FACTORS INFLUENCING POST-ADOPTIVE ENTERPRISE RESOURCE PLANNNING (ERP) UTILIZATION

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Organizations expend a great deal of time, effort and money on the implementation of enterprise resource planning (ERP) systems. They are considered the price of entry for large organizations to do business. Yet the success rate of ERP systems is poor. IS literature suggests that one possible reason for this is the underutilization of these systems. Existing ERP literature is replete with research to improve ERP project implementation success; however, notably absent from these streams is the research that identifies how ERP systems are utilized by individuals or organizations.

This dissertation posits that increased ERP utilization can result from increased software and business process understanding gained from both formal training and experiential interventions. New dimensions of system utilization (required vs. optional) are proposed. The purpose of this dissertation is to examine how these interventions impact ERP utilization.

The results of this dissertation show that while software-training interventions are important to understanding, it is the business process training interventions that seem to provide the greater effect on understanding. This increased understanding positively affects utilization scenarios where a mixture (required vs. optional) of software features and business process tasks can be leveraged by end-users. The improved understanding of post-adoptive ERP utilization gained from this study benefits both researchers and practitioners.

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CHAPTER 1
INTRODUCTION

In order to provide information systems capabilities that are highly integrated with business processes, many firms have adopted enterprise resource planning (ERP) systems. These systems are considered the price of entry for large organizations to do business (Wu & Wang, 2006; Kumar & van Hillegersberg, 2000). Almost 70 percent of large and mid-size organizations have adopted some form of ERP system (Liang, Saraf, Hue & Xue, 2007). These systems require organizations to spend a great deal of time, effort and resources on their implementation. Some organizations spend as much as $100 million for their initial implementation (Jasperson, Carter & Zmud, 2005; Robey, Ross & Boudreau, 2002). Yet the success rate of these implementations is poor. Between 40 and 60 percent of ERP projects fail to meet their expected implementation goals (Liang et al., 2007). Since most information systems are often underutilized by organizations, even those ERP implementation projects that do succeed are likely to provide only limited returns (Jasperson et al., 2005).

Existing ERP literature is replete with research to improve ERP project implementation success. The inherent size and scope of these projects introduce project management complexities that most organizations have never encountered. Early ERP research focuses largely on implementation methodologies, critical success factors (CSF) for initial go-live and project effects on organizations (Nah, Lau & Kuang, 2001; Robey et al., 2002). Implementation methodologies focus on software selection, acquisition, project management and the training necessary for these large projects (Esteves, 2007; Esteves and Pastor, 2001). CSF literature addresses traditional project

metrics: budgets, project milestones, communications and business process benefits (Robey et al., 2002). ERP effects research is focused on the outcomes or the impacts of ERP projects; data quality, organizational impact, process improvements/degradation, business value and user satisfaction (Liang et al., 2007; Robey et al., 2002).

Research has begun to touch upon post implementation aspects of ERP projects (Liang et al., 2007; Esteves, 2007; Esteves and Pastor, 2001). A number of post implementation research streams are emerging. ERP optimization research provides insight into the system adjustments that occur after a system goes live (Botta-Genoulaz, Millet and Grabot, 2005; Cumbie, Jourdan, Peachey, Dugo, and Craighead, 2005). These corrective actions and their impact on the organization can be seen as extensions to the original implementation project. ERP usefulness is another research stream. This is largely an assessment of user satisfaction (Botta-Genoulaz et al., 2005). Achievement of competitive advantage is a third research stream. It addresses post-implementation measures put in place to gauge ERP financial benefits. This is an extension of calculations and ratios used for the original justification of the ERP project (Botta-Genoulaz et al., 2005; Cumbie et al., 2005).

Notably absent from these streams is research that identifies how well an ERP system is utilized by an organization. Utilization is the extent that software features and capabilities are used by end users to perform tasks (Burton-Jones and Gallivan, 2007). Neither the antecedent factors of utilization nor the organizational benefits of ERP utilization appear to have been widely addressed in literature. The exception to this has been research focused on the costs and outcomes on local level organizational

components (Gattiker and Goodhue, 2002, 2004, 2005). However, there has been little empirical research on post-implementation behaviors for information systems in general, or ERP systems in particular (Jones, Zmud and Clark, 2008; Jasperson et al., 2005). Indeed, some literature suggests that existing perspectives of information system utilization should be reexamined (Burton-Jones and Straub, 2006; Jasperson et al., 2005)

Increased systems utilization increases ERP benefits to organizations (Jasperson et al., 2005). It is posited that increased utilization can result from both training and experiential interventions. While the term 'intervention' has multiple connotations, we use it to mean the redirection of some course of events (Jasperson et al., 2005). Training interventions are events where the appropriate skill contexts are provided to end-users. They improve utilization by providing the necessary skills to fully leverage the software and business process capabilities available to the organization by the ERP system (Jones et al., 2008). Experiential interventions are individual events initiated by end-users that leverage their understanding and experience in both system and process capabilities. This includes for the experimentation and application of system and business process capabilities to address novel business situations (Jones et al., 2008).

The lack of post implementation ERP utilization research and the existing literature that argues for a reexamination of IS utilization, make the study of ERP utilization relevant. The purpose of this dissertation is to examine how organizations can improve utilization of ERP system functionality. The *primary research question* is: what are the factors that influence post-adoptive ERP utilization. Specifically, how is

utilization affected by formal ERP software and organizational business process training interventions, along with user's individual experiences with software and business processes? The combination of formal training and end-user initiated experimentation with the system may provide for a better understanding of the software and business process capabilities of the organization. The possible relationship between interventions and understanding are illustrated in Figure 1. It is important to note that both types of interventions (training and experiential) support both types of understanding.

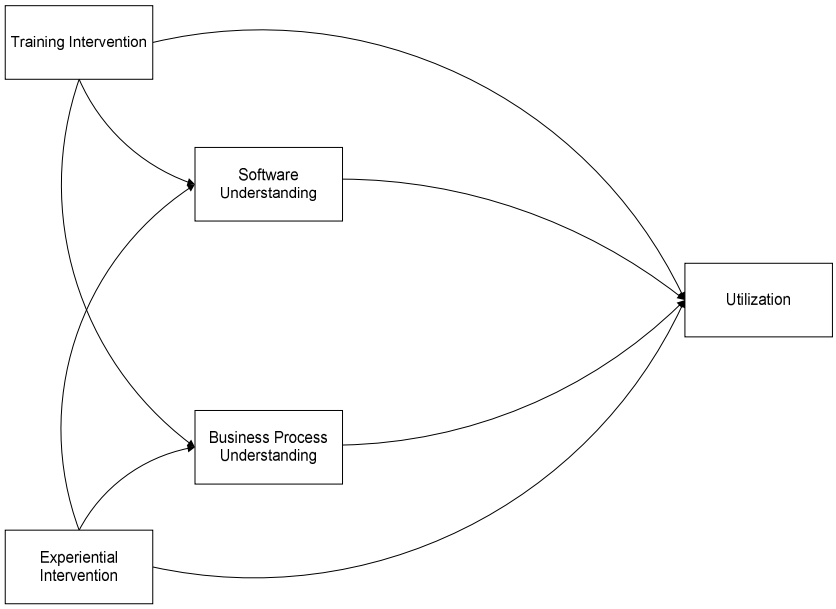

Figure 1. – Relationship between interventions, understanding and utilization.

For this dissertation, data is collected using a field survey that examines a cross-section of organizations that have implemented ERP software. Subjects are identified through an ERP user community that represents approximately 85,000 individuals representing 2000 organizations in 17 industries.

The contribution of this study will benefit both researchers and practitioners. Primarily, this research will provide academicians with a clearer understanding of the factors that help to improve ERP utilization**.** As a component of the information technology (IT) artifact's nomological net, utilization (usage) is an important component worthy of continued research (Benbasat and Zmud, 2003). For practitioners, leveraging the understanding of ERP utilization will translate into tangible benefits for the organization by improving utilization goal setting, and by improving the potential for users to expand ERP utilization.

This dissertation reviews existing ERP literature in chapter 2. Current literature is used to describe and discuss existing perspectives on IS utilization, and focused on ERP utilization. The various types and focus of interventions are described and used to discuss the factors that influence post-adoptive ERP utilization. Chapter 3 provides a detailed description of the methodology employed, the development of the instrument, and a discussion on the analytical methods employed. Chapter 4 discusses data analysis results. Chapter 5 provides interpretation of the findings, future research recommendations, conclusions and contributions.

CHAPTER 2
LITERATURE REVIEW

Introduction

Many organizations see enterprise resource planning (ERP) as a fundamental requirement to maintain competiveness in the market place (Wu & Wang, 2006). Yet the success rate for the implementation of these systems is poor; between 40 and 60 percent of ERP projects fail to meet their expected implementation goals (Liang et al., 2007). Since most information systems are often underutilized by organizations, even those projects that do succeed are likely to provide only limited returns (Jasperson et al., 2005).

Expected benefits are part of the justification for an ERP implementation project. Once implemented, the achievement of these benefits often acts as a success measure for the overall project (Shang and Seddon, 2002). Unfortunately, ERP implementations often fail to achieve the benefits originally envisioned (Jones, Zmud and Clark, 2008; Karimi, Somers and Bhattacherjee, 2007; Beatty and Williams, 2006; Gattiker and Goodhue, 2005). Gaps in perceived and actual benefits can adversely affect user and organizational morale and can deepen the perception of missed expectations (Shang and Seddon, 2002). Simply implementing an ERP solution does not automatically provide an organization with benefits (Stratman, 2007). As with any information system, an ERP system must be utilized in order to provide those expected benefits (Jasperson et al., 2005). Organizations limit the value they can gain when they do not fully employ potential functionality (Jasperson et al., 2005; Lassila and Brancheau, 1999).

Utilization is the extent that software features and capabilities are used by end-users to perform a task (Burton-Jones and Gallivan, 2007). When end-users fail to utilize the full breadth of features, then the system is considered underutilized (Jasperson et al., 2005). Underutilization is partly due to inadequate training and the failure to ensure that process and system changes are well communicated to, and understood by end-users (Jasperson et al., 2005; Robey et al., 2002). This inadequate training may limit actions taken by individuals or organizations to help end-users better understand their ERP system and business process environment. Limited training or change management can hamper a user's ability to understand and exploit system capabilities available and thus limit utilization of the system (Jasperson et al., 2005).

For many organizations, the initial appeal of ERP systems is the integration it can provide to the various business processes within the organization (Hitt, Wu and Zhou, 2002). This integration subsequently leads to achievement of operational goals such as cost savings, customer service, and operational efficiency (Shang and Seddon, 2002; Nicolaou, 2004). These operational and strategic goals are quantified to help set and measure the expected benefits of ERP (Stratman, 2007).

Figure 2 provides the conceptual model used to address the research question of this dissertation: what factors influence post-adoptive ERP utilization. It is posited that three constructs influence ERP utilization. Training interventions are formal activities initiated by organizations to provide end-user with the software and business process skills necessary for them to perform their duties. Experiential interventions are those activities engaged in by the end-users themselves to better understand the software and business process capabilities at their disposal (Jones et al., 2008). Both types of

interventions influence the user's perceived understanding of the software and business processes. Software understanding is focused on the capabilities of the ERP system, while business process understanding addresses the various tasks that the individual is expected to perform. The research question of this dissertation does not address the direct effects of interventions upon utilization. While Figure 1, illustrated the possible relationships between these constructs, Figure 2 illustrates the relationship paths to be examined in this dissertation.

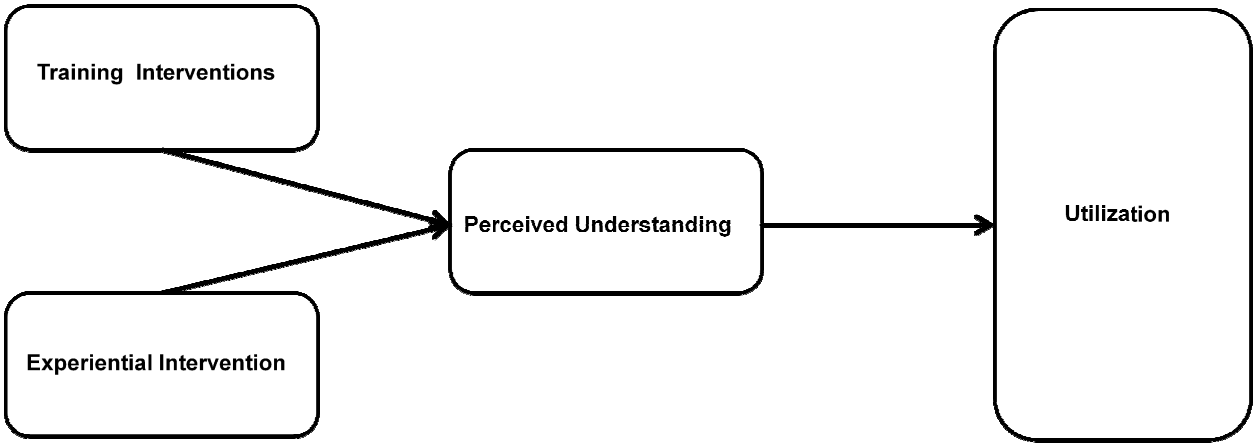

Figure 2. – High-level conceptual model.

This chapter will first review literature for the dependent variable, utilization. Various utilization perspectives from literature will be presented, richness of utilizations measures will be examined and the complexities of utilization levels of analysis will be reviewed. A definition for utilization is proposed, independent variable constructs are then reviewed. Training and experiential interventions will be discussed, as well as perceived software and business process understanding. A research model and hypotheses will then be presented.

