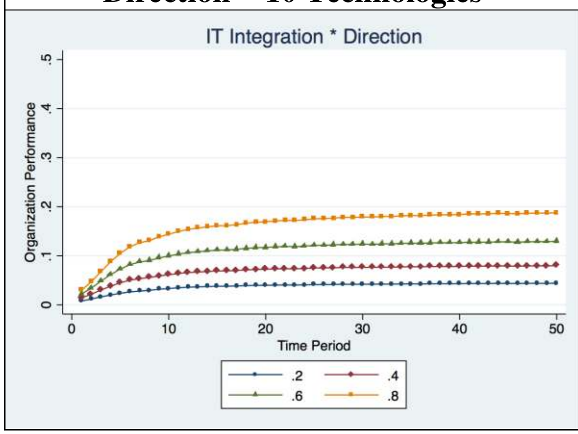


Direction = 30 Technologies

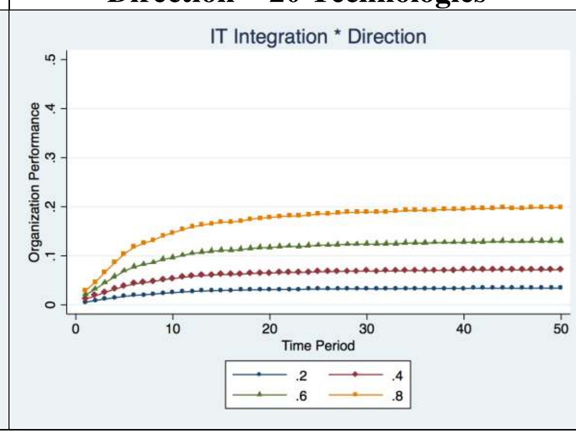


Moderation of IT Integration on Organization Performance

Direction = 10 Technologies



Direction = 20 Technologies



Direction = 30 Technologies

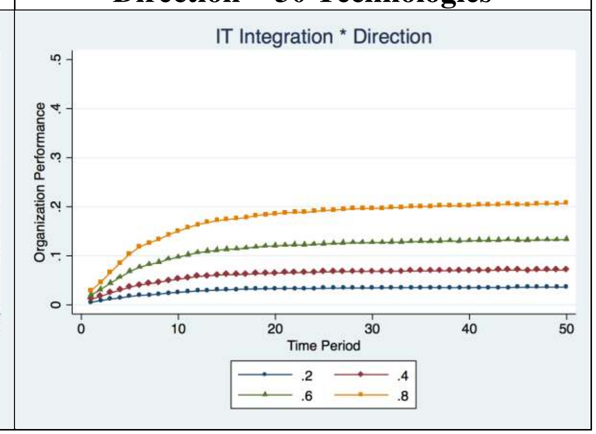
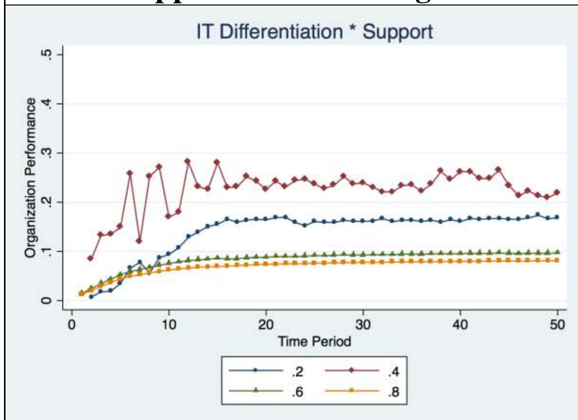


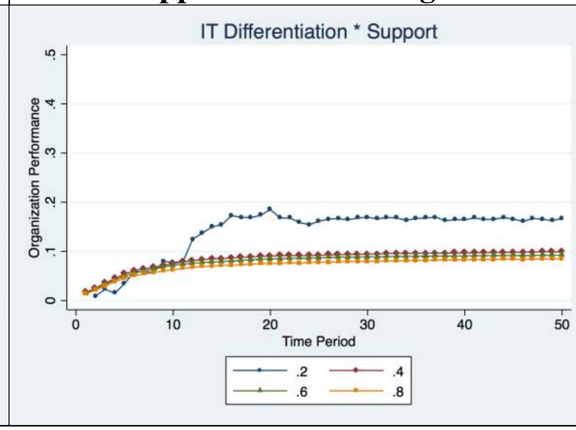
Figure 4.10. Interaction of Support on the Impact of IT Differentiation and Integration on Organization Performance

Moderation of IT Differentiation on Organization Performance

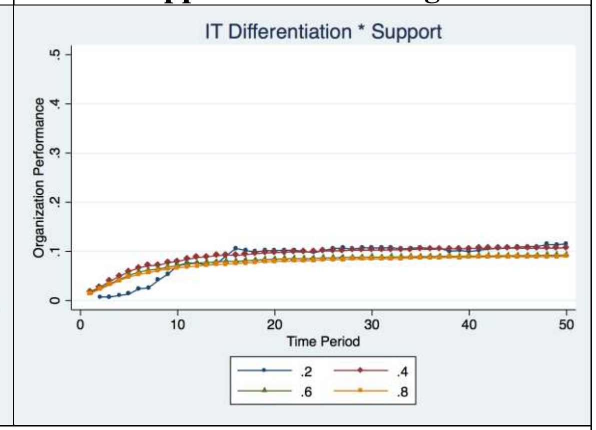
Support = 3 Technologies



Support = 4 Technologies

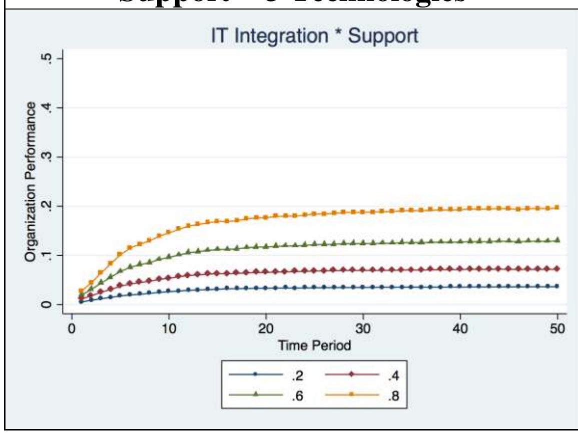


Support = 5 Technologies

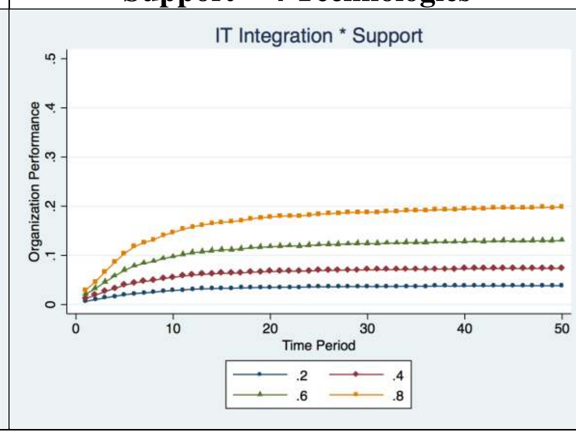


Moderation of IT Integration on Organization Performance

Support = 3 Technologies



Support = 4 Technologies



Support = 5 Technologies

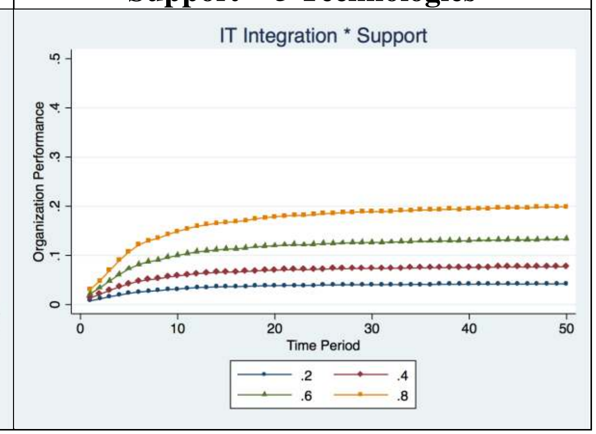
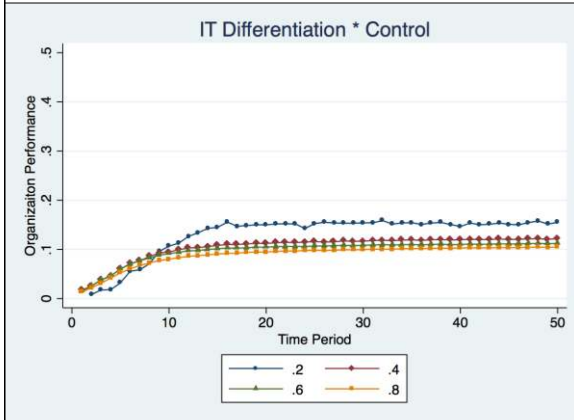


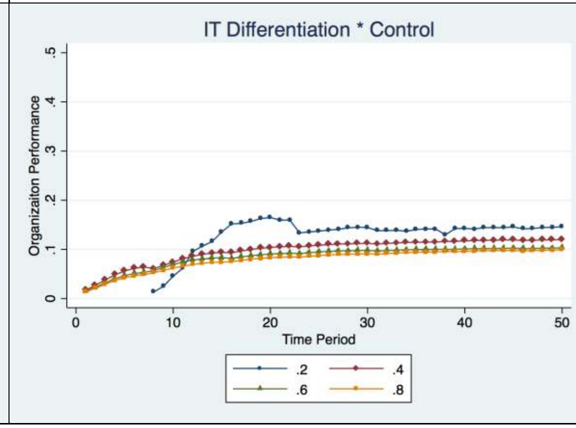
Figure 4.11. Interaction of Control on the Impact of IT Differentiation and Integration on Organization Performance

Moderation of IT Differentiation on Organization Performance

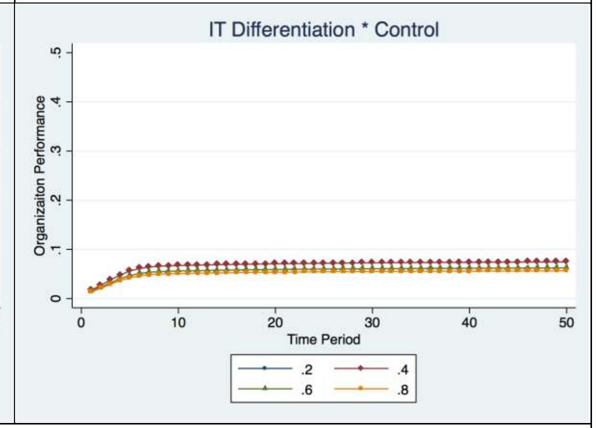
Control = 15 Time Periods



Control = 75 Time Periods

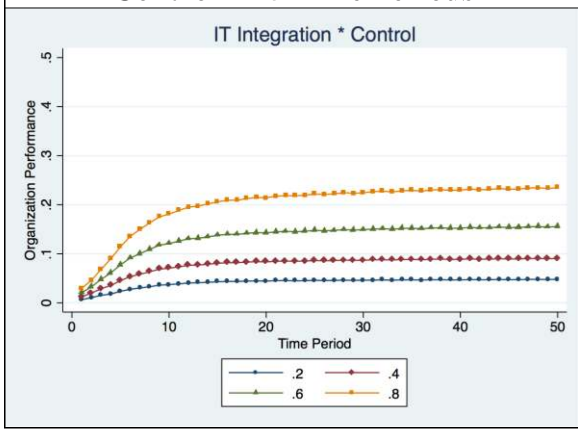


Control = 520 Time Periods

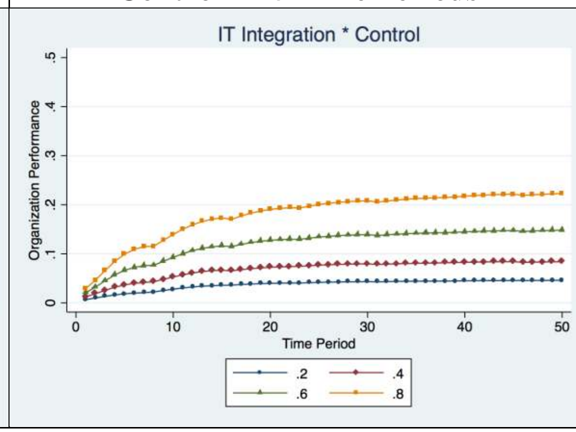


Moderation of IT Integration on Organization Performance

Control = 15 Time Periods



Control = 75 Time Periods



Control = 520 Time Periods

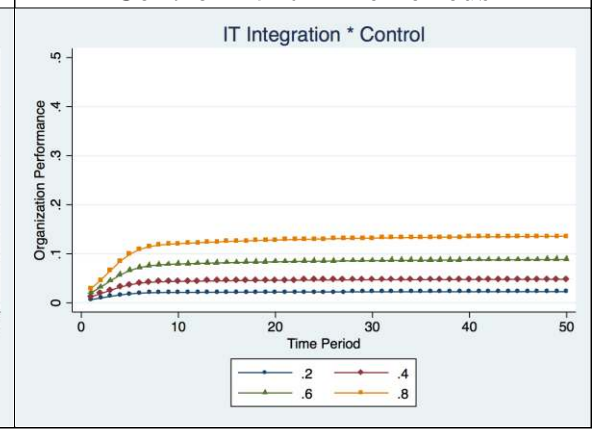


Figure 4.12. Interaction of IT Integration and IT Differentiation on Organization Performance

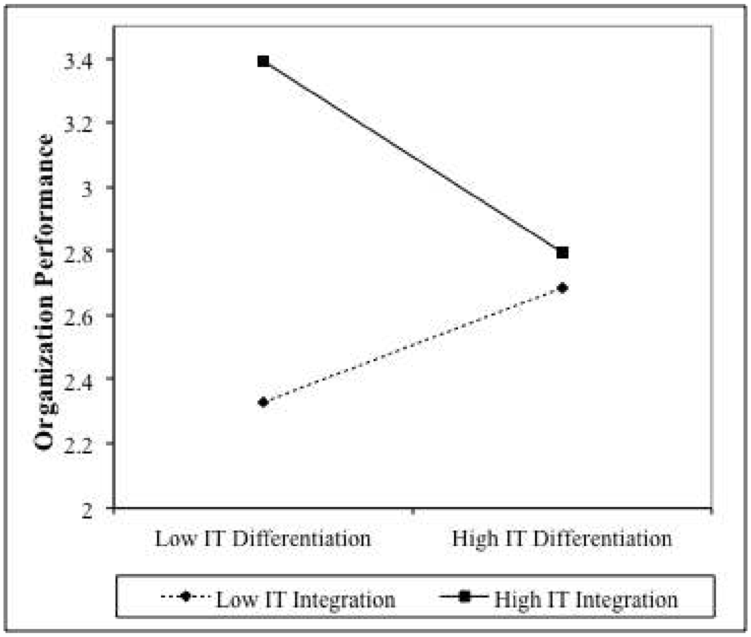


Figure 4.13. Interaction of Support and IT Differentiation on Organization Performance