Utilization

Although utilization is a common IS research topic there is no single agreed upon definition of the term in IS research (Burton-Jones and Gallivan, 2007; Burton-Jones and Straub, 2006; Trice and Treacy, 1988). This lack of consensus has resulted in a number of definitions and perspectives for the utilization construct. These variations not only influence the perspectives of utilization, but they also influence the level of detail used in various utilization measures. This in turn affects the level of analysis that has been used to examine utilization.

Before proposing the definition of utilization used in this dissertation, we first review existing utilization definitions, discuss the various perspectives that utilization holds in IS research. This dissertation will also discuss the importance of understanding the levels of analysis that utilization measures address. We then discuss a taxonomy for the classification of usage definitions. Table 1 lists a selection of utilization definitions used in IS research. Some address the simple use (yes/no) of an information system (Trice and Treacy, 1988; Seddon, 1997). Other definitions provide a broader perspective. In addition to simply identifying if a system is used or not, they describe to what extent the system is used (DeLone and McLean, 1992; Jones et al., 2008). Still others add a contextual perspective to address the task that end-users carry out using the system (Burton-Jones and Gallivan, 2007; Clark et al., 2009). Various combinations of user, task and system help to formalize the definition for utilization. This three-part perspective of utilization measures forms the basic structure proposed by Burton-Jones and Straub (2006).

Table 1 – Example Utilization Definition

Utilization Definition	Researcher(s)
"...the amount of effort expended interacting with an information system."	Trice and Treacy (1988)
"… using the system. It is expected that resources such as human effort will be consumed as the system is used."	Seddon (1997)
"... determining whether the full functionality of a system is being used for the intended purposes."	DeLone and McLean, (1992)
"Extent to which users use installed ERP Functionality."	Jones et al. (2008)
"The volume of technology use, the reliance on the technology to get one's job done and the diversity of different functions put to use."	Lassila and Brancheau, (1999)
"A users employment of a system to perform a task"	Burton-Jones and Gallivan (2007)
" … The extent to which users are making use of features in their ERP system , as well as the extent to which they are gaining understanding of both software and work processes …"	Clark et al. (2009)

There are many different ways to view utilization. Four conceptualizations depict how utilization can be viewed and used in information systems research: IS success, IS acceptance, IS implementation, and IS for decision making (Burton-Jones and Straub, 2006). Each conceptualization can be used to provide a unique perspective on ERP utilization.

The 'IS success' perspective represents the antecedents of system utilization and the impact ERP utilization has upon the individuals or organizations (Burton-Jones and Straub, 2006; Seddon, 1997). Often system benefits are used to measure the individual or organizational impact of ERP utilization. Antecedents such as perceived

usefulness, ERP software stability, and perceptions of benefits influence system utilization. This in turn influences the actual benefits achieved (Clark et al, 2009). However, utilization is sometimes implied within this relationship; it is combined with the dependent construct. For example, antecedent constructs such as interdependence, differentiation and data quality influence are overall benefits, yet it is implied that ERP utilization occurred in order to realize those benefits (Gattiker and Goodhue, 2005). In this perspective, ERP utilization is used as an independent variable (Burton-Jones and Straub, 2006).

The 'IS acceptance' perspective represents ERP utilization as the manifestation of a user's intent to use the ERP system (Burton-Jones and Straub, 2006). Antecedent constructs lead to the user's decision to use. The ultimate measure is the end-user's actual utilization of the system. The technology acceptance model (TAM) and its constructs have often been applied to ERP software. Antecedents such as perceived usefulness and ease of use influence intention to use which is then measured by system usage (Nah et al., 2004). Utilization, in this perspective, is treated as a dependent variable (Burton-Jones and Straub, 2006).

'IS implementation' uses the perspective that utilization is the result of the implementation processes (Burton-Jones and Straub, 2006). If the system has been successfully implemented, it is assumed that utilization will occur, thus indicating implementation success (Lucas, 1977; Seddon, 1997). It is possible that in a mandated use environment, ERP utilization is assumed, and thus implicit in the implementation success measure. Numerous examples can be found where financial markets influenced the value of the firm simply through the expectation that an

announced ERP implementation will eventually come to fruition (Brazel, and Dang 2008; Hunton et al., 2003; Nicolaou and Bhattacharya, 2006). In this perspective, utilization is treated as a dependent variable (Burton-Jones and Straub, 2006).

The 'IS for decision-making' perspective represents utilization as a facilitator to help end-users improve the decisions they make (Burton-Jones and Straub, 2006). One example is the utilization of a system to align extracted data with the cognitive style of the user, thus potentially improving the resultant decisions (Burton-Jones and Straub, 2006; Barkin and Dickson, 1977). Examples of this perspective are largely missing from ERP research. On exception is Holsapple and Sena (2003), who show that ERP systems are a good base for an organization's data decision making infrastructure. In this perspective, utilization can be viewed as either a dependent or independent variable. (Burton-Jones and Straub, 2006)

Although utilization is sometimes used as independent variable (e.g. IS success perspective) utilization is typically used as a dependent variable (Burton-Jones and Straub, 2006; Trice and Treacy, 1988). As a dependent variable, it is likely that operationalized definitions for utilization may have multiple dimensions. These dimensions are dependent upon the phenomena being studied (Trice and Treacy, 1988). The level of analysis for any of these four perspectives could be individual, group or organizational.

These four perspectives illustrate that ERP utilization is context dependent. The meaning and understanding of utilization can change based on the phenomena being measured (Trice and Treacy, 1988). Yet, these perspectives lack solid formal structure.

To address this, Burton-Jones and Straub propose a staged approach to utilization measures. Their six levels incorporate various combinations of three dimensions, User, Task and System, to define the richness of the utilization measures used in research. As first shown in Table 1, utilization definitions typically call out their expected measures. The definition circumscribes the perspective that will be used to measure the utilization construct. For purposes of this dissertation, the IS acceptance perspective best suits our needs. This acceptance will be manifest by how end-users utilize ERP systems.

Richness of Utilization Measures.

The richness definitions presented in Table 2 help to define the various perspectives used when examining system utilization. They delineate the three dimensions used to identify how rich utilization measures are. One dimension is the extent that system functionality is utilized. The second dimension is the extent of tasks for which the system is employed. The third dimension is the extent to which users employ the system (Burton-Jones and Straub, 2006). Those definitions that provide only one perspective are considered lean; those that use all three utilization perspectives are considered rich (Burton-Jones and Straub, 2006). Lean measures of utilization capture a broad, generic measure of use, whereas richer measures address the specific nature of the utilization. Each progressive layer provides increasing detail regarding utilization (Table 2). This three-dimension perspective allows for the reconciliation of various, possibly conflicting, usage definitions and minimizes misuse of the usage construct (Burton-Jones and Straub, 2006).

Six utilization measurement levels are used to address the various combinations of the three dimensions. They range from very lean to very rich. Using the utilization definitions from Table 1, and by extension, their intended measurement, examples of research are provided for each richness level.

Table 2 – Richness Measures of System Utilization

Level	Title	Description / Elements	Selected Research
1	Very Lean	Presence of use (yes/no)	Alavi and Henderson, 1981
2	Lean	Extent of use (duration or use counts)	Trice and Treacy, 1988; Seddon, 1997
3	Somewhat Rich	Extent to which the SYSTEM is used (e.g. # of features utilized)	DeLone and McLean 1992
4	Rich - User	Extent to which USERS employ the SYSTEM.	Jones et al., 2008
5	Rich - Task	Extent to which the SYSTEM is used to carry out a TASK.	Lassila and Brancheau, 1999; Burton-Jones and Gallivan, 2007
6	Very Rich	Extent to which the USER employs the SYSTEM to carry out a TASK.	Clark et al., 2009

Level of Analysis

In order to provide the correct context for utilization, it is important to know how utilization will be viewed. An important aspect of this viewpoint is understanding the level of analysis. Three levels of analysis are typically recognized in utilization research: individual, group and organization (Burton-Jones and Gallivan, 2007). Individual level reflects system utilization by a single end-user. Group level is the aggregation of individual utilization results based on some logical sub-grouping within the organization. Organization level analysis can be viewed from two perspectives. First, it can reflect the

aggregation of all end-users within the organization. Second, it can be the use of measures unique to the organization, indivisible at the individual level (Burton-Jones and Gallivan, 2007). These three levels are often considered mutually exclusive in IS research. However, there may be research considerations that require the simultaneous review of usage across multiple levels of analysis (Burton-Jones and Gallivan, 2007).

One means of addressing utilization that incorporates multiple levels of analysis is collective utilization. Collective utilization is an aggregation of individual utilization that also addresses the interactions and interdependencies of the measurements (Burton-Jones and Gallivan, 2007). This allows for multiple levels of analysis to be addressed at the same time. This is not the same as examining two levels of analysis independently. Rather, data are collected in such a way as to address both analysis needs. Table 3 provides a matrix that can be used to identify whether individual utilization data can be aggregated to some collective level. Fundamentally, the researcher needs to understand if the members being measured (group or organization) see themselves as part of a particular member collective.

Table 3 – Collective Usage Scenarios
Burton-Jones and Gallivan, 2007, p.664.

		Strength of interdependencies-in-use among members	
		Weak or None	Moderate to strong
Proportion of members directly interacting with the ERP System	Most	Collective utilization does not exist	Collective utilization exists
	Few	Collective utilization does not exist	Collective utilization exists (by proxy)

In the case of ERP utilization, the integrated nature of the business processes and software forces interdependence among system end-users (Jones et al., 2008). For ERP systems, the integrated nature of its business processes makes the interdependence of its end-users quite strong. The proportion of the collective's members who interact with the ERP system is a variable element in ERP research. Depending upon the proportion of members directly using the system the collectiveness may vary. If there are significantly many organizational (or organizational unit members) who use the system, then utilization is considered collective. If there are few members of the organization or organizational sub-unit using the ERP solution, then utilization is considered collective by proxy (Burton-Jones and Straub, 2006).

Table 3 summarizes how utilization can be evaluated to see if it should be examined for the 'collective' perspective. If the context is that of collective use, then the process in Figure 3 outlines how levels of usage are interconnected. For example, individual task performance cannot be aggregated into collective systems usage without first going through the individual system usage process, or by going thorough collective task performance (Burton-Jones and Gallivan, 2007).

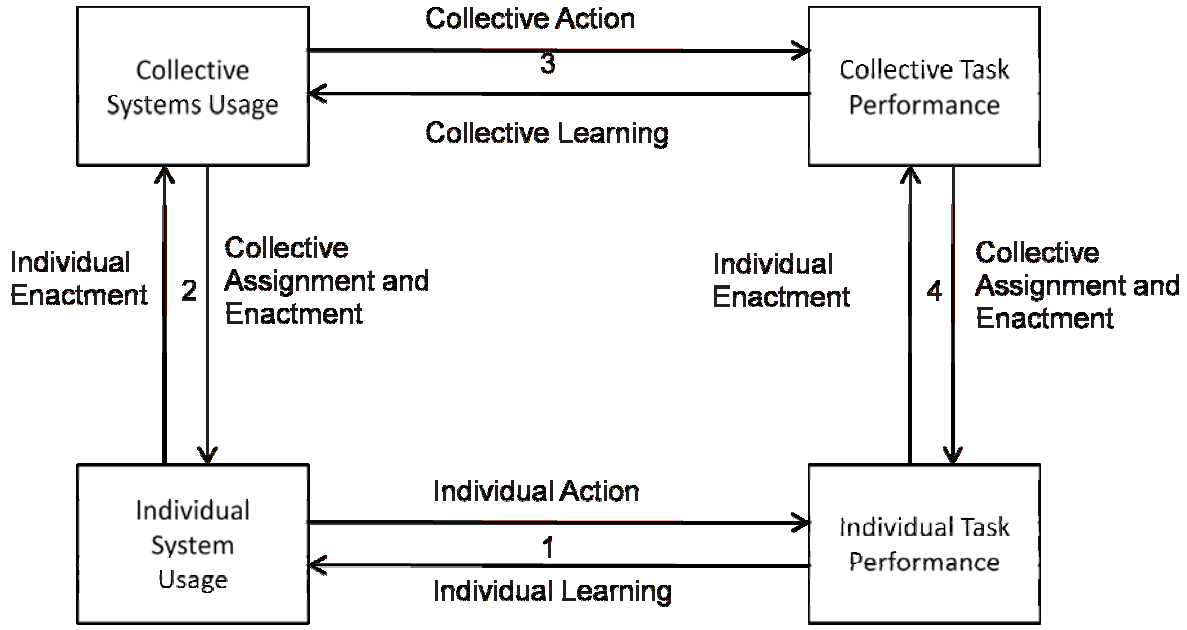

Figure 3. – Multi-level reconciliation of usage.
Adapted from Burton-Jones and Gallivan, 2007, p.662.

Utilization Defined

Using IS utilization definitions, their use in research, and revised perspectives of rich utilization measures provides the necessary context to propose a utilization definition for this dissertation. We adopt the Burton-Jones and Gallivan's (2007) utilization definition, utilization is the extent that software features and capabilities are used by end-users to perform a task. When operationalized, this definition satisfies Burton-Jones and Straub's (2006) classification of a very rich utilization measure. It contains the three necessary components: user, system and task. This definition is representative of the 'IS acceptance' perspective in IS research. In addition, by their very nature, ERP systems support the possibility of collective system usage level of analysis (Burton-Jones and Gallivan, 2007).

Although ERP system use is mandated by the organization, individual end-users have a great deal of discretion in ERP's actual use (Jasperson et al., 2005). Some

tasks and software features may be explicitly required, yet optional software features may be available to end-users to address various perceived needs. The various combinations of optional and required use can be categorized. Business process tasks and software features may be required, optional or novel. Required tasks and functionality are simply that, their use is mandated and enforced by the organization. Optional tasks and functionality allow for the user's discretion in their use. Novel tasks and functionality are those where the use-requirements are previously unknown or unused by the organization (Jasperson et al., 2005).