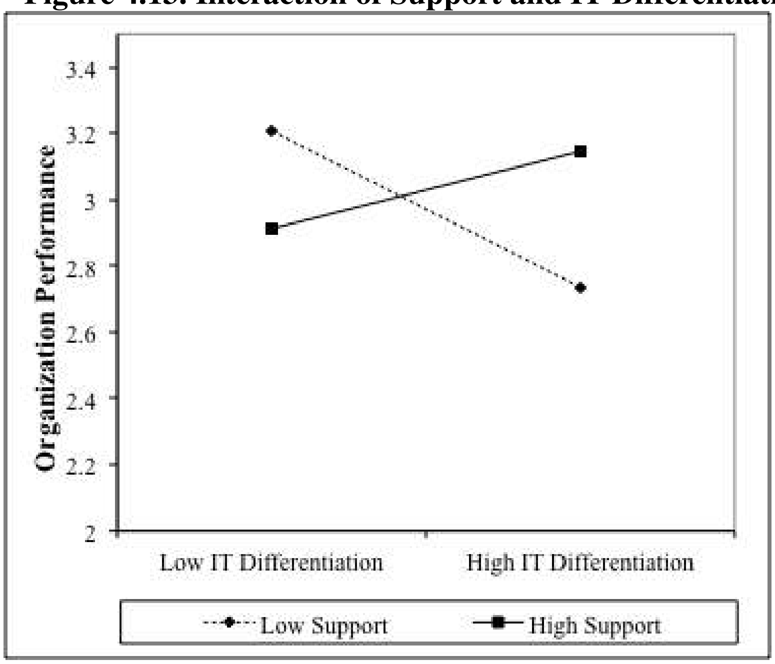


Figure 4.14. Interaction of Support and IT Integration on Organization Performance

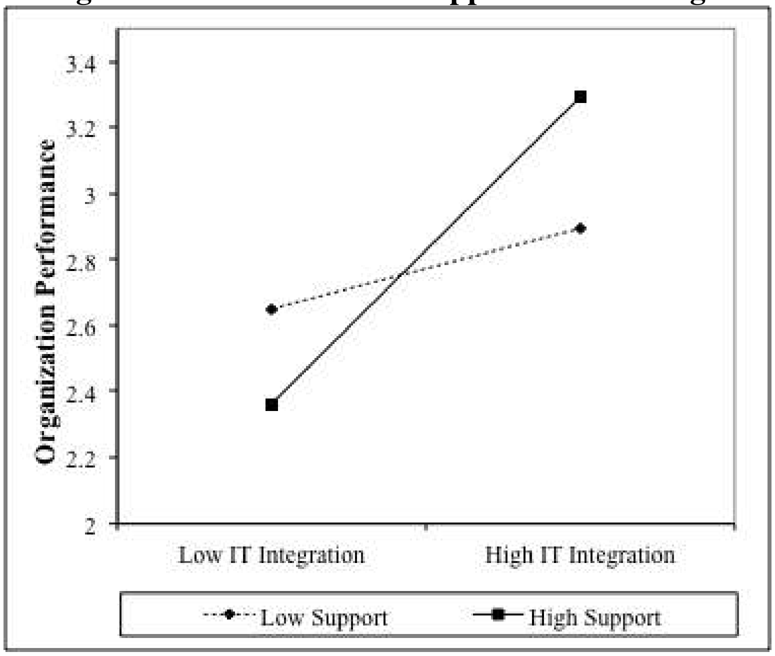


Figure 4.15. IT Differentiation and IT Integration on Organizational Performance under Rational IDM

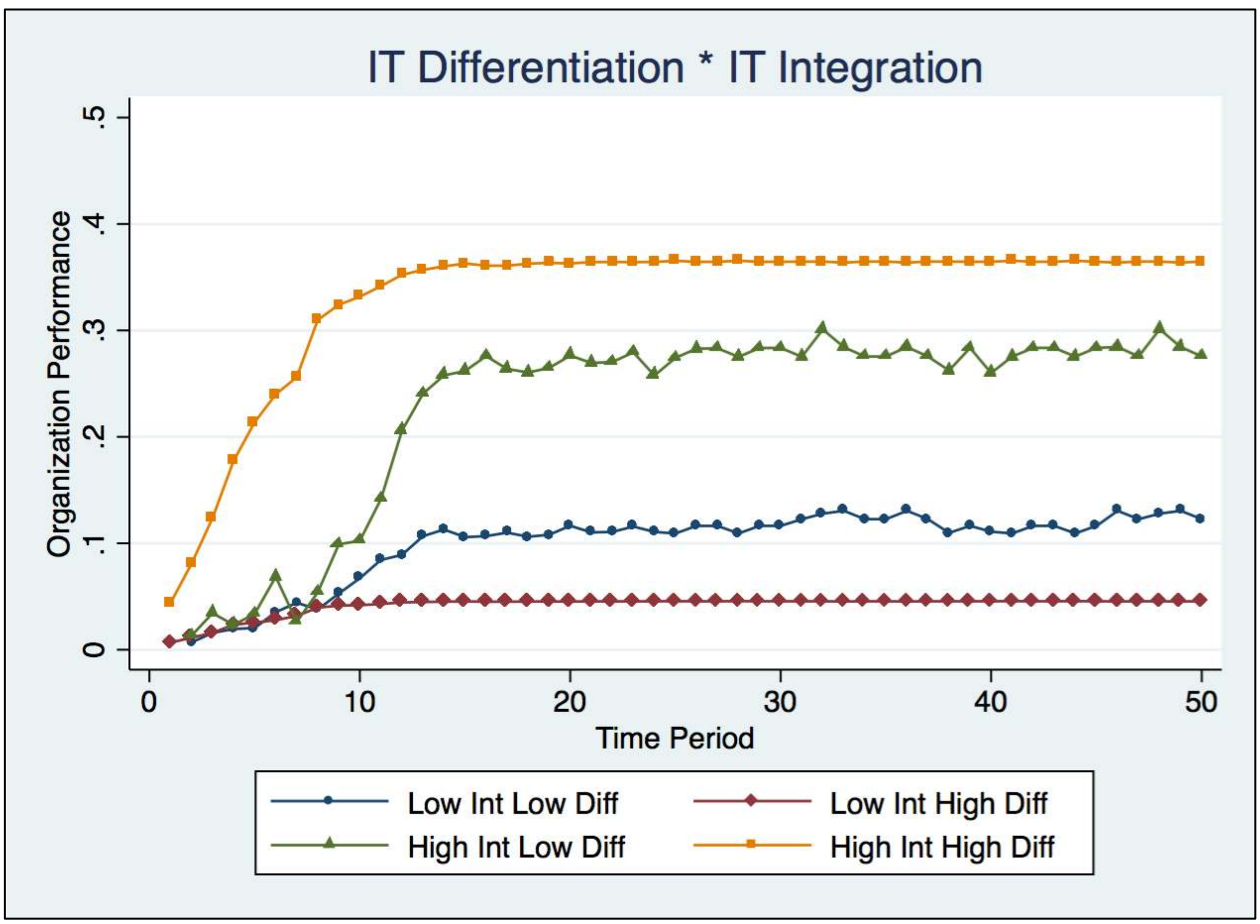


Figure 4.B1. Simulation Environment

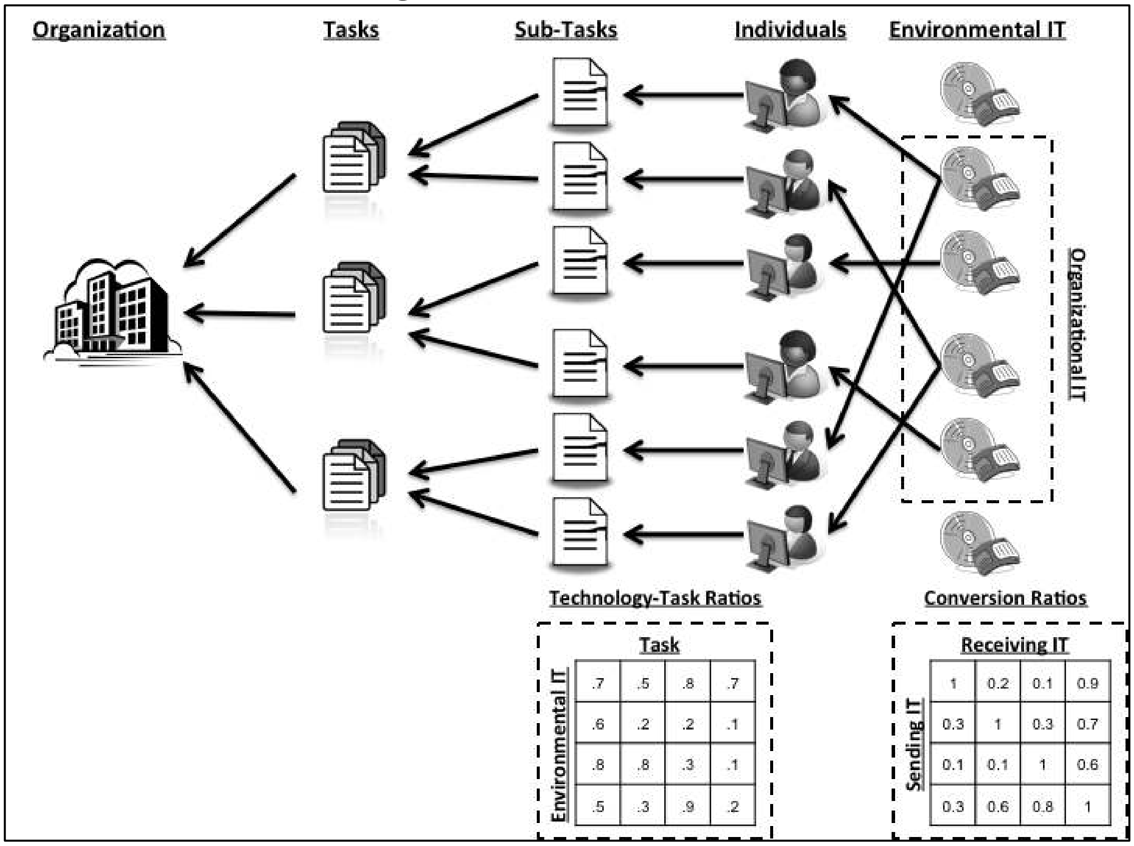
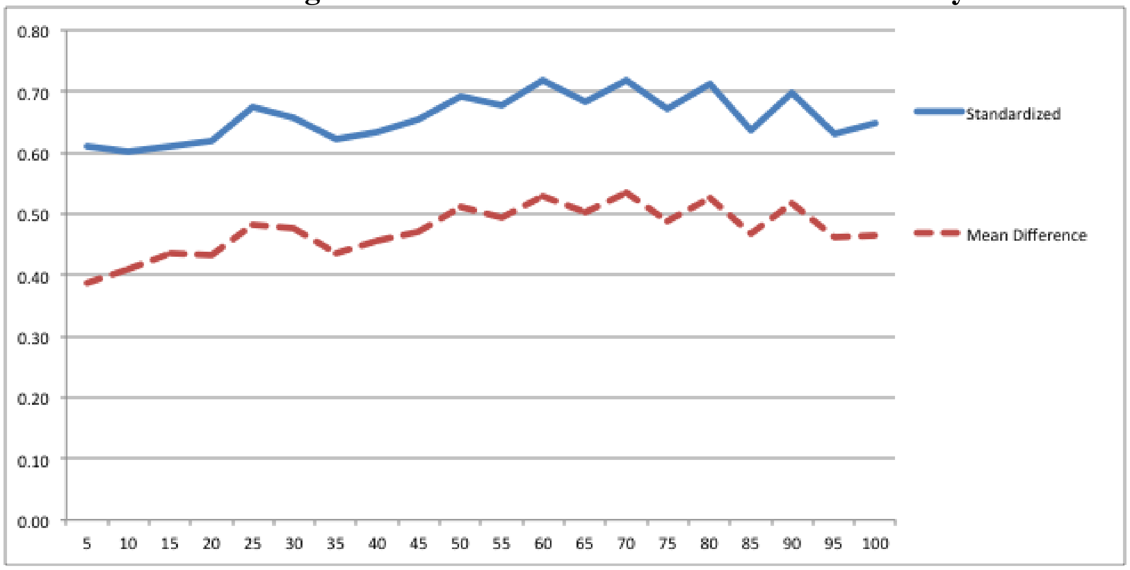


Figure 4.B2. IT Differentiation Measure Similarity[a]



[a] To compare the different IT differentiation measures this graph depicts the similarities between the Euclidean Distances and mean-difference estimations from 5 to 100 actors in the network.

Table 4.1. Individual Decision Making Models

Decision Models	Prior Literature	Study Models	Description	Prior IS Literature	Vignette Examples
Rationality	Decision making efforts will focus on the maximization of benefits with the reduction in costs through a "consistent" pattern of decisions. (Edwards ,1954; Simon 1954, 1959)	Rational	Individuals will attempt to choose the best technology options for their assigned tasks based on the ability for each technology to complete each task.	Task-Technology Fit (Goodhue 1998); Perceived Usefulness (Davis et al. 1989); Performance Expectancy (Venkatesh et al. 2003)	*“I always use the best technology available for completing my tasks.”, “I first assess whether a specific technology provides superior functionality for the task at hand…”, “My thought process usually isn't complicated. It usually begins by what will have the best quality for the specific task.”, “I would choose the best quality available no matter who the client was.”, “I would use what I believe to be the technology that gives the most professional results. Different products have different results, regardless if they provide the same services or not.”*
Bounded Rationality	Due to limited cognitive resources, time, and effort constraints individuals will utilize a bounded rational and simplified decision rules to satisfy the needs of the decision task. (Simon 1972, 1991; Rubenstein 1998); Gigerenzer & Selten 2002)	Experience	Individuals will attempt to choose a technology for their assigned tasks based on their prior experience and knowledge with each technology.	Inertia (Polites and Karahanna 2012); Perceived Ease of Use (Davis et al. 1998); Effort Expectancy (Venkatesh et al. 2003)	*“I would select the technology most similar to technology that I have experience with and those that seem the most easily learned.”, “I would probably narrow the choice down to the ones I have experience with…”, “I would use a mix of technologies I was already comfortable with using…”, “I would start with the technologies I know.”, “I would review the two technologies and determine which I had the most experience with…”, "I would choose the technology that I am most familiar with. In this case, I would choose Word because it is what I have used my whole life.", "I almost never look for new technology!! I don't like change. I seek new technology only when the old programs no longer work on a new computer that I am forced to buy."*

Table 4.1. Individual Decision Making Models (Cont.)