By combining the three use-requirement dimensions with the business process tasks and software features aspects of our utilization definition, a three-by-three matrix can be produced and examined. These nine unique combinations identify the possible utilization scenarios (Table 4). Each cell is a unique combination of use-requirements, business process tasks and software features.

Table 4 – Utilization Scenarios

		Business Process Tasks		
		Required Tasks (RT)	Optional Tasks (OT)	Novel Tasks (NT)
Software Features	Required Features (RF)	**RT/RF:** Using prescribed SW features to address required business process tasks.	**OT/RF**: Using prescribed SW features to address an optional business process tasks.	**NT/RF**: Using prescribed SW features to address new/ad hoc business process tasks.
	Optional Features (OF)	**RT/OF**: Use of optional SW features to address a required business process tasks.	**OT/OF**: Use of optional SW features to address an optional business process tasks.	**NT/OF**: Use of optional SW features to address a new/ad-hoc business process tasks.
	Novel Features (NF)	**RT/NF**: Expansion or enhancement of current SW features to address required business process tasks.	**OT/NF**: Expansion or enhancement of current SW features to address an optional business process tasks.	**NT/TF**: Expansion or enhancement of current SW features to address a new/ad-hoc Business process tasks.

In Table 4, Required Features (RF) is the mandated use of prescribed software features. Optional Features (OF) is the use of software functionality that is at the discretion of the end-user. Novel Features (NF) is the creative use of existing software capabilities to provide new functionality. Required business process tasks (RT) are mandated business tasks necessary to complete a specific business process. Optional business process tasks (OT) are those tasks in a process at the discretion of the end-user. Novel business process tasks (NT) are those business requests that are new to the organization. Regulatory changes or changing customer needs can motivate these new requests. Once the requirements for these requests are understood, they may become either optional or required business processes.

Utilization is only one aspect of our overall model. Antecedent to utilization is an understanding of the ERP software capabilities as well as a detailed understanding of the business process tasks that the ERP is used for. This understanding is gained by various interventions initiated by the organization, end-users themselves, and their peers (Jones et al., 2008; Jasperson et al., 2005).

Interventions

Interventions are acts upon established behaviors: they are intended to cause redirection or change in some course of events (Jasperson et al., 2005). In our model interventions are the activities used to provide end-users with the software and business process skills and knowledge necessary to leverage the ERP system to address required and optional tasks. We address two types of interventions, training and experiential. Training interventions are further distinguished by their focus: software or

business process. Experiential interventions are often less structured than training interventions, and can have various initiators. The end-user themselves, their peers or their management, can influence the end-user to engage in an experiential intervention (Jones et al., 2008, Jasperson et al., 2005). These experiential interventions can also be further distinguished by their focus on either software or business process.

Training Interventions

Training interventions are coordinated activities used to provide end-users with software and business process skills (Jones et al., 2008). ERP software and business process training is representative of the type of activities that occur in training interventions. Training interventions have the express intent of increasing understanding across the organization or across a specific piece of the organization (Jones et al., 2008; Clark et al., 2009). Intervention activities are explicitly managed by the organization, and end-users may be required to participate or may volunteer to participate (Hsieh and Wagner, 2007). The ultimate intended impact of training intervention is an increase in ERP utilization. Both software training and business process training are used to leverage ERP functionality to best address the business needs of the organization.

User training is considered a critical success factor for ERP implementations (Bajwa et al., 2004; Karimi et al., 2007; Muscatello and Parente, 2006; Plant and Willcocks, 2007; Wang et al., 2008; Al-Mashari, 2002). However, budgetary considerations can reduce the amount of training organizations offer their end-users (Scott, 2005). End-users often receive the minimum training necessary to satisfy their immediate system needs (Jones, et al., 2008; Bradley and Lee, 2007). The failure of

training can hamper a user's ability to understand and exploit the systems capabilities available and thus limit utilization of the ERP system (Jasperson et al., 2005). In addition, organizations often underestimate the amount of training end-users need, especially training in how business process will change with ERP (Jones, 2006)

Software training provides end-users with the skills necessary to effectively complete a specific business task (Nelson and Cheney, 1987). There are a number of factors for the efficient delivery of software training. Training content, delivery techniques, investment, planning and satisfaction can influence training effectiveness (Bradley and Lee, 2007; Calvert and Carroll, 2005; Scott, 2005; McNurlin, 2001; Nelson and Somers, 2001). However, little research has addressed ERP training in post-adoptive environments; most literature is focused on the training necessary for the initial ERP implementation (Jones et al., 2008; Bradley and Lee, 2007).

ERP training has a key role in the ERP utilization (Peslak, Subramanian and Clayton, 2008). It provides the foundation for end-users to leverage the ERP system to reap its potential benefits. Training improves productivity, improves transaction quality and ultimately reduces the amount of user support needed after the system has been implemented (Scott, 2005). Providing end-users with the proper skills also influences their acceptance of the technology (Bradley and Lee 2007; Vekatesh, Speier and Morris, 2002; Nelson and Cheney, 1987). Failure to adequately provide for training can seriously affect a project's ability to achieve its stated goals (Scott, 2005). In a worst-case scenario, it could result in an ERP implementation failure (Jasperson et al., 2005). Even though an implementation may appear to succeed, many ERP implementations ultimately fail to reap benefits until well into their life cycle (Jones et al., 2008).

Training is a commodity that must be delivered when needed. Early or late training limits its effectiveness for end-users. Often end-users and managers would like more time for training, especially on business process changes (Scott, 2005). Training, however, is often focused on the technical aspects of the system. It commonly addresses how to accomplish a business task and the immediate needs to be addressed, not necessarily the business process being enabled by the technology (Jones et al., 2008; Nelson and Cheney, 1987). The focus is on the "how to" of the software rather than the "why" or "how" of the business process itself.

End-users desire training that is focused on the business process itself (Scott, 2005). From a user perspective, the ERP system is only part of the changes taking place within the organization. Changes to existing business processes must be reconciled, and appropriate training provided (Scott, 2005). In order to deliver upon organizational improvement goals, the implementation of an ERP must address associated business process changes (Botta-Genoulaz, Millet and Brabot, 2005).

Software training interventions and business process training interventions are not mutually exclusive. Unfortunately, most research views software training interventions and business process training interventions separately. As a result, the lens thru which researchers have come to view them does not provide a bridge between the two. Software and business process training interventions in practice are linked and it is important to view them as such in examining how they influence understanding and utilization of ERP. For example, research indicates that software training provides a basis for understanding ERP software. However, without required business process training, not only is business process understanding limited, but software

understanding may be limited as well (Jones et al., 2008). Therefore, it is important to view software and business process training not as mutually exclusive, but rather as synergistic of each other. Table 5 provides an illustration of the synergy between the two types of interventions.

There are, however, different approaches to gaining this synergy. Breadth addresses the variety of the skills and perspectives provided in the training intervention (Munro et al., 1997). In the case of software functionality, broader perspectives on systems capabilities or complimentary functionality provide the end-user with more insight into how and when capabilities can be utilized. In the case of business processes, the context of the business procedures provides breadth so that the impact on other business procedures can be visualized. It is posited that a broad approach to training interventions can help identify opportunities where ERP can be used for non-required (optional) tasks or to help address novel, ad-hoc tasks. A narrow approach addresses the completeness of the end-user knowledge provided during the training intervention (Munro et al., 1997). In the case of software, it provides the details necessary to master specific system functionality.

Table 5 – Approaches to Training Intervention

		Business Process Training	
		Narrow	Broad
SW Feature Training	Narrow	Provides the detailed skills necessary to support both required use of software features AND required tasks (RT/RF)	Provides the detailed software skills necessary to support required SW features used across a variety of business processes (OT/RF)
	Broad	Provides understanding of various, complementary SW features that can used to address required business processes tasks (RT/OF)	Provides understanding of various, complementary SW features used across a variety of business processes (OT/OF)

In summary, training interventions provide the skills necessary to properly leverage software features or business processes. Training interventions can also allow software and business processes to be viewed in context. Training can increase the effectiveness, efficiency, perceived ease of use and usefulness of the ERP system and these advantages can quickly increase a user's ability to positively influence ERPs value to the firm (Bradley and Lee, 2007). The level of detail provided during the training intervention helps to provide the context necessary for end-users to make sense of the software and business capabilities available to them.

There is a plateau in the value incurred from training interventions. Once an ERP implementation stabilizes, system use becomes routine and the value gained from training stabilizes (Orlikowski, 2000). As the implemented system and business processes begin to age, routine maintenance and upgrades are required. As these changes are implemented in the ERP software and/or its business processes, corresponding training interventions are required in order for end-users to best leverage the system and its capabilities.

Experiential Interventions

Experiential interventions leverage the end-user's familiarity with ERP system capabilities and his/her understanding of the organizational business processes (Clark et al., 2009; Jones et al., 2008; Jasperson et al., 2005). Improvement in ERP utilization is gained as individuals assess their own levels of expertise and actively seek ways of improving their use and understanding of the ERP system independent of the training interventions. End-users often want to overcome the discrepancies they perceive in their understanding of the ERP system and revised business processes (Jasperson et al., 2005). These experiential activities seek substantive alternatives to perceived system or process issues.

The window for these experiential activities may be short-lived (Tyre and Orlikowski, 1994). Frequently, newly introduced technologies are not quickly embraced by end-users. They may be slow to incorporate newfound capabilities into the familiar routines of an organization (Hefridsson and Soderholm, 2000). This slow commitment to new technology is compounded by the relatively short timeframe after introduction where end-users actively explore the new technology. Yet this first exposure to new technology is fundamental in determining how the technology will be leveraged by the organization (Tyre and Orlikowski, 1994).

After initial exploration of the technology, the potential for user adaptation is reduced. The adaptation that does occur happens at irregular intervals (Tyre and Orlikowski, 1994). This inconsistency in adaptation levels may be explained by the varying needs of individual end-users to perform the task at hand. As end-users encounter new software or business process capabilities they may seek understanding

that allows them to address the task at hand in the most efficient way possible by them (Scott, 2005). When these new software or business process capabilities are exhausted, then the user's incentive to adapt may be reduced (Clark et al., 2009). However, novel features or processes may renew interest in exploring system and process capabilities. As with any technology, changes to the implemented system are expected, and adaptation to these changes needs to occur (Griffith, 1999)

In addition to the software understanding that is occurring, end-users are also adapting to changes in familiar business processes (Griffith, 1999). Relearning roles is difficult for end-users (Scott, 2005; Ross, 1999). Support is needed to help end-users focus on the task at hand (Scott, 2005). This support, and the understanding it helps to ensure, can positively affect the user's perception of ERP usefulness (Bradley and Lee, 2007).

If software or business process training is not available to end-users, the experiential activities they attempt may not improve their effectiveness or efficiency with the ERP system. Instead, it may foster system workarounds (Peslak et al., 2007). While training intervention is often explicitly managed by the organization experiential intervention is often initiated and managed by the individual. A solid understanding of how experiential intervention can affect ERP utilization is lacking in IS literature (Jasperson et al., 2005).

While experiential interventions are managed by the individual end-user, the trigger for the intervention may have a number of different sources including the end-users themselves, peers, and managers (Jones et al., 2008; Jasperson, 2005). Peers are the user's colleagues, but they do not need to be in the same work group, or even

the same organization. Peers can trigger experiential interventions through pressure to use or through their own exploration and learning. Management includes all supervisors, managers and executives within the organization (Jasperson et al., 2005). They can trigger experiential interventions through use incentives or use disincentives. There is some evidence that peer influence may be strongest and management the least influential of ERP experiential interventions (Jasperson et al, 2008).

In summary, experiential interventions are the exploration of functional and process capabilities of an information system by end-users in search of solutions to novel system or process issues (Clark et al., 2009; Jones et al., 2008; Jasperson et al., 2005). It is managed by the end-user, and it may leverage skills and knowledge gathered from training interventions. Experiential interventions by end-users are often short lived and often occur soon after a system or process change has occurred (Tyre and Orlikowski, 1994). These system or process changes may be in the form of a system upgrade, business process change, or some sort of management influence. Once this formative time is over, user habits or routines become routine (Orlikowski, 2000).

Summary of Interventions

The two types of intervention (training and experiential) as well as the focus of these interventions (systems and business process) are shown in Table 6. The intersections of these four dimensions identify possible intervention activities. In the case of ERP, formal system interventions manifest as traditional training sessions designed to provide end-users with the basic understanding of the ERP software. This is often coupled with business process training to reinforce organizations best practices

or to train end-users on newly modified business processes (Clark et al., 2009). Training interventions are typically coordinated by the organization, and are often provided to large user populations at coordinated times (Scott, 2005).

Table 6 – Examples of Intervention by Type and Focus

		Focus of Intervention	
		System	Business Process
Type of Intervention	Training	Traditional ERP training focused on system functionality.	Change management and BPR training.
	Experiential	Initial exploration of system functionality by end-users.	Experimentation with system capabilities to address novel business process issues.

In the case of experiential interventions, the end-user is initiating the activities. For ERP, an example of experiential interventions is the user's first unscripted navigation of the system; exploring the system and reinforcing the knowledge gained via the training interventions. Experiential business process interventions are most appropriate for unscripted problem solving where system use varies depending on the problem presented (Clark et al., 2009).

Table 6 does not imply that the four combinations of intervention type and focus provide equal benefit or are equally leveraged. For example, research indicates that interventions with a business process focus provide greater influence on end-user understanding than software interventions (Jones et al., 2008).