Decision Models	Prior Literature	Study Models	Description	Prior IS Literature	Vignette Examples
Bounded Rationality	Due to limited cognitive resources, time, and effort constraints individuals will utilize a bounded rational and simplified decision rules to satisfy the needs of the decision task. (Simon 1972, 1991; Rubenstein 1998); Gigerenzer & Selten 2002)	Satisfaction	Individuals will attempt to choose a technology for their assigned tasks based upon their level of satisfaction with each technology in prior time periods.	IS Continuance (Bhattacherjee 2001; Bhattacherjee & Premkumar 2004); Technology Addiction (Turel et al. 2011)	*"I would most likely choose 2 out of the few technologies which I am already familiar with, assuming that I am satisfied with their performance.", "I would start by assessing the technologies that I am familiar with-- if I like using these technologies … then I would go with the best of those.", "I would select the technology I liked best…", "…whenever I am presented with a situation like that I just go with whatever is comfortable…", "I think people select technologies based on the ones they are most comfortable using.", "I normally just purchase what I like and learn from there…", "I am a loyal Apple customer. So whenever there is a choice to use an Apple product I choose it."*
		Network	Individuals will attempt to choose a technology for their assigned tasks based upon the number of individuals using each technology in their immediate network.	Subjective Norms (Venkatesh and Davis 2000); Social Factors (Thompson et al. 1991); Social Influence (Venkatesh et al. 2003); Social Network Influence (Fang et al. 2012)	*"I would probably ask the staff what they prefer and go on from there", "Compare features of suitable technologies, pick the most appropriate ones and get feedback from other staff on their preferences.", "I would select the technology that was … the most common in the work environment.", "I would probably ask the staff what they prefer and go on from there."*

Table 4.2. End-user Computing and BYOD Issues and Opportunities

Opportunities	End-user Computing	Bring Your Own Device
Productivity	(Alavi and Weiss 1985; Alavi 1985; Bergeron et al. 1993; Sipior and Sanders 1989)	Ballenstedt, 2012; McGee, 2012; Ackerman, 2013; Unisys 2012; Kaneshige, 2012; Donston-Miller, 2012; Kendrick, 2012;
Work-Life Balance	**NEW ISSUE**	Ballenstedt, 2012; CIO Council, 2012a, 2012b
Cost savings	**NEW ISSUE**	Ballenstedt, 2012; Willis, 2012; Ackerman, 2013; Rains, 2012
Satisfaction	(Bergeron et al. 1993; Cheney et al. 1986; Doll and Torkzadeh 1991; Rivard and Huff 1988)	Rains, 2012; Donston-Miller, 2012
Issues	**End-user Computing**	**Bring Your Own Device**
Data Security	(Alavi and Weiss 1985; Alavi 1985; Cheney et al. 1986; Galletta and Hufnagel 1992; Guimaraes and Ramanujam 1986; Guimaraes et al. 1999; Henderson and Treacy 1986; Raho et al. 1987; Sipior and Sanders 1989)	Ballenstedt, 2012; Unisys 2012; Saran 2012; Thomson, 2012
Legal Ramifications	**NEW ISSUE**	Ballenstedt, 2012; McGee, 2012; Casey, 2012; Kaneshige, 2012
Support	(Alavi and Weiss 1985; Benson 1983; Cheney et al. 1986; Guimaraes and Ramanujam 1986; Guimaraes et al. 1999; Henderson and Treacy 1986; McLean et al. 1993)	Willis, 2012; Unisys 2012; Savitz and Pandey 2012; Kaneshige, 2012; Hamblen, 2012
Increased Budge Costs	(Guimaraes and Ramanujam 1986; Guimaraes et al. 1999; Henderson and Treacy 1986)	Ackerman, 2013
Infrastructure and System Compatibility	(Alavi and Weiss 1985; Alavi 1985; Galletta and Hufnagel 1992; Guimaraes and Ramanujam 1986; Henderson and Treacy 1986; McLean et al. 1993; Raho et al. 1987; Sipior and Sanders 1989)	Ballenstedt, 2012; Saran 2012; Hamblen, 2012
Ineffective or Inappropriate Technologies	(Alavi and Weiss 1985; Galletta and Hufnagel 1992; Guimaraes et al. 1999; McLean et al. 1993; Montazemi et al. 1996)	**UNDEREXPLORED ISSUE**

Table 4.3. End-User Computing Management Strategies

Strategy	**Description as outlined by Alavi et al. (1987, 1988)**
Laissez-faire	This strategy lacks formal organizational procedures to either support or control the growth of end-user computing within the organization. The growth of end-user computing is allowed to evolve in an organic manner driven by the end-users without the intervention of the organization.
Monopolistic	This strategy utilizes firm control on all end-user computing activities to slow the growth of end-user computing within the organization. This is based on the belief that the central IS organization should control all IT based decisions. The growth of end-user computing is kept to a minimum unless approved and verified by the central IS organization.
Acceleration	This strategy utilizes an approach in opposition of the monopolistic strategy by providing significant levels of support to end-users to build a high growth environment for end-user computing practices. End-user computing is allowed to grow in an undirected manner, which encourages innovation and experimentation by providing increased end-user support through facilities such as Information Centers.
Marketing	This strategy utilizes a directed growth strategy by encouraging end-users to adopt specific technologies and practices and providing high levels of support for those directed technologies. A high level of growth is achieved in value-added and supported technologies, which provide a highly directed growth strategy for the organizational IT, portfolios.
Operations-based	This strategy utilizes an approach that focuses on the on-going management of technology within the organization and reducing unnecessary duplications of technology for increased efficiency. Growth is controlled through increased control of end-user computing, highly directed activities, and support for only technologies that are selected and prioritized by the central IS organization based on traditional cost/benefit analyses.

Table 4.4. Organizational IT Policy Attributes

Policy Attributes	Description	IT Management Implications	Simulation Implementation
Direction	The plan and strategy of the organization's views towards technology management such as the policies and procedures, the management of technologies options, and standards for technology adoptions (i.e. the variety of technology options, selection of pre-approved technologies, and goals for the organization).	To control the spread of variety within the organization and provide directives to the employees, organizations can limit the potential technologies available for employees to select for their various tasks.	The number of environmental technologies available for individual adoption is varied across simulations to determine the impact of controlling the environmental options.
Support	The activities referring to the provision of tools, training, and expertise to support the variety of technology within the organization. This support ability provides individuals with increased options within the organization that can be utilized effectively due to the organizational support implementations.	The organization can limit or encourage the ownership of multiple technologies for each individual, which will increase the potential support costs within the organization as the number of individual technologies increase. Allowing individuals to own multiple technologies may imply the organization's encouragement of variety through increased support resources.	The number of technologies and individual can own in their individual IT portfolio is varied across simulations to determine the impact of organizational support resources.
Control	Organizational control of the individual behaviors regarding what portions of the technology can be changed, modified, and adjusted to meet financial constraints and budgeting.	To control the potential costs of individual technology selections within the organization, the organization can limit how often employees are able to switch technologies or upgrade their individual IT portfolios.	The frequency with which individuals can switch technologies in their personal IT portfolio is varied across simulations to determine the impact of organizational control efforts.

Table 4.5. Summary Statistics[a]

	Variable	AVE	Mean	S.D.	# of Items	CR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Age	1.00	23.24	11.69	1	1.00	**1.00**													
2	Education	1.00	4.27	1.31	1	1.00	0.01	**1.00**												
3	Gender	1.00	0.54	0.50	1	1.00	-0.02	0.00	**1.00**											
4	Tenure	1.00	5.08	5.22	1	1.00	0.31*	0.00	-0.01	**1.00**										
5	Control	0.88	2.73	1.17	2	0.94	-0.08	0.02	0.05	-0.09*	**0.94**									
6	Direction	0.80	3.59	0.88	5	0.95	-0.03	-0.02	-0.02	-0.05	0.21*	**0.89**								
7	Support	0.90	2.95	1.08	2	0.95	-0.07	0.00	0.04	-0.07	0.61*	0.33*	**0.95**							
8	Rational IDM	0.81	3.99	0.78	4	0.94	-0.04	0.00	0.06	-0.03	0.3*	0.21*	0.34*	**0.90**						
9	Experience IDM	0.82	3.80	0.81	4	0.95	-0.04	0.10*	0.10*	-0.02	0.23*	0.12*	0.26*	0.61*	**0.91**					
10	Network IDM	0.86	3.10	1.02	3	0.95	-0.06	0.00	-0.01	-0.07	0.16*	0.08	0.19*	0.13*	0.24*	**0.93**				
11	Satisfaction IDM	0.62	3.94	0.82	4	0.83	0.01	0.00	0.00	-0.01	0.03	0.05	0.03	0.06	0.04	-0.04	**0.78**			
12	IT Integration	0.69	3.51	0.80	5	0.92	0.02	0.08	0.11*	-0.05	0.17*	0.12*	0.15*	0.22*	0.21*	0.09	0.05	**0.83**		
13	IT Differentiation	0.77	2.75	1.00	5	0.94	-0.09*	0.03	-0.06	-0.06	0.38*	0.10*	0.47*	0.08	0.09*	0.17*	-0.01	-0.22*	**0.88**	
14	Organizational Performance	0.79	4.12	0.68	5	0.95	0.04	-0.06	0.01	-0.01	0.03	0.18*	0.07	0.33*	0.22*	-0.01	0.05	0.30*	-0.12*	**0.89**

[a] N = 497; CR = Composite Reliability; AVE = average variance extracted; S.D. = standard deviation; Square-root of the AVE is on the diagonal; * $p < 0.05$

Table 4.6. PLS Model Results[a]

Variables	(1) IT Differentiation	(2) IT Integration	(3) Organization Performance
	Dependent Variables		
Age	-0.053	0.031	0.056
Education	0.029	0.086*	-0.101**
Gender	-0.075*	0.061	0.014
Tenure	-0.005	-0.050	-0.019
Support	0.420***	0.161**	0.027
Control	-0.152**	-0.145**	0.010
Direction	-0.064	0.043	0.126**
Experience IDM	0.005	0.076	
Network IDM	0.075*	0.063	
Rational IDM	-0.102*	0.088	
Satisfaction IDM	-0.015	0.031	
IT Differentiation		-0.379***	-0.060
IT Integration			0.293***
IT Differentiation * IT Integration			-0.239***
IT Differentiation * Support			0.177***
IT Differentiation * Control			-0.066
IT Differentiation * Direction			-0.002
IT Integration * Support			0.171**
IT Integration * Control			0.012
IT Integration * Direction			-0.008
R^2	0.266	0.196	0.180

[a] N = 497; * p<0.05; ** p<0.01; *** p<0.001

Table 4.7. Agent-based Simulation and PLS Study Comparison

Relationship	Simulation Results	Survey Results	Consistency Between Methods
IT Differentiation -> Organization Performance	Negative	Non-significant	Non-Consistent
IT Integration -> Organization Performance	Positive	Positive	Consistent Significant
IT Differentiation * IT Integration -> Organization Performance	Negative	Negative	Consistent Significant
Rational -> IT Differentiation	Negative	Negative	Consistent Significant
Experience -> IT Differentiation	Non-significant	Non-significant	Consistent Non-Significant
Satisfaction -> IT Differentiation	Non-significant	Non-significant	Consistent Non-Significant
Network -> IT Differentiation	Negative	Positive	Non-Consistent
Rational -> IT Integration	Non-significant	Non-significant	Consistent Non-Significant
Experience -> IT Integration	Non-significant	Non-significant	Consistent Non-Significant
Satisfaction -> IT Integration	Non-significant	Non-significant	Consistent Non-Significant
Network -> IT Integration	Non-significant	Non-significant	Consistent Non-Significant
Support -> IT Differentiation	Negative	Positive	Non-Consistent
Control -> IT Differentiation	Negative	Negative	Consistent Significant
Direction -> IT Differentiation	Positive	Non-significant	Non-Consistent
Support -> IT Integration	Non-significant	Positive	Non-Consistent
Control -> IT Integration	Non-significant	Negative	Non-Consistent
Direction -> IT Integration	Negative	Non-significant	Non-Consistent
IT Differentiation * Support -> Organization Performance	Negative	Positive	Non-Consistent
IT Differentiation * Control -> Organization Performance	Negative	Non-significant	Non-Consistent
IT Differentiation * Direction -> Organization Performance	Positive	Non-significant	Non-Consistent
IT Integration * Support -> Organization Performance	Non-significant	Positive	Non-Consistent
IT Integration * Control -> Organization Performance	Negative	Non-significant	Non-Consistent
IT Integration * Direction -> Organization Performance	Non-significant	Non-significant	Consistent Non-Significant

Table 4.A1. Vignette Scenario Text Design

Influence	Condition	Sentence	Word Count
Introduction		You have just started a new position at an organization and need to select the set of technologies that you would like to use for your tasks.	27
Number of Technologies Available	Two	Your organization will let you select from 2 different technologies.	10
	Five	Your organization will let you select from 5 different technologies.	10
	Many	Your organization will let you select any technology you like.	10
Level of Experience	No Experience	You do not have any prior experience with the technologies available for selection.	13
	Some Experience	You have some experience with only a few of the technologies available for selection.	14
Interdependence with Co-workers	W/ Coworkers	In this position you typically have to work closely with other individuals in your department for your everyday tasks.	19
	W/O Coworkers	In this position you typically have to work independently of other individuals in your department for your everyday tasks.	19
Technology Similarities	Similar	The technologies are all very similar and any technology can be used to complete all the required tasks for your position.	21
	Not Similar	The technologies are all very different but any technology can be used to complete all the required tasks for your position.	21
Description Prompt		How would you go about selecting a technology?	8

Table 4.B1. Simulation Parameter Settings

Parameter	Description	Values used in final model	Values used for sensitivity
Individual Decision Making Models	The heuristics utilized to determine which technology to select for use on a task and switch to after failed attempts.	Rational, Satisfaction, Experience, Network	-
Direction	The number of potential technologies to select from within the environment.	10, 20	5, 15, 30
Support	The number of technologies an individual owns within their Personal IT portfolios.	3, 4, 5	1, 2
Control	The threshold at which an individual decides to switch from one technology to an alternative based on failed attempts.	15, 75, 520	30, 50, 500
Successful Task Completion Threshold	The threshold at which an individual considers their task completed successfully.	0.75	0.5, 0.90
Number of Actors	The number of individuals within the organization.	100	50
Task Interdependency	The number of individuals who must work together to complete and combine sub-tasks.	1, 3, 6	10, 15
Task Variety	The number of task types for individual assignment within the organization.	1, 5, 10	20, 30
Task Complexity	The number of skills and technologies that each sub-task requires for completion by an individual.	1, 2, 3	4, 5
Average Technology-Technology Ratio	The average level of technology-to-technology conversion ratio that exists for each technology within the environment.	0.1, 0.25, 0.5, 0.75, 1	-
Average Task Knowledge	The average level of task knowledge an individual holds for all potential environmental tasks.	0.75	0.5, 0.90
Average Technology Knowledge	The average level of technology knowledge an individual holds for all environmental technologies.	0.75	0.5, 0.90
Average Task-Technology Ratio	The average level of ability for each technology to complete each task successfully.	0.75	0.5, 0.90

Table 4.C1. Construct Definitions Rating Task Example

Items	**IT Differentiation** - is defined as the organization's level of IT variety between the individuals' IT Portfolios.	**IT Integration** - is defined as the level of coordination of effort among the individuals' IT Portfolios within an organization's IT Portfolio.
Item 1	1 – "Very Low" to 5 – "Very High"	1 – "Very Low" to 5 – "Very High"
Item 2	1 – "Very Low" to 5 – "Very High"	1 – "Very Low" to 5 – "Very High"
Item 3	1 – "Very Low" to 5 – "Very High"	1 – "Very Low" to 5 – "Very High"

Chapter 5. Contributions

This dissertation contributes to the IS literature through three essays by examining: the impact of organizational IT portfolio configurations on organizational and individual performance; the management of IT portfolios within the organization; the selection, adoption, and switching of technologies at the individual level; and especially to the phenomenon of Bring-Your-Own-Device (BYOD) initiatives which has seen scarce examination or discussion in the academic literature despite the expansive growth in practice.