Understanding

The effect of interventions on utilization may be partly mediated by user software and business process understanding. Training and experiential interventions may

have an indirect influence on utilization. Interventions translate through understanding to utilization (Clark et al., 2009; Jones et al., 2008). Understanding is an individual end-user's net reconciliation of ERP software training interventions, business process training interventions, experiential interventions, and their knowledge decay (Clark et al., 2009). The end-user's prior experiences are employed to help reconcile the knowledge they have gained through the various interventions. These experiences provide context in which end-users evaluate the intervention, and determine how the knowledge can be applied for a given situation (Clark et al., 2009).

Two different dimensions of understanding exist: software and business process. Business process understanding is the contextual knowledge of how to perform an end-user's work activities, and how those activities fit into the activities of others (Jones et al, 2008). Knowing how to perform a particular business process is not the same as understanding when it should be applied, or how it affects other processes (Clark et al., 2009). This understanding is the reconciliation of specific task knowledge, gained from business process training interventions, and of innovative exploration via experiential interventions (Henfridsson and Soderholm, 2000).

Software understating is the extent to which end-users can properly apply the features of the ERP system and understand how the use of those features affects other aspects of ERP functionality (Jones et al., 2008). As with business process understanding, software understanding is gained via the reconciliation of software training interventions and experiential interventions. Implicit in understanding is the relationship between software features understanding and business process

understanding (Clark et al, 2009). It allows end-users to appreciate the impact of software use upon the business process, and vice-versa.

Both software and business process understanding can be affected by disuse (Clark et al., 2009; Jones et al., 2008; Jasperson et al., 2005). Specific skills and understanding can degrade over time, they can also be incorrectly reinforced (Clark et al., 2009; Jasperson et al., 2005). This atrophy of knowledge may negatively impact the effectiveness of training and experiential interventions.

In summary, training and experiential interventions are not the sole influence on utilization. The understanding that these interventions generate are also important to utilization. The two types of understanding provide the context necessary to fully leverage knowledge gained via the training interventions. However, the affect that each understanding has on utilization may not be uniform. Business process interventions may have more influence on business process understanding than software interventions have on software understanding (Jones et al., 2008).

Research Model and Hypotheses

Training and experiential interventions influence utilization through improved understanding of ERP software features and the organizations business processes. Interventions are acts upon established behaviors; they are intended to cause redirection or change in some course of events (Jasperson et al., 2005). These interventions allow for improved understanding of software features and business processes. Improved understanding allows end-users to increase utilization of ERP capabilities. Underutilized information systems limit the benefits organizations can gain from ERP systems (Jasperson et al., 2005).

Training Intervention and Understanding

Underutilization of information systems is partly due to Inadequate training (Jasperson et al., 2005). Project cost considerations often allow for just enough of the user population to be adequately trained. The training is typically the minimum amount needed for end-users to perform their tasks (Jones et al., 2008). Unfortunately, these abridged training interventions come at a critical time for user acceptance and adoption of information systems (Jones et al., 2008).

Training interventions affect the perceived understanding of the end-user. Understanding has two dimensions: software feature understanding and business process understanding. Software understanding and business process understanding are linked to each type of intervention (Jones et al., 2008). Improvements in each type of training intervention improve its corresponding understanding. These improvements are not necessarily uniform across the different types of interventions. Based on this discussion, the following two hypotheses are proposed:

> H_1: The greater the software training intervention, the greater the perceived software understanding.
>
> H_2: The greater the business process training intervention, the greater the perceived business process understanding.

However, the understanding gained is not limited to its intervention type. Some research suggests that the interventions of one type can affect the understanding of another (Jones et al., 2008). Software understanding is not solely influenced by software training interactions, nor is business process understanding solely influenced by business process training interventions. It is likely that each moderates the others affect on understanding. Software training interventions may improve the impact

business process training has on perceived business process understanding. Equally, business process training may improve the impact of software training interventions on perceived software understanding. Based on this discussion, the following two hypotheses are proposed:

> H_{3a}: Increased Software understanding from software training interventions is moderated by increased business process training interventions.
>
> H_{3b}: Increased Business process understanding from business process training interventions is moderated by increased software training interventions.

Experiential Interventions and Understanding

Along with training interventions, experiential interventions are critical to helping the organization establish initial routines for system use (Jasperson et al., 2005). Immediately after an end-user's initial ERP and business process training, they are most ready to apply their new found skills and understanding (Tyre and Orlikowski, 1994). There is a short timeframe where end-users have not yet established set routines; the result is a delicate balance between when training can be delivered and when it will be utilized. Early usage, after initial training, sets the stage for future utilization of the system (Jones et al., 2008; Jasperson et al., 2005).

These early uses of the system allow end-users to innovate and discover the capabilities provided by the system and the real-world requirements of the business process they are attempting to complete (Tyre and Orlikowski, 1994). As differences between expected and actual system capabilities become known, the desire to reconcile these differences drives end-users to search out 'new' capabilities not identified in the initial training interventions (Jasperson et al., 2005). As with training

interventions, experiential interventions are thought to increase end-user understanding (Jones et al., 2008). The type of intervention influences its corresponding understanding; it can influence how well the user understands the software features and business processes. Based on this discussion the following hypotheses are proposed:

> H_4: The greater the software experiential interventions, the greater the perceived software understanding.
>
> H_5: The greater the business process experiential interventions, the greater the perceived business process understanding.

Understanding and Utilization

Utilization is not simply a dichotomous measure of whether there is usage or not; rich utilization measures require that in addition to the user, the task being performed and the system features used are explicitly identified. Given that there may be a number of possible approaches to complete a given task, utilization has different scenarios to be considered. Business processes can be optional or required; the same is true for software features. Understanding supports the various optional/required combinations differently.

In the case of software, the understanding gained though software training interventions support required software feature utilization. Organizations train end-users to use the required features, not on optional features (Jones et al., 2008). The understanding generated by this training intervention is fundamental to required software feature utilization. This software understanding may also allow end-users to evaluate required features and apply them to optional business tasks. Thus, two hypotheses are proposed:

$H6_{\mathbf{a}}$: The greater the software understanding, the greater the required task and required feature utilization.

$H6_{\mathbf{b}}$: The greater the software understanding, the greater the optional task and required feature utilization.

Similar to software understanding, business process understanding supports required business tasks. Organizations train end-users to execute required business processes, not necessarily optional ones. The understanding generated is fundamental to required task utilization. However, with a business process understanding, and software understanding, end-users may be able to identify the use of optional software features to address required tasks. They may also identify required software features to support optional tasks, or the use of optional features to address optional tasks. Three hypotheses are proposed:

$H7_{\mathbf{a}}$: The greater the business process understanding, the greater the required task and optional feature utilization.

$H7_{\mathbf{b}}$: The greater the business process understanding, the greater the optional task and required feature utilization.

$H7_{\mathbf{c}}$: The greater the business process understanding, the greater the optional task and optional features utilization

While Hypotheses 6_a and 6_b have focused on the impact of software understanding on utilization, and Hypotheses 7_a, 7_b and 7_c have focused on the business process understanding impact on utilization, there is a combined effect to be considered. The two understandings may leverage each other for even greater increases in utilization.

The impact of business process understanding on utilization is improved when there is a base level of software understanding that can be leveraged (Jones et al., 2008). This allows the end-user to see new opportunities to use optional software features to address optional business tasks. It is posited that the opposite is also true, the impact of software understanding on utilization can be improved when there is a base level of business process understanding. Required features can be leveraged to address optional business tasks.

> $H8_{a}$: Optional task and optional feature utilization from business process understanding is moderated by software understanding.
>
> $H8_{b}$: Optional task and required feature utilization from software understanding is moderated by business process understanding.

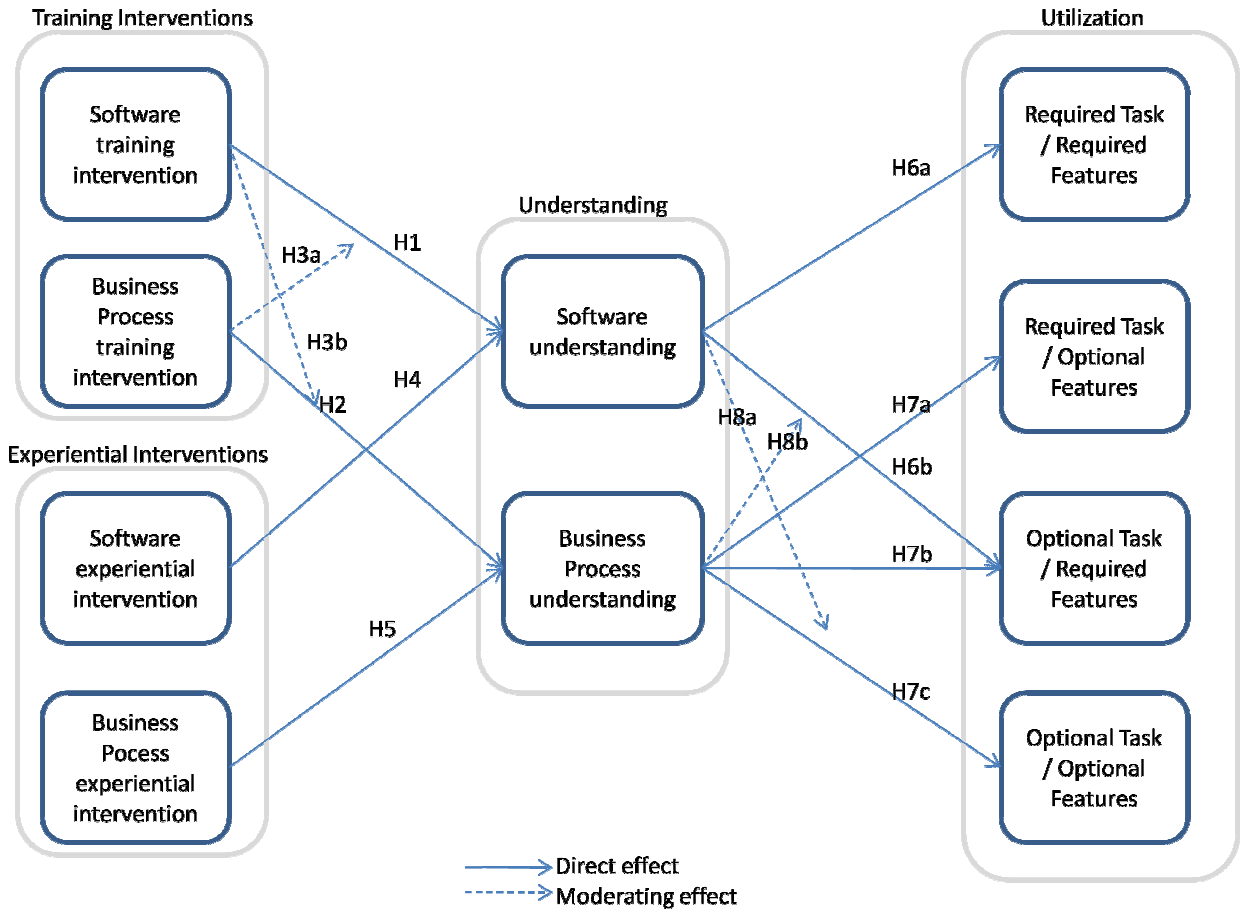

Figure 4. – Research model.

CHAPTER 3
METHODOLOGY

Introduction

This chapter describes the methodology that will be used to investigate this dissertation's hypotheses. First, the overall research design is presented. Then, the development and design of the survey instrument are described and independent and dependent variables are defined. Next, the research population and sample are discussed as well as the instrument administration. Reliability and validity are then described and data analysis procedures are presented.

Research Design

A number of possible study designs are available to researchers. The research question drives not only the research design, but also the methods of observation, measurement and types of analysis (Kerlinger and Lee, 2000). These decisions must also be balanced with practical matters of cost and administration effort (Kerlinger and Lee, 2000; Dillman, 2007). For this dissertation, the research design will be a field study. A survey instrument will serve as the method of data collection. Surveys provide the potential to extract large amounts of information from large populations with accuracy (Kerlinger and Lee, 2000).

Survey methodology is appropriate to use when 1) the research question is asking "what" or "why", 2) the control of the variables (both dependent and independent) is not possible, 3) the study cannot be conducted in a controlled environment, and 4) the topic of interest is currently occurring or is in the recent past. (Pinsonneault and Kraemer, 1993). The study in this dissertation meets these criteria.

Surveys provide a relatively inexpensive approach to reaching a large cross section of the desired population (Kerlinger and Lee, 2000). They also provide straight forward gathering of nominal, categorical and continuous measures (Kerlinger and Lee, 2000). The survey in this study is web-based. This approach avoids the costly activities of survey reproduction and postage, reduces data entry costs and reduces the effort and duration of survey distribution (Dillman, 2007). Coupled with e-mail, the communication costs with the survey population can also be reduced (Dillman, 2007).

Instrument Design and Development

The effectiveness of surveys is greatly impacted by the wording and content of the survey items. Research offers a number of techniques to improve survey items. First questions should be logically ordered (Schuman and Pressor, 1981). The questions need to be short and direct (Armstrong and Overton, 1971). Terminology for each question needs to be clearly understood by respondents (Dillman, 2007). Because the proposed survey population will be made up of enterprise resource planning (ERP) users familiar with a specific software product, the name of the software product (SAP) will be substituted for the term ERP in the survey instrument. This should minimize any confusion caused by end-users being unfamiliar with the term 'ERP'.