Insights into the Outcomes of BYOD Initiatives

While BYOD initiatives have been a popular topic with practitioners, it has seen little to no academic research recently. This dissertation has explored this phenomenon through three essays utilizing a variety of research methods to provide a broad and in-depth view of the topic. The use of qualitative case studies helped identify new and emergent issues related to BYOD initiatives and their impacts on both employees and the organization. Throughout this data collection, a series of important insights were obtained into the benefits, issues, and opportunities that arise from the implementation of BYOD initiatives.

The emergent insights derived from the qualitative case studies used in this dissertation indicated that organizations may be in one of four stages of BYOD adoption. These stages – called “enable,” “optimize,” “encourage,” and “innovate” – are shown in Figure 5.1, and then discussed in terms of the focus in each stage, the changes made relative to the previous stage, and the associated outcomes.

[See Figure 5.1]

Stage 1 (Enable) begins with each organization focused on the employee demand for freedom and flexibility in their IT choices. To enable corporate networks to handle personal and external devices, each organization focused on implementing a combination of formal policies and procedures in addition to the required networking technologies (e.g., mobile device management; MDM) to support and control network access. This initial stage enabled organizations to manage the potential security issues of BYOD, however only a limited number of employees (e.g., executives) typically adopt in this stage due to a lack of adequate incentives.

> "We are going to put this solution [MDM] in place anyway because we want to protect our government-issued devices. It's just a side benefit to other people that will be able to BYOD." – GOV

Stage 2 (Optimize) involved optimizing the organizational IT services by scaling the BYOD rollout through increased adoption incentives for their employees. The initial benefit for employees, and especially for those who were not previously provided a corporate device, was the increased connectivity to the corporate network through their mobile devices. The connectivity of employees increased for each organization at this stage, but the cost savings varied greatly as well. RET and TEC both required employees to purchase their own devices, reducing some costs for each company. TEC offered to cover their employees' entire mobile service expenses, whereas RET managed a very large number of employees and would probably not see a cost reduction using the same policy. RET instead utilized a joint effort with their mobile service providers to utilize their large scale of new service lines to negotiate significant cost savings that went directly to the employees.

> "They [the employees] are winning with saving money. We are not having to support as many devices and we're saving money …" –RET
> "Because, before you had the capability of bringing your personal plan and expensing that and having that paid. Listen, I don't have to have a corporate paid plan, I just can't expense it now. Or, I can have a corporate paid plan." –TEC

Stage 3 (Encourage) transitioned into the advanced stages of BYOD evolution where significant productivity and innovation outcomes begin to emerge. TEC has focused their efforts to develop mobile applications and collaboration tools for their BYOD devices to change the way that employees work. Employees noted alterations to their work patterns and use of their downtime at home and work more efficiently to eliminate many administrative tasks. The organizational benefits provided by these efforts included increased productivity and satisfaction across the workforce due to more efficient use of work hours and processes.

> "[The] store has corporate approved but personally acquired applications…this list has grown this year. It will continue to grow as apps are a driving force behind it. " –RET
> "We go beyond just the simple email, calendaring, contact list management…using it for HR related activities as I'm a people manager…I can go into my personal profile and request days off or submit my time card or submit my expense reports." –TEC

Stage 4 (Innovate) focused on providing employees the ability to innovate and adjust their tasks to work more efficiently and effectively. TEC has an open policy of allowing their employees to adopt new technologies, applications and hardware, which enable more efficient work for their individual tasks. While this initially increased the variety of technologies that are operating inside the organization, this freedom is needed to drive increased innovation within the organization. The key to managing the organizational IT portfolio in this stage is to monitor and track the technologies adopted to identify beneficial ITs in the organization that should be supported and shared throughout the rest of the organization to enable process innovation in a controlled manner.

> "Our assumption is that if you just have to break the policy, you are not being malicious. You are just trying to get your job done and it sounds crazy because it kind of is." – TEC

Utilizing in-depth case studies from three organizations, this initial research on BYOD initiatives has found support for the benefits of freedom for employees to select and use their own technologies for their individual tasks. However, the key to optimal success within the organization involves the active management of the integration of these varied technologies through specific IT selections and policy implications. To further explore these insights through an academic investigation, this dissertation utilized three essays to explore these outcomes at different levels (i.e. individual and organizational), environmental conditions (i.e. task environment), IT policy formats (i.e. IT policy attributes), and individual employee reactions (i.e. individual decision-making models).

Insights from the Essays

Essay 1 has provided the initial development of the theory of the differentiation and integration of information technologies (T-DINIT) through a mixed-method analysis of qualitative interviews and survey questionnaires. This essay has used three in-depth organizational case studies in Study 1 to explore the impact of varying levels of IT differentiation and IT Integration on employees within the organization. The theoretical research model and proposed relationships were then tested in Study 2 utilizing individual survey questionnaires of 497 individuals across multiple organizations to validate and refine the theoretical model.

Through the exploration of an emergent organizational IT management phenomenon, BYOD initiatives, this theory provided insights into how the development of IT flexibility within the organization's IT portfolio impact employee performance, satisfaction, and work-life conflicts. Additionally, the impact of IT integration within the organization was examined to determine how organizations can encourage and develop the beneficial outcomes and reduce the potential negative impacts related to BYOD policies in the organization.

Further, this initial investigation into T-DINIT provides early empirical evidence of the benefits and consequences that can occur within the organization that initiates BYOD policies. First, employees have the potential to see significant increased performance implications by utilizing technologies they are more experienced, satisfied, and comfortable using. This freedom in their job role has additional implications by increasing the perceived job satisfaction due to the increased choices and control provided to the employees.

However, providing employees the potential to utilize their personal devices for work tasks leads to increased issues regarding work-life conflicts. Employees have the ability to both reduce work-controlled off-hours time by reducing the mundane tasks (e.g. check emails, monitoring processes) as well as increase off-hours time by increasing the number and variety of tasks they can access away from their office. The burden of work-life conflicts becomes a much more salient issue that employers need to monitor and attempt to manage through training and support programs if possible to reduce a potential issue of reduced job satisfaction and burnout due to work overload.

While Essay 1 provided a foundational development of T-DINIT, it only examined the relationships between organizational IT portfolios and employee outcomes for individuals at a single point in time. Through the use of one detailed case study, computational modeling, and agent-based simulations, Essay 2 provided details into how the employee adoption and switching of technologies over time influence the long-term configuration of the organization's IT portfolios under different environmental and task conditions.