A two step process is used to refine the survey items. First, academic experts reviewed the items. Their knowledge of the subject matter and their experience as researchers was used to address any ambiguity in the question items, and the sequencing of the items. Second, 20 ERP end-users pilot tested the survey. The

appropriateness of each question was reviewed, based on their responses appropriate changes were made.

The instrument consists of three main sections (Appendix A). The first section is to collect demographic information of respondents. The second section measures the dependent variable, ERP Utilization. The third section measures the independent variables; training interventions, experiential interventions and perceived understanding. Four constructs are operationalized: Training interventions, experiential interventions, perceived understanding and ERP utilization. The first eight questions of the survey capture demographic information.

Demographic Information

Question 1 requests the respondents gender. Question 2 identifies the organization functional area that the respondent belongs. Ten areas are identified, with an additional 'other' category (with option to specify). The type of managerial responsibily is requested in question 3 (operational, mid-level, strategic). Next, the organization size is determined based on the number of employees. Respondents need not know the exact number, various ranges are provided. Question 5 captures the industry that the respondents organization is in. Ten industries are identified with an additional 'other' category provided (with option to specify). The respondent then identifies how long they have worked with the ERP system. Question 7 determines when the organization initiall implemented ERP. Question 8 requests the approximate percentage of employees that use the ERP.

ERP Utilization

Measures for the dependent variable assess the extent to which ERP end-users leverage SAP functionality. Item wording comes from question 8 of the user survey items in Jones et al. (2008). The groupings of features (SAP modules) were updated to include the complete list of core SAP function models from Hayen (2007). While the Jones et al. (2008) question addressed how much the ERP system is utilized, it does not address if that utilization is optional or required. Two additional questions were created for this dissertation; they interrogate the optional and required utilization of the SAP modules and associated business processes. Combined, these utilization questions will be used to classify respondents by the type of software and business process utilization they perform.

Training Interventions

Measures for software and business process training interventions are taken from the four training intervention items (questions 6 and 7) of the user survey items in Jones et al. (2008). Additional question items created for this survey interrogate the source of these training interventions.

Experiential Interventions

The 21 measures for experiential interventions are taken from questions 1, 2, 3 and 4 of the user survey items of Jones et al. (2008). Four additional items were created to capture the frequency that end-users experimented or explored ERP functionality and business process capabilities.

Understanding

Software understanding is measured by six items taken from question 9 in the user survey items of Jones et al. (2008). Business process understanding is measured by five items taken from question 10 in the user survey items of Jones et al. (2008).

Utilization

Respondent classification into one of the four utilization scenarios is determined based on respondent answers to questions 11 and 12. These items were developed for the survey instrument. Question 11 measures the respondent's mandated use of various ERP features. The individual functionality responses are averaged into a composite score. Respondents who indicated that more than 50 percent of their software use is mandated by the organization are classified as RF (required features). Those respondents with less than 50 percent of their ERP use mandated by the organization are classified as 'OF' (optional features).

Question 12 measures the type of task activity the respondent is responsible fore. Respondents who indicated that more than 50 percent of their business process task activity is voluntary are classified as OT (optional tasks), while those with less than 50 percent were classified as RT (required tasks). The two classifications are then comined into 1 of 4 utilization scenarios, RT/RF, RT/OF, OT/RF, OT/OF.

Research Population and Sample

The research question and hypothesis are focused on the end-users utilization of ERP functionality and capabilities. Our population will be end-users of ERP systems. A number of ERP user communities exist, both formal and informal. An organization with active participants, broad industry representation and sizeable member base is desired.

The Americas SAP User Group represents approximately 85,000 individuals in over 2000 organization spread across 17 industries. These individuals are distributed across all levels of the organization. Thus, this is the sampling frame used.

There are various approaches to determine an adequate sample size. An *a priori* power analysis is one recommended technique to determine an appropriate sample size (Cohen, 1988). Power is the probability of rejecting the null hypothesis when it is indeed false (Huck, 2004). In other words, power is the ability to correctly find a hypothesized relationship when it exists (Hair et al., 2006).

There are three steps when performing an *a priori* power analysis. First, the desired power is stated. A recommended minimum power level is .80 (Chin, 1998). Second, desired statistical significance (α) is identified. An α level of .05 is typical in research (Chin, 1998). The last step is to estimate the effect size. When engaged in new areas of research, a small effect size (0.2) is common (Cohen, 1988). These statistics provide the parameters needed for specialized software to calculate the proposed power. G*power 3, will be the power analysis software used for this dissertation. Using a power of .8, an α level of .05 and an effect size of 0.2, the minimum sample size needed is 35. A less formal approach, but one steeped in experience, are the general 'Rules of Thumb' presented by Hair et al. (2000). While simple regression can be performed with samples sizes as small as 20, Hair et al. suggests at least 10 observations per variable, and where possible a preferred ration of 20-to-1. No fewer than 50 observations should be used (Hair et al., 2000). Using Hair et al.'s most conservative sample size rules, our seven variables require a minimum of 140 observations.

Survey Administration

Proper execution of the survey will help assure the quality of the study results. The self-reported nature of surveys introduces potential concerns regarding response rates and non-response bias. Insufficient response rates may adversely affect the study results, reliability and validity.

Poor response rates can adversely affect the reliability and generalizability of the findings. Appropriate follow-up reminders, respondent support and promises of anonymity are a few approaches to improving survey response rates (Dillman, 2007). To increase the response rates, the following techniques will be utilized. The initial communication to survey participants will include clear instructions, and a statement that participation is voluntary, and that no identifying information is gathered in the execution of the survey (Dillman, 2007). Participants are also informed that the final analysis and executive summary will be shared with the Americas SAP User group upon completion of the dissertation.

A web-based survey will be used to obtain the sample data using a three-step process. First, a personalized e-mail will be sent to the sample population. It will provide a cover letter, a hyperlink to the instrument, and clear instructions. A second e-mail will be sent three weeks after the initial e-mail. This reminder will thank those who have already completed the survey, and remind those who have not participated to do so. This reminder will also reinforce the potential value of the survey results for the user group. A final reminder will be sent three weeks after the first reminder. Follow-up reminders have been shown to improve response rates (Dillman 2007).

Through out the data collection timeframe, analysis of the data will be made to identify non-response bias. The average values for each demographic will be compared weekly. Results will be assessed using t-tests and chi-square tests (Armstrong and Overton, 1977).

Reliability and Validity Issues

Reliability

Reliability is a measure of consistency. If we were to measure an object multiple times using the same instrument, we should get the same result each time with little or no measurement error (Kerlinger and Lee, 2000). Internal consistency is a commonly used indicator of reliability. This form of reliability assesses how consistently subjects respond to survey items (Cronbach, 1951). Cronbach's coefficient alpha is widely used as this reliability criterion. A coefficient greater than .80 is typically considered internally reliable (Nunnally and Bernstein, 1994). Cronbach's coefficient alpha is used to assess reliability on multi item scales.

Validity

There are many types of validity, but they all share a common focus: "are we measuring what we think we are measuring?" (Kerlinger and Lee, 2000). A number of validity forms exist: content, construct, convergence and discriminate, and external. Content validity is an assessment of how well the instrument items address the phenomena being investigated. Content validity is subjective; subject matter experts make a judgment as to whether or not the measure is representative of the domain (Huck, 2004; Kerlinger and Lee, 2000). One approach to minimize this subjectivity is to build the instrument using vetted items from instruments used in prior research. For this

dissertation, ERP subject matter experts from both industry and academia are used to assess content validity. The instrument is modified based on their feedback.

Construct validity is an assessment of the items thought to measure a given construct actually measure that construct. This allows for inferences from operationalizations to theoretical constructs (Hair et al., 2006). These inferences imply a dimensionality that can be used to assess the validity of a construct. Exploratory factor analysis is used to assess construct validity via this dimensionality, even when the items are new and their association with theoretical constructs is not known (Hair et al., 2006). In this dissertation, principle axis factor analysis with an orthogonal rotation is used to assess the dependent variables. Dimensionality of each factor will be examined by the factor loading. Factor loadings greater than 0.50 for items on hypothesized constructs will be considered adequate (Hair et al., 2006). Items with factor loadings greater than 0.40 on other factors is used to determine if they are indeed measuring another factor (Hair et al., 2006). Confirmatory factor analysis will be used on the resultant factor structure to assess dimensionality.

Convergent and discriminate validity are two aspects of construct validity. Convergent validity is the correlation of different measures indicating similar meanings of the construct (Kerlinger and lee, 2000). Discriminate validity is the use of different measures to empirically differentiate between constructs. Correlations between constructs are used to assess these two types of validity.

External validity addresses the causal relationships that can be generalized to various populations. Generalizability usually addresses the persons (subjects), the setting or the time (Kerlinger and Lee, 2000). While it is true that the sample will

represent a single software platform, the hallmark of ERP software is their uniform perspective of the enterprise. The aspects being investigated here are independent of the technology itself. The sample frame for this survey is a cross section of ERP users, organizations and industries.

Data Analysis Procedures

Our model is evaluated using two types of regression. Hypotheses 1 through 5 use Ordinary Least Square (simple) regression. Due to their binary dependent variables, Hypotheses 6_a through 8_b use logistic regression. While other modeling tools could have been used, the binary dependent variables are best addressed by logistic regression (Hair et al., 2000). Listwise missing data procedure is used to ensure that only complete observations are used for analysis. Because moderators have been modeled, special considerations need to be made in testing the moderated relationships. Moderating effects can be shown by performing multiple regression on dependent and independent variables. This is compared with a multiple regression on the dependent variable, along with the independent and moderator variable (Baron and Kenny, 1986). Table 7 provides the specific statistical tests that will be performed to test each hypothesis.

Pilot Study

A pilot study was conducted with a sample of 30 end-users at two major chemical manufacturers. While ample feedback was provided, only eight usable surveys were completed. This precluded any meaningful analysis of the responses. However, comments on the instrument itself were positive and no appreciable modifications were made to item questions. The poor response rate was attributed to the reluctance of

respondents to performing activities not directly related to the organization (like completing a survey).

Table 7 – Hypotheses and Statistical Tests

Hypotheses	Statistical test
H_1: The greater the software training intervention, the greater the perceived software understanding.	$swun= \beta_0+\beta_1 swti+\beta_2 swei+\varepsilon$
H_2: The greater the business process training intervention, the greater the perceived business process understanding.	$bpun= \beta_0+\beta_1 bpti+\beta 2 bpei+\varepsilon$
H_{3a}: Software understanding from software training interventions is moderated by business process training interventions.	$swun= \beta_0+\beta_1 swti+\beta_2 swei+\beta_3 bpti+\beta_4 (swti*bpti)+\varepsilon$
H_{3b}: Business process understanding from business process training interventions is moderated by software training interventions.	$bpun= \beta_0+\beta_1 swti+\beta_2 swei+\beta_3 bpti+\beta_4 (swti*bpti)+\varepsilon$
H_4: The greater the software experiential interventions, the greater the perceived software understanding.	$swun= \beta_0+\beta_1 swti+\beta_2 swei+\varepsilon$
H_5: The greater the business process experiential interventions, the greater the perceived business process understanding	$bpun= \beta_0+\beta_1 bpti+\beta_2 bpei+\varepsilon$
H_{6a}: The greater the software understanding, the greater the required task and required feature utilization.	$rtrf= \beta_0+\beta_1 swun+\varepsilon$
H_{6b}: The greater the software understanding, the greater the optional task and required feature utilization.	$otrf= \beta_0+\beta_1 bpun+\beta_2 swun+\varepsilon$
H_{7a}: The greater the business process understanding, the greater the required task and optional feature utilization.	$rtof= \beta_0+\beta_1 bpun+\varepsilon$
H_{7b}: The greater the business process understanding, the greater the optional task and required feature utilization.	$otrf= \beta_0+\beta_1 bpun+\beta_2 swun+\varepsilon$
H_{7c}: The greater the business process understanding, the greater the optional task and optional features utilization	$otof= \beta_0+\beta_1 bpun+\varepsilon$
H_{8a}: Optional task and optional feature utilization from business process understanding is moderated by software understanding.	$otof= \beta_0+\beta_1 bpun+\beta_2 swun+ \beta_3 (bpun*swun)+\varepsilon$
H_{8b}: Optional task and required feature utilization from software understanding is moderated by business process understanding.	$otrf= \beta_0+\beta_1 bpun+\beta_2 swun+ \beta_3 (swun*bpun)+\varepsilon$

swti = Software training intervention
bpti = Business process training intervention
swei = Software experiential intervention
bpei = Business process experiential intervention
swun = Software understanding
bpun = Business process understanding
rtrf = Required Task, Required Feature
rtof = Required Task, Optional Feature
otrf = Optional Task, Required Feature
otof = Optional Task, Optional Feature

CHAPTER 4
DATA ANALYSIS AND RESULTS

This chapter describes the data analysis and results for this dissertation. The chapter is divided into three sections. Response rate and analysis of non-response bias are discussed in the first section. The second section discusses sample characteristics, validity and reliability of the data and the instrument. The third section presents the statistical tests of the dissertation hypotheses.

Response Rate and Non-Response Bias

The research population for this dissertation consists of individuals from the Americas' SAP User Group (ASUG). ASUG represents approximately 85,000 potential respondents in over 2000 organizations spread across 17 industries in the United States and Canada. These individuals are distributed across all functional and managerial levels of the organization.

Collaborating with the research and benchmarking department of ASUG, the survey was administered to 45,670 members through three e-mails. The content of the emails was the same (see Appendix B) and the second e-mail was sent approximately three weeks after the first. The third e-mail was sent approximately three weeks after the second.

Of the total number of members exposed to the survey, the ASUG benchmarking team estimates that only about 25% of these members participate in ASUG activities, making an effective sampling frame of 11,417. Of the 308 responses collected, 43 responses were deemed incomplete, leaving 265 usable responses. This corresponds to a 2.3% response rate. This response rate is better than those often produced in web-based surveys (Basi, 1999).

Reasons for not completing e-mailed surveys include time constraints, dislike of surveys and lack of incentives (Basi, 1999). In addition, anecdotal evidence provided by pilot respondents indicated another reason. They voiced concern that performing activities not directly related to the organization (like completing a survey) could be negatively viewed by their immediate supervisors during an economic downturn. This survey was administered in 2010 when many firms were still grappling with a major US economic downturn. This sample size satisfies a much more aggressive power level and α requirement. The 265 usable responses allow for a power level of .95, α=.001 and an effect size of .1 .

Assessment of non-response bias was made by comparing early respondent demographic and independent variables to those of late respondents. It is assumed that late respondents who responded less readily are similar to those who would not respond at all (Kanuk and Berenson, 1975). This approach has been often used by IS researchers (Karahanna, Straub and Chervany 1999; Ryan, Harrison and Schkade 2002).

Independent Sample t-tests were used to examine the differences in responses between the initial e-mail (n=132) and responses from the second and third e-mails (n=133). As shown in Table 8, there are no significant differences for the independent variables between the early and late responders at the .05 level. The results indicate that there is no response bias at the .05 level for the independent variables.

Table 8 – Ind. Samples t-tests for Non-response Bias – Independent Var.

		t-test for Equality of Means				
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Independent Variables	Training Initiatives - Software	-.828	250	.409	-.0679	.0821
	Training Initiatives – Business Process	.609	241	.543	.0893	.1466
	Experiential Initiatives - Software	-.321	244	.748	-.0289	.0900
	Experiential Initiatives – Business Process	-.669	244	.504	-.0712	.1065
	Understanding - Software	.167	243	.868	.0193	.1159
	Understanding – Business Process	.470	240	.639	.0460	.0980

In addition, a chi-square test of independence was performed on the demographic responses. Similar in function to the independent sample t-test, the Chi Square determines if a relationship exists between discrete variables. Results provided in Table 9 show that for seven of the eight demographic questions, there is no significant difference between the means of early and late responders. The one exception is ‘Industry’. Specifically, respondents in the manufacturing industry, and those who reported as ‘other’ responded later than those in the other five industries.

Table 9 – Chi-squared Test for Non-response Bias – Demographics

	χ^2
Gender	.323
Functional Area	.279
Activity Type	.473
Organization Size	.373
Industry	.050**
Ind Length of ERP usage	.993
Organization ERP usage	.430
Percent of users	.522

Missing Data and Univariate Normality Tests

The data were examined for missing values. Of 308 respondents, there were 43 for which insufficient answers were provided. These were removed from the data set. The data were examined for normality and all independent and dependent variables were examined for sknewness and kurtosis. Skewness values between -3 and 3 and kurtosis values between -8 and 8 are deemed acceptable (Kline, 1997). All independent and dependent variables were within the acceptable range.

Demographics

The majority of respondents were male (62%). Half of all respondents worked within the IT function of their organization (Table 10). Forty-five percent of respondents identified themselves as having an operational focus in their daily activities, while another 41% identified themselves as mid-level management. Only 13% self-identified as upper-level management (Table 11). Sixty-eight percent of respondents have over 5

years experience with enterprise resource planning (ERP) systems including 45% that have more than 10 years experience (Table 12).

Table 10 - Descriptive Statistics on Respondent Functional Area

	Number of responses	Percentage
General Management	8	3.02%
Corporate Communications	-	-
Finance / Accounting / Planning	34	12.83%
Human Resources / Personnel	19	7.17%
Information Technology	135	50.94%
Legal	-	-
Manufacturing / Operations	16	6.04%
Marketing	4	1.51%
Sales	6	2.26%
Supply Chain	28	10.57%
Other	15	5.66%
Total	265	100.00%

Table 11 - Descriptive Statistics on Respondents Focus of Activity

	Number of responses	Percentage
Operational/Tactical	121	45.66%
Mid-Level Management	110	41.51%
Upper-level Management/Strategic	34	12.83%
Total	265	100.00%

Table 12 - Descriptive Statistics on Respondent Time Using ERP

	Number of responses	Percentage
Less than 1 year	7	2.64%
Between 1 year and less than 5 years	73	27.55%
Between 5 years and less than 10 years	58	21.89%
Between 10 years and less than 15 years	106	40.00%
15 years or greater	21	7.92%
Total	265	100.00%

Most organizations represented in the data were large, with 45% having more than 5000 employees. This is typical of organizations implementing ERP systems, and the targeted sample population (Table 13). A majority of early implementers of ERP are large organizations who could more easily manage the costs and organizational needs of these expensive system implementations (Equey and Fragniere, 2008). A large portion of respondents (50%) are involved in manufacturing (Table 14); government, utilities and wholesale are also well represented. Thirty five percent of respondents are using ERP systems initially implemented during the late 1990s; while approximately the same percentage of respondents are using ERP systems implemented in the last 5 years (Table 15). Only 20% of respondents are using ERP system implemented shortly after Y2K (2000-2004). Very few respondents (3.7 %) are using ERP systems implemented before 1995. The number of identified ERP users for each organization is flatly distributed across the range of possible values (Table 16).

Table 13 - Descriptive Statistics on Organization Size

	Number of responses	Percentage
Less than 100	13	4.91%
100-499	25	9.43%
500-999	25	9.43%
1,000-4,999	78	29.43%
5,000-9,999	26	9.81%
10,000-14,999	30	11.32%
15,000 or more	68	25.66%
Total	265	100.00%

Table 14 - Descriptive Statistics on Organization Industry

	Number of responses	Percentage
Aerospace and Defense	3	1.13%
Banking	-	-
Consulting	3	1.13%
Education	10	3.77%
Finance	-	-
Government	22	8.30%
Insurance	2	0.75%
Manufacturing	133	50.19%
Transportation	9	3.40%
Technology	8	3.02%
Utilities	30	11.32%
Wholesale & Retail Trade	21	7.92%
Other	24	9.06%
Total	265	100.00%

Table 15 - Descriptive Statistics of the Year Organizations Initially Installed ERP

	Number of responses	Percentage
2009 - 2010	26	9.81%
2005 - 2008	70	26.42%
2000 - 2004	56	21.13%
1995 - 1999	93	35.09%
< 1995	10	3.77%
Missing	10	3.77%
Total	265	100.00%

Table 16 - Descriptive Statistics on the Percent of ERP Users in Organizations

	Number of responses	Percentage
Less than 25%	54	20.38%
25% to less than 50%	77	29.06%
50% to less than 75%	56	21.13%
Greater than 75%	77	29.06%
Missing	1	0.38%
Total	265	100.00%

Exploratory Factor Analysis and Internal Consistency

The survey instrument used several measurement items to measure each of the constructs used as variables in the study's hypotheses. Dimensionality and reliability are used to assess the construct validity of the construct items (Kerlinger & Lee, 2000).

An exploratory factor analysis is used to assess the dimensionality of the measurement items. This assesses the correlation among the items thought to measure a given dimension (factor). These factors reflect the constructs being examined. The 48 items are hypothesized to load on six factors: software training intervention, business process training intervention, software experiential intervention, business process experiential intervention, software understanding and business process understanding.

Principle Component Analysis using a Varimax rotation with an Eigenvalue greater than 1 is used to extract the number of factors. The loading of each item on the factor is used to assess whether the item is representative of the factor (Hair et al., 1998). As a rule, two criteria are used to assess factor loadings. First, items with a factor loading great than 0.5 are considered satisfactory measures of a factor. Second, items with a primary loading greater than 0.5 on one factor, yet have a secondary loading greater than 0.4 on another factor are not considered dependable measures of the factor (Hair et al., 1998) The initial exploratory factor loading of the independent variable items is shown in Table 17.

Table 17 - Initial Independent Variable Factor Analysis

	Component										
	1	2	3	4	5	6	7	8	9	10	11
UN204	**.887**	.341	.086	.060	.133	.137	.025	.033	-.037	.002	.009
UN205	**.879**	.293	.114	.079	.123	.186	-.010	.059	-.058	-.012	.003
UN202	**.873**	.339	.054	.045	.136	.164	.015	.025	-.042	.020	-.021
UN201	**.861**	.335	.087	.066	.153	.196	-.007	.057	-.013	.003	.030
UN203	**.853**	.325	.133	.026	.148	.124	.044	.007	-.063	.004	.058
UN103	.360	**.759**	.107	.012	.113	.081	-.034	.064	-.010	.029	-.009
UN106	.252	**.734**	.224	.116	.132	.128	.035	.049	-.035	.119	.108
UN104	.419	**.723**	.063	.062	.170	.122	-.017	-.031	-.093	-.021	.070
UN102	.221	**.719**	.334	.073	.085	.030	-.002	.090	-.007	.013	-.065
UN101	.375	**.703**	.116	.114	.169	.176	-.063	.012	-.104	.107	.053
UN105	.174	**.665**	.187	.164	.007	-.024	.123	.078	.169	-.015	-.022
UN401	.414	**.592**	.139	.247	.088	.202	.017	-.005	-.142	.162	-.031
UN304	.100	.231	**.844**	.096	.001	.108	.008	.013	.003	.132	-.025
UN302	.082	.091	**.838**	.141	.085	.002	.018	.013	-.122	.062	.006
UN303	.027	.160	**.837**	.090	-.050	.047	-.035	.069	-.143	.010	-.024
UN305	.080	.118	**.802**	.073	.036	.112	.147	.090	-.002	.011	.027
UN301	.109	.172	**.698**	.138	.006	.013	.142	.030	.075	.121	-.013
UN501	.012	.067	.181	**.848**	.042	-.009	.032	.006	.066	.130	-.069
UN504	.039	.102	.064	**.840**	.000	.014	.081	.006	.144	.042	.084
UN503	.049	.091	.064	**.791**	.068	.086	.117	.001	.109	.020	.139
UN502	.020	.034	.121	**.784**	-.024	.053	.125	-.020	.107	.114	-.038
UN402	.126	.149	.083	**.761**	-.056	-.003	-.003	-.074	-.091	.049	.007
EI104	.166	.065	.051	-.016	**.877**	.152	.125	.010	.102	-.023	-.146
EI103	.183	.062	.048	.037	**.850**	.141	.102	.026	.090	-.036	-.188
EI102	.110	.162	.020	-.015	**.755**	.322	.033	.144	-.097	.134	.199
EI101	.157	.179	-.006	-.009	**.748**	.297	.068	.095	-.063	.162	.192
EI203	.074	.201	-.038	.043	**.630**	.226	-.010	.230	-.151	-.091	.222
EI402	.200	.171	.049	.049	.206	**.810**	.111	.131	-.185	.029	-.164
EI403	.251	.121	.056	.059	.219	**.808**	.156	.086	-.143	-.033	-.129
EI405	.179	.197	.146	-.002	.255	**.776**	.147	.077	-.133	.121	-.066
EI401	.205	.006	.076	.045	.291	**.686**	-.011	-.082	.103	-.096	.288
EI404	.116	.058	.065	.050	.327	**.618**	.016	-.106	.164	-.025	.377
EI303	.005	.099	.081	.138	.076	.141	**.812**	.091	.005	.034	.231
EI304	-.026	.075	.131	.148	.017	.176	**.777**	.060	-.037	.087	.201
EI302	.009	-.085	.052	-.015	.118	-.008	**.770**	.008	.081	.074	-.153
EI301	.041	-.053	.030	.074	.029	.005	**.699**	.002	.368	.003	-.240
TI106	.073	.134	-.076	-.087	.245	.000	-.083	**.706**	-.068	.040	.081
TI105	.030	.015	-.005	.036	-.111	.046	.048	**.689**	.139	.147	.160
EI201	-.072	.189	.093	-.101	.155	.047	.192	**.684**	.070	.038	-.254

EI202	-.042	.130	.164	.047	.034	.148	.227	**.600**	.018	.010	-.403
TI103	.095	-.218	.213	-.019	.120	-.090	-.105	**.600**	.033	-.214	.058
TI102	.183	-.054	.006	.126	-.009	.067	.290	**.331**	.300	.224	.034
TI104	-.104	.012	-.121	.097	-.034	-.168	.035	.121	**.781**	.092	.111
TI101	-.111	-.063	-.066	.193	.020	-.040	.207	.054	**.706**	.025	-.075
TI201	.011	.138	.251	.260	-.019	.056	.165	.002	.209	**.729**	-.021
TI202	.005	.110	.194	.338	.128	.051	.209	.109	.101	**.685**	.059
EI204	-.011	-.005	-.007	.079	-.024	.295	.307	-.060	.298	**-.466**	.145
EI305	.031	.120	-.013	.219	.133	.060	.476	.061	.055	-.041	**.575**

UN = Understanding
TI = Training Intervention
EI = Experiential Intervention

Using the stated criteria, the initial factor loadings were reviewed. Items identified as cross loading, or failing to achieve a sufficient minimum loading were identified for removal. After an item was removed, the EFA analysis was re-executed and all item loadings were again reviewed. Fourteen EFA runs were completed. In the initial run, item UN401– “Where on the ERP learning curve do you think you are?” was identified as having an undesirable cross loading of .414 (Table 17). The item was removed and the EFA re-executed. The resulting factor loading is shown in Table 18. Upon examination, item EI305– “Managers support of SAP in the last year: Personally uses ERP Software?” was identified for removal due to a heavy cross loading of .471. The rerun EFA (Table 19) shows that item TI102– “How much have you relied on the following within the last year: external formal training paid for by my company” failed to achieve a minimum loading of 0.5 on any factor, so it was removed. The fourth EFA run (Table 20) identified item UN101– “Your level of understanding for: navigation of the ERP software” as cross loading (.405) and was removed. The fifth EFA run identified UN104-“Level of understanding: performing transaction using the ERP software” as cross loading (.505), therefore it was removed (Table 21).