This essay provided additional insights into how the configuration of the organization's IT portfolio can increase both organizational and individual performance. By examining the ability for the organization's IT portfolio to increase performance and address the demands due to varying organizational task portfolios, specifically in terms of three characteristics (task variety, complexity, and interdependency), this essay provided insights into the optimal organizational IT portfolio configurations for differing task portfolios.

The results of this essay provided important directives for practitioners within organizations that are looking to manage the IT portfolio more efficiently and effectively. While the popular press indicates that providing employees the freedom to choice their own technologies will lead to increased performance and satisfaction for their employees and the organization as a whole, these insights provide clear caveats to these claims. First, it is important to remember that organizations range significantly in their organizational task portfolios both between other organizations and across departments within the organization. While one department may have a significant level of variety in the tasks they complete on a day-to-day basis (e.g. R&D departments), others may have a very stable task portfolio that does not require multiple technology options (e.g. customer support). Therefore, a BYOD policy needs to be tailored not only to the organization and its environment but the specific task portfolios of the departments as well.

Additionally, this research provided a unique examination of varying IT portfolio configurations and their impacts on organizational performance. Prior literature has primarily used IT budgets to examine the impact of IT on the organization and noted this as a potential reason for inconsistent findings (Aral and Weill 2007; Banker et al. 2006; Mithas et al. 2012). By utilizing a ***configuration*** perspective of IT investments in the organization, deeper insights are obtained into why some organizations have failed to realize the claimed benefits of large IT implementations such as enterprise systems.

In Essay 3, the unique decision-making scenario created by the adoption of BYOD policies within the organization was explored through a further examination of T-DINIT. The antecedents of the organization's IT portfolio configuration were explored by examining the impacts that both individuals and organizations may have on the IT portfolio. Building on the literature on individual decision making (IDM; Simon 1959; Edwards 1954) and prior IS literature on organizational IT policies (Alavi et al. 1987; Rockart and Flannery 1983), the influence that these individual and organizational behaviors have on the IT portfolio have been explored.

A mixed-method approach was utilized consisting of qualitative online interview vignettes to develop the theoretical insights, agent-based simulations to explore the model over time, and a survey questionnaire to explore the research model through real-world individual beliefs. The results indicated various IDM models influence the level of IT differentiation in the organization as employees configure their IT portfolio with technologies they perceive to be either the “best,” most experienced with, satisfactory, or recommended across the organization. Alternatively, the IDMs have little influence on the level of IT integration within the organization’s IT portfolio, as individuals focus primarily on their own needs and not those of the entire organization.

These insights provide critical directives and caution to organizations who are deciding on the implementation of a BYOD policy. First, if the organization believes that their employee may lack the knowledge needed to select the “best” technology for their specific task needs then the implementation of a BYOD policy may cause more problems than it solves. With the increased variation in individual preferences, the potential for inappropriate and ineffective technologies to be utilized by the employees is amplified. However, for those organizations that are comprised of highly IT knowledgeable employees, the utilization of a BYOD policy has the potential to increase performance in those departments and tasks that may be currently hindered by organizationally selected technologies. This brings to light the increased complexity in implementing a BYOD policy, which has seen conflicting results across different organizations as of late.

Further, the configuration of the organization’s IT policy can both encourage and constrain the development and benefits of the organization’s IT portfolio. The configuration of the organization's IT policy influences both the potential variety of the organization's IT portfolio as well as the beneficial impact of both IT differentiation and IT integration on organizational performance. For those organizations that do decide to implement a BYOD policy, a strong development and examination of what constraints are placed on the employees for their IT selections is needed. An "anything goes" attitude towards BYOD policies has the potential to cause more problems as individuals are now making more decisions within the organization that have significant impacts on the rest of the organization if they lack the knowledge needed to determine the best technologies.

In summary, this dissertation has provided insights into the management of the organization's IT portfolio through the conceptualization and development of IT differentiation and IT integration. Based on these three essays, direction and suggestions on the management, development, and optimization of organizational IT portfolio configurations have been offered for future research and practice. While the dissertation has been based in the context of the BYOD phenomenon, its contributions, including the T-DINIT theory, potentially extend to the broader arena of IT management at the individual, team, and organizational levels.

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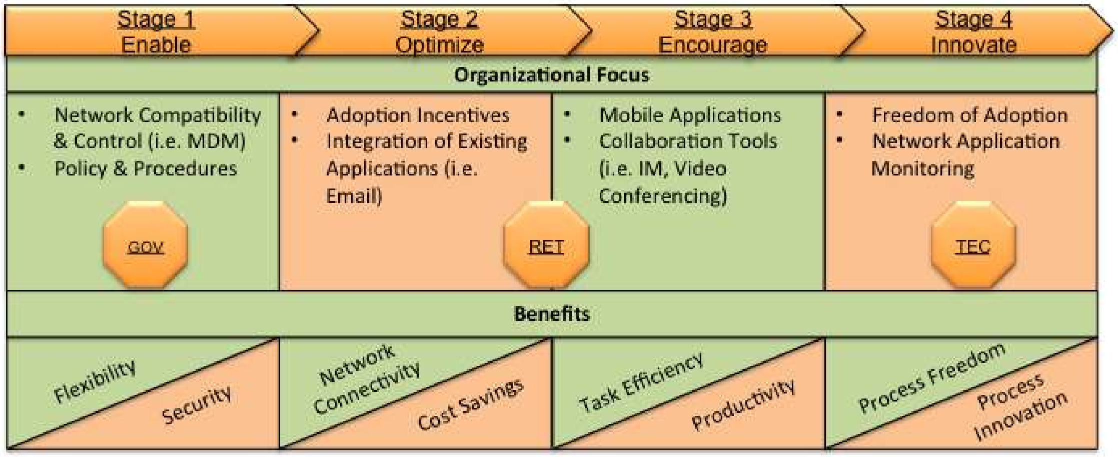
Chapter 5. Figures

Figure 5.1. Organizational Case Study BYOD Implementation Stages



Note: GOV = Government Agency; RET = Global Retailer; TEC = IT Vendor

Appendix: Research Compliance Protocol Letter

July 10, 2014

MEMORANDUM

TO:	Zach Steelman Rajiv Sabherwal
FROM:	Ro Windwalker IRB Coordinator
RE:	PROJECT MODIFICATION
IRB Protocol #:	14-02-468
Protocol Title:	*The Differentiation and Integration of Information Technologies: Three Empirical Studies on "Bring Your Own Devices" - Survey Questionnaire Study*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 07/10/2014 Expiration Date: 02/16/2015

Your request to modify the referenced protocol has been approved by the IRB. **This protocol is currently approved for 1,700 total participants.** If you wish to make any further modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

Please note that this approval does not extend the Approved Project Period. Should you wish to extend your project beyond the current expiration date, you must submit a request for continuation using the UAF IRB form "Continuing Review for IRB Approved Projects." The request should be sent to the IRB Coordinator, 210 Administration.

For protocols requiring FULL IRB review, please submit your request at least one month prior to the current expiration date. (High-risk protocols may require even more time for approval.) For protocols requiring an EXPEDITED or EXEMPT review, submit your request at least two weeks prior to the current expiration date. Failure to obtain approval for a continuation *on or prior to* the currently approved expiration date will result in termination of the protocol and you will be required to submit a new protocol to the IRB before continuing the project. Data collected past the protocol expiration date may need to be eliminated from the dataset should you wish to publish. Only data collected under a currently approved protocol can be certified by the IRB for any purpose.

If you have questions or need any assistance from the IRB, please contact me at 210 Administration Building, 5-2208, or irb@uark.edu.