The next EFA run (Table 22) identified UN103– “Your level of understanding for: what is meant by master data in the ERP software” as cross loading (.523) and was removed. The seventh run identified UN102– “Your level of understanding for: what is meant by organizational units in the ER software” with a three way cross loading (Table 23), yet with no single factor greater than 0.5, thus it was removed. The eight run identified item UN106– “Your level of understanding for: producing reports in the ERP system” as cross loading (Table 24), therefore it was removed. The ninth run showed that UN105– “Your level of understanding for: what is meant by workflow in the ERP system” failed to sufficiently load on any factor, it was removed (Table 25). The same is true in the 10th run, item EI204–“failed to load on any factor (Table 26). While the 11th run appears to be a stable EFA (Table 27), Item TI202–“Overall I feel that my training on how my ob changed after ERP was…” was removed because it is the single item that best represents business process training intervention variable. After re-running the EFA, it was found that TI201–“Overall, I feel that my training on how to use the ERP software was…” failed to load on any factors (Table 28) and was removed.

With all items meeting a sufficient minimum loading, and with all cross loading items removed. Internal consistency for each factor was then examined using Cronbach’s alpha (Table 29). A minimum value of .7 is considered acceptable (Hair et al., 1998). Cronbach’s alpha requires three or more items to properly measure internal reliability. When only two items are available (as in the case for factor 8), internal reliability is assessed using a correlation between items. Factors 1 thru 7 achieved minimum Cronbach’s alpha of .7 or above. The two items for factor 8 (TI101 and TI104) were found to have a significant ($p<.000$) correlation (**Table 29**).

Table 18 – 2nd EFA Run – 1st Item Removed

	Component										
	1	2	3	4	5	6	7	8	9	10	11
UN204	**.905**	.089	.066	.134	.289	.136	.027	.033	-.040	.006	.010
UN205	**.894**	.117	.084	.124	.242	.185	-.007	.060	-.060	-.009	.005
UN202	**.891**	.058	.050	.137	.287	.164	.016	.024	-.043	.024	-.020
UN201	**.878**	.089	.073	.154	.288	.195	-.004	.058	-.018	.008	.030
UN203	**.870**	.135	.032	.148	.276	.121	.047	.008	-.068	.009	.059
UN304	.110	**.849**	.097	.001	.208	.108	.005	.012	.006	.133	-.017
UN303	.034	**.841**	.091	-.049	.144	.048	-.034	.067	-.142	.010	-.024
UN302	.084	**.839**	.142	.086	.074	.000	.020	.013	-.123	.061	.004
UN305	.082	**.804**	.073	.038	.103	.110	.149	.089	-.001	.009	.029
UN301	.112	**.694**	.143	-.001	.167	.017	.140	.026	.068	.132	-.016
UN501	.016	.185	**.847**	.046	.048	-.009	.031	.005	.072	.127	-.066
UN504	.043	.061	**.843**	.003	.100	.012	.084	.008	.136	.044	.078
UN503	.049	.062	**.794**	.067	.087	.084	.118	.003	.102	.023	.136
UN502	.021	.122	**.786**	-.023	.024	.055	.123	-.023	.109	.115	-.038
UN402	.137	.093	**.758**	-.055	.116	-.003	-.008	-.073	-.082	.050	.018
EI104	.175	.055	-.019	**.879**	.045	.149	.121	.005	.115	-.024	-.126
EI103	.192	.053	.034	**.852**	.039	.139	.099	.021	.105	-.039	-.169
EI102	.120	.016	-.011	**.757**	.158	.314	.040	.146	-.108	.133	.192
EI101	.168	-.009	-.004	**.750**	.172	.289	.074	.097	-.074	.162	.186
EI203	.083	-.047	.050	**.631**	.213	.221	.004	.229	-.169	-.087	.196
UN103	.405	.111	.025	.115	**.743**	.088	-.035	.056	-.023	.043	-.022
UN106	.296	.230	.125	.139	**.711**	.129	.037	.047	-.046	.128	.100
UN104	.464	.073	.070	.175	**.689**	.124	-.019	-.033	-.098	-.012	.070
UN102	.267	.348	.077	.094	**.687**	.035	-.004	.085	-.003	.017	-.063
UN105	.212	.188	.175	.011	**.662**	-.017	.124	.071	.156	-.003	-.036
UN101	.420	.130	.118	.176	**.660**	.176	-.065	.012	-.104	.112	.058
EI402	.215	.050	.053	.214	.151	**.814**	.113	.119	-.180	.029	-.161
EI403	.263	.059	.061	.228	.096	**.809**	.157	.077	-.136	-.036	-.120
EI405	.195	.148	.001	.264	.175	**.776**	.149	.070	-.130	.120	-.058
EI401	.207	.083	.041	.289	-.022	**.674**	-.017	-.072	.106	-.094	.331
EI404	.121	.074	.045	.325	.033	**.604**	.009	-.093	.165	-.023	.423
EI303	.006	.074	.143	.080	.110	.137	**.817**	.089	-.002	.034	.210
EI304	-.025	.118	.153	.025	.092	.172	**.785**	.058	-.049	.083	.169
EI302	.011	.056	-.021	.121	-.094	-.007	**.765**	.002	.102	.073	-.141
EI301	.042	.041	.065	.030	-.074	.007	**.688**	-.005	.398	.001	-.211
TI106	.077	-.075	-.085	.245	.135	.001	-.078	**.708**	-.075	.038	.057
TI105	.029	.004	.033	-.116	.007	.045	.044	**.695**	.140	.146	.161
EI201	-.061	.090	-.099	.161	.203	.059	.197	**.669**	.071	.040	-.282
TI103	.077	.216	-.025	.121	-.226	-.096	-.101	**.607**	.039	-.228	.051

EI202	-.032	.161	.049	.038	.140	.166	.229	**.580**	.026	.018	-.425
TI102	.182	.009	.123	.001	-.070	.057	.296	**.337**	.302	.208	.038
TI104	-.112	-.130	.101	-.038	.043	-.170	.034	.126	**.767**	.094	.112
TI101	-.120	-.067	.191	.018	-.050	-.040	.200	.053	**.710**	.023	-.060
TI201	.016	.251	.263	-.021	.126	.060	.160	.000	.206	**.736**	-.020
TI202	.010	.195	.340	.127	.097	.052	.207	.110	.098	**.690**	.056
EI204	-.017	-.017	.082	-.027	.020	.294	.311	-.062	.287	**-.459**	.150
EI305	.034	-.007	.217	.124	.115	.048	.471	.075	.047	-.032	**.587**

Table 19 – 3rd EFA Run – 2nd item removed

	Component									
	1	2	3	4	5	6	7	8	9	10
UN204	**.898**	.087	.301	.067	.138	.140	.022	.029	-.038	.000
UN205	**.894**	.115	.246	.083	.126	.183	-.016	.058	-.066	-.006
UN202	**.889**	.056	.293	.050	.140	.157	.017	.026	-.054	.023
UN201	**.873**	.087	.297	.074	.157	.201	-.009	.052	-.018	.001
UN203	**.859**	.133	.293	.035	.153	.140	.030	-.003	-.051	.000
UN304	.114	**.849**	.201	.096	-.002	.102	.014	.030	-.009	.139
UN303	.036	**.841**	.138	.089	-.051	.041	-.043	.082	-.145	.022
UN302	.077	**.838**	.080	.144	.087	.010	.010	.020	-.110	.060
UN305	.074	**.801**	.113	.077	.036	.122	.149	.097	.003	-.004
UN301	.109	**.693**	.170	.147	.001	.014	.153	.037	.059	.115
UN103	.398	.114	**.746**	.024	.116	.075	-.025	.075	-.031	.038
UN106	.279	.231	**.725**	.129	.141	.149	.025	.051	-.019	.113
UN104	.451	.076	**.699**	.070	.177	.135	-.030	-.027	-.085	-.013
UN101	.407	.131	**.671**	.119	.176	.185	-.073	.020	-.089	.107
UN102	.274	.351	**.667**	.072	.093	.010	.003	.116	-.029	.043
UN105	.216	.192	**.647**	.171	.013	-.035	.138	.096	.129	.008
UN504	.039	.059	.105	**.847**	.005	.027	.086	-.005	.145	.019
UN501	.023	.186	.039	**.845**	.046	-.028	.047	.020	.049	.130
UN503	.032	.062	.108	**.797**	.067	.121	.106	-.009	.131	.004
UN502	.028	.121	.017	**.784**	-.025	.040	.138	-.009	.082	.118
UN402	.144	.094	.106	**.757**	-.052	-.009	-.021	-.073	-.088	.062
EI104	.189	.057	.021	-.026	**.874**	.125	.155	.035	.051	.000
EI103	.210	.056	.009	.024	**.846**	.102	.136	.057	.029	-.006
EI102	.095	.012	.184	-.002	**.756**	.371	.008	.123	-.057	.099
EI101	.143	-.013	.199	.005	**.749**	.346	.046	.076	-.025	.130
EI203	.062	-.050	.231	.057	**.632**	.274	-.044	.204	-.114	-.107
EI401	.189	.080	.002	.046	.275	**.749**	-.027	-.096	.131	-.108
EI403	.281	.056	.077	.052	.208	**.747**	.193	.140	-.245	.006
EI402	.235	.047	.130	.045	.195	**.739**	.154	.189	-.295	.068
EI405	.204	.144	.167	-.003	.246	**.735**	.177	.123	-.209	.144

EI404	.096	.071	.064	.055	.315	**.706**	-.012	-.133	.219	-.051
EI302	.015	.051	-.098	-.019	.123	-.039	**.781**	.038	.042	.082
EI303	-.029	.065	.159	.161	.086	.194	**.776**	.072	.044	-.021
EI304	-.058	.108	.139	.170	.029	.216	**.750**	.049	-.013	.033
EI301	.073	.042	-.114	.057	.027	-.054	**.737**	.049	.282	.042
EI201	-.026	.088	.150	-.107	.158	-.023	.208	**.725**	-.006	.088
TI106	.051	-.081	.165	-.073	.251	.031	-.119	**.681**	.007	-.014
EI202	.026	.159	.060	.034	.033	.028	.270	**.666**	-.123	.087
TI105	.007	-.004	.035	.046	-.110	.094	-.001	**.657**	.229	.093
TI103	.064	.211	-.213	-.023	.122	-.057	-.143	**.579**	.105	-.242
TI102	.178	.003	-.063	.131	.004	.072	.296	**.328**	.314	.178
TI104	-.121	-.129	.053	.106	-.039	-.123	.076	.103	**.791**	.052
TI101	-.096	-.062	-.084	.180	.009	-.049	.252	.080	**.643**	.059
TI201	.012	.249	.134	.265	-.025	.066	.171	.021	.212	**.731**
TI202	-.005	.192	.116	.345	.126	.080	.186	.114	.138	**.673**
EI204	-.018	-.021	.024	.091	-.027	.308	.345	-.072	.247	**-.498**

Table 20 – 4th EFA Run – 3rd Item Removed

	Component									
	1	2	3	4	5	6	7	8	9	10
UN204	**.900**	.086	.301	.068	.138	.139	.021	.028	-.041	.000
UN205	**.894**	.114	.247	.083	.127	.183	-.019	.055	-.071	-.006
UN202	**.894**	.054	.290	.049	.138	.158	.015	.028	-.052	.028
UN201	**.879**	.085	.292	.074	.154	.203	-.010	.055	-.015	.007
UN203	**.858**	.133	.296	.035	.155	.138	.027	-.007	-.057	-.002
UN304	.114	**.848**	.201	.096	-.002	.101	.015	.031	-.010	.141
UN303	.033	**.841**	.141	.089	-.050	.039	-.042	.081	-.147	.020
UN302	.072	**.839**	.085	.144	.089	.008	.009	.015	-.116	.057
UN305	.076	**.800**	.111	.078	.035	.122	.150	.099	.003	.001
UN301	.111	**.693**	.168	.147	.000	.015	.152	.037	.059	.121
UN103	.397	.114	**.746**	.023	.116	.075	-.025	.077	-.031	.041
UN106	.274	.231	**.728**	.129	.143	.148	.025	.050	-.025	.112
UN104	.439	.078	**.710**	.071	.182	.131	-.032	-.034	-.098	-.023
UN101	.405	.131	**.673**	.119	.177	.183	-.072	.022	-.091	.106
UN102	.275	.351	**.665**	.071	.092	.011	.005	.119	-.027	.047
UN105	.212	.192	**.651**	.173	.014	-.036	.140	.096	.123	.008
UN504	.034	.060	.110	**.848**	.008	.026	.085	-.011	.133	.017
UN501	.020	.186	.042	**.846**	.048	-.029	.045	.014	.040	.130
UN503	.035	.061	.105	**.797**	.066	.123	.108	-.007	.130	.010
UN502	.038	.119	.008	**.783**	-.030	.044	.139	-.003	.089	.132
UN402	.138	.095	.113	**.757**	-.049	-.012	-.022	-.080	-.098	.056
EI104	.189	.057	.021	-.026	**.874**	.123	.156	.034	.050	.001

EI103	.207	.057	.013	.025	**.848**	.100	.135	.051	.021	-.009
EI102	.089	.012	.189	.000	**.760**	.366	.008	.118	-.068	.093
EI101	.139	-.013	.202	.006	**.752**	.342	.045	.072	-.034	.126
EI203	.071	-.050	.220	.053	**.626**	.278	-.043	.212	-.100	-.094
EI401	.195	.079	-.002	.046	.274	**.751**	-.026	-.090	.137	-.098
EI403	.283	.056	.074	.050	.208	**.747**	.189	.138	-.248	.013
EI402	.232	.048	.131	.044	.197	**.737**	.149	.183	-.303	.070
EI405	.201	.144	.168	-.003	.249	**.732**	.173	.118	-.218	.145
EI404	.093	.070	.068	.057	.318	**.704**	-.011	-.133	.213	-.051
EI302	.016	.050	-.097	-.015	.124	-.041	**.784**	.037	.034	.083
EI303	-.028	.064	.158	.164	.087	.194	**.778**	.072	.037	-.016
EI304	-.049	.106	.129	.170	.025	.220	**.752**	.056	-.008	.048
EI301	.073	.041	-.111	.061	.029	-.054	**.737**	.044	.270	.045
EI201	-.006	.086	.128	-.110	.149	-.015	.207	**.736**	.011	.115
TI106	.050	-.082	.165	-.069	.255	.027	-.115	**.681**	-.004	-.020
EI202	.050	.156	.034	.030	.023	.038	.269	**.678**	-.101	.120
TI105	-.007	-.006	.052	.059	-.096	.082	.005	**.648**	.194	.067
TI103	.071	.211	-.220	-.021	.120	-.055	-.139	**.583**	.108	-.237
TI104	-.105	-.133	.040	.110	-.044	-.118	.083	.119	**.802**	.070
TI101	-.078	-.064	-.101	.179	.002	-.040	.251	.090	**.657**	.086
TI201	.030	.245	.116	.263	-.031	.069	.166	.032	.222	**.753**
TI202	.000	.189	.112	.345	.127	.078	.179	.112	.129	**.680**
EI204	-.010	-.021	.016	.090	-.032	.316	.348	-.066	.260	**-.479**

Table 21 – 5th EFA Run – 4th item removed

	Component									
	1	2	3	4	5	6	7	8	9	10
UN204	**.922**	.090	.071	.138	.139	.019	.222	.029	-.041	.004
UN202	**.915**	.059	.052	.139	.158	.015	.206	.029	-.051	.031
UN205	**.912**	.118	.086	.127	.183	-.020	.167	.056	-.071	-.003
UN201	**.901**	.089	.076	.155	.203	-.012	.212	.056	-.015	.011
UN203	**.880**	.137	.038	.156	.139	.025	.219	-.006	-.057	.003
UN304	.130	**.851**	.097	.000	.103	.012	.175	.031	-.011	.143
UN303	.042	**.842**	.089	-.048	.041	-.045	.130	.080	-.148	.021
UN302	.077	**.840**	.144	.089	.009	.009	.059	.015	-.116	.056
UN305	.083	**.802**	.078	.036	.124	.150	.090	.099	.003	.001
UN301	.124	**.696**	.148	.002	.016	.151	.140	.038	.058	.122
UN504	.042	.063	**.849**	.009	.027	.084	.097	-.011	.133	.018
UN501	.024	.188	**.846**	.048	-.029	.045	.022	.015	.040	.130
UN503	.042	.062	**.798**	.067	.124	.106	.098	-.007	.130	.011
UN502	.035	.119	**.783**	-.031	.045	.138	.002	-.002	.088	.132
UN402	.147	.097	**.758**	-.048	-.011	-.024	.093	-.079	-.099	.058

EI104	.194	.058	-.025	**.873**	.122	.159	-.017	.035	.050	.000
EI103	.210	.058	.025	**.848**	.099	.138	-.024	.053	.022	-.010
EI102	.106	.015	.001	**.763**	.367	.004	.172	.117	-.068	.094
EI101	.157	-.009	.007	**.755**	.343	.042	.177	.071	-.034	.127
EI203	.088	-.049	.054	**.629**	.281	-.049	.222	.209	-.102	-.090
EI403	.288	.056	.051	.208	**.749**	.187	.046	.137	-.246	.013
EI401	.200	.081	.047	.274	**.748**	-.025	-.042	-.090	.140	-.100
EI402	.243	.050	.044	.198	**.739**	.145	.104	.182	-.301	.071
EI405	.216	.147	-.002	.250	**.735**	.168	.145	.117	-.217	.147
EI404	.106	.074	.058	.320	**.701**	-.011	.035	-.132	.216	-.052
EI302	.011	.052	-.015	.123	-.042	**.789**	-.114	.041	.034	.080
EI303	-.019	.065	.164	.088	.198	**.775**	.173	.071	.036	-.013
EI304	-.044	.105	.170	.026	.224	**.747**	.157	.054	-.010	.051
EI301	.061	.038	.061	.026	-.054	**.740**	-.108	.045	.269	.045
UN106	.337	.245	.134	.154	.151	.012	**.698**	.049	-.029	.123
UN103	.464	.130	.029	.128	.077	-.035	**.696**	.078	-.033	.050
UN105	.263	.201	.177	.024	-.031	.127	**.650**	.093	.118	.020
UN104	.505	.096	.077	.193	.132	-.040	**.643**	-.032	-.100	-.016
UN102	.336	.367	.076	.103	.012	-.004	**.615**	.121	-.029	.055
EI201	.002	.087	-.110	.151	-.013	.204	.133	**.735**	.009	.117
TI106	.064	-.079	-.068	.257	.028	-.117	.157	**.681**	-.004	-.020
EI202	.053	.158	.030	.023	.039	.269	.023	**.679**	-.102	.120
TI105	-.002	-.003	.060	-.095	.081	.005	.046	**.649**	.194	.066
TI103	.053	.208	-.022	.116	-.058	-.132	-.243	**.585**	.110	-.244
TI104	-.107	-.136	.109	-.044	-.118	.080	.075	.117	**.800**	.073
TI101	-.089	-.066	.178	.000	-.041	.255	-.091	.091	**.657**	.084
TI201	.038	.248	.264	-.029	.069	.164	.098	.033	.222	**.755**
TI202	.008	.192	.346	.129	.079	.176	.098	.113	.128	**.681**
EI204	-.009	-.022	.089	-.033	.316	.347	.032	-.067	.260	**-.478**

Table 22 – 6th EFA Run – 5th Item Removed

	Component									
	1	2	3	4	5	6	7	8	9	10
UN204	**.935**	.094	.077	.143	.141	.021	.026	.148	-.043	.003
UN202	**.927**	.062	.058	.144	.159	.016	.025	.144	-.054	.028
UN205	**.920**	.120	.090	.130	.185	-.018	.052	.098	-.072	-.004
UN201	**.912**	.092	.082	.160	.203	-.010	.052	.148	-.017	.007
UN203	**.893**	.142	.045	.160	.140	.028	-.009	.148	-.060	.001
UN304	.144	**.856**	.101	.003	.106	.011	.033	.136	-.008	.146
UN303	.053	**.845**	.095	-.042	.041	-.048	.081	.104	-.147	.023
UN302	.081	**.840**	.150	.092	.009	.009	.015	.034	-.115	.054
UN305	.090	**.802**	.086	.040	.124	.153	.097	.075	.001	-.003

UN301	.136	**.696**	.154	.003	.020	.156	.036	.127	.057	.117
UN504	.051	.072	**.852**	.017	.027	.085	-.012	.098	.128	.015
UN501	.028	.195	**.847**	.050	-.024	.046	.018	-.002	.043	.134
UN503	.051	.069	**.801**	.071	.123	.110	-.008	.099	.124	.006
UN502	.039	.121	**.785**	-.029	.048	.140	-.003	.003	.088	.131
UN402	.157	.105	**.761**	-.046	-.006	-.022	-.077	.067	-.095	.062
EI104	.195	.062	-.022	**.871**	.122	.158	.032	-.061	.056	.011
EI103	.212	.061	.027	**.845**	.099	.137	.049	-.065	.028	.001
EI102	.117	.022	.010	**.770**	.361	.005	.112	.163	-.072	.084
EI101	.168	-.001	.016	**.762**	.338	.044	.068	.157	-.037	.119
EI203	.102	-.041	.054	**.639**	.271	-.056	.207	.204	-.103	-.101
EI403	.291	.058	.053	.211	**.751**	.186	.138	.017	-.243	.019
EI401	.195	.080	.051	.274	**.749**	-.022	-.091	-.062	.141	-.100
EI402	.252	.054	.047	.202	**.742**	.143	.184	.071	-.297	.078
EI405	.228	.150	.001	.256	**.735**	.165	.117	.124	-.215	.149
EI404	.107	.075	.063	.322	**.701**	-.008	-.135	.030	.216	-.056
EI302	.004	.053	-.006	.118	-.033	**.792**	.045	-.121	.038	.090
EI303	-.008	.075	.185	.101	.194	**.771**	.072	.196	.027	-.028
EI304	-.037	.108	.181	.036	.218	**.747**	.054	.200	-.020	.030
EI301	.060	.031	.048	.009	-.042	**.738**	.050	-.128	.276	.062
EI201	.017	.089	-.111	.156	-.013	.199	**.733**	.140	.011	.118
EI202	.054	.154	.010	.019	.040	.253	**.683**	-.002	-.089	.128
TI106	.073	-.074	-.051	.272	.021	-.115	**.670**	.181	-.015	-.039
TI105	.001	-.003	.064	-.091	.081	.002	**.651**	.045	.193	.060
TI103	.037	.205	-.026	.110	-.058	-.132	**.588**	-.296	.115	-.238
UN106	.393	.265	.140	.171	.146	.002	.050	**.661**	-.031	.116
UN105	.315	.216	.180	.040	-.036	.116	.090	**.649**	.114	.011
UN103	.523	.154	.035	.140	.079	-.041	.083	**.612**	-.032	.056
UN102	.394	.387	.080	.111	.016	-.009	.123	**.543**	-.025	.066
TI104	-.108	-.142	.096	-.044	-.125	.070	.118	.107	**.795**	.061
TI101	-.092	-.063	.191	.001	-.035	.257	.089	-.084	**.655**	.094
TI201	.043	.252	.275	-.025	.075	.163	.037	.096	.222	**.748**
TI202	.017	.198	.359	.133	.084	.177	.115	.091	.129	**.672**
EI204	-.003	-.017	.092	-.031	.317	.347	-.063	.019	.262	**-.477**

Table 23 – 7th EFA Run – 6th Item Removed

	Component									
	1	2	3	4	5	6	7	8	9	10
UN204	**.941**	.099	.076	.143	.142	.018	.026	-.042	.001	.082
UN202	**.934**	.066	.058	.144	.161	.012	.025	-.052	.028	.076
UN205	**.923**	.122	.090	.129	.187	-.022	.051	-.070	-.006	.031
UN201	**.919**	.096	.081	.160	.204	-.014	.052	-.016	.004	.088

UN203	**.899**	.146	.044	.160	.141	.025	-.009	-.058	-.003	.094
UN102	**.445**	.414	.080	.118	.007	-.008	.136	-.028	.094	.433
UN304	.153	**.861**	.102	.004	.107	.009	.034	-.006	.147	.078
UN303	.060	**.849**	.094	-.041	.041	-.049	.080	-.146	.024	.059
UN302	.079	**.841**	.150	.092	.011	.008	.013	-.113	.048	-.003
UN305	.092	**.803**	.085	.039	.124	.151	.096	.002	-.009	.057
UN301	.142	**.701**	.155	.004	.020	.155	.036	.058	.114	.086
UN504	.058	.077	**.853**	.018	.026	.085	-.010	.126	.013	.080
UN501	.026	.196	**.850**	.049	-.019	.044	.017	.044	.134	-.040
UN503	.057	.073	**.801**	.072	.120	.110	-.007	.122	.000	.107
UN502	.041	.121	**.785**	-.030	.049	.137	-.004	.090	.131	-.007
UN402	.165	.107	**.758**	-.046	-.008	-.025	-.077	-.094	.066	.061
EI104	.193	.061	-.019	**.868**	.131	.157	.031	.060	.020	-.132
EI103	.212	.060	.030	**.842**	.108	.136	.047	.032	.013	-.145
EI102	.126	.027	.008	**.772**	.356	.006	.114	-.073	.074	.187
EI101	.175	.004	.016	**.763**	.335	.045	.070	-.038	.109	.167
EI203	.120	-.034	.050	**.641**	.263	-.054	.211	-.107	-.104	.226
EI403	.296	.059	.054	.208	**.755**	.182	.138	-.239	.031	-.032
EI401	.183	.075	.052	.271	**.752**	-.022	-.095	.141	-.113	-.051
EI402	.260	.059	.050	.201	**.746**	.140	.186	-.294	.093	.003
EI405	.239	.157	.003	.255	**.737**	.163	.120	-.212	.159	.078
EI404	.105	.073	.061	.320	**.698**	-.008	-.136	.215	-.070	.072
EI302	-.006	.047	-.006	.115	-.028	**.790**	.042	.042	.088	-.112
EI303	.003	.083	.185	.103	.186	**.775**	.077	.022	-.038	.229
EI304	-.025	.116	.182	.038	.211	**.750**	.060	-.024	.021	.230
EI301	.055	.026	.050	.004	-.034	**.734**	.049	.282	.075	-.169
EI201	.036	.099	-.110	.157	-.013	.196	**.737**	.014	.137	.076
EI202	.064	.157	.012	.018	.047	.247	**.684**	-.083	.153	-.089
TI106	.082	-.067	-.052	.276	.014	-.112	**.672**	-.019	-.053	.206
TI105	-.004	-.003	.062	-.089	.077	.001	**.650**	.192	.038	.096
TI103	.006	.192	-.023	.107	-.048	-.132	**.579**	.115	-.258	-.316
TI104	-.099	-.136	.098	-.041	-.129	.069	.121	**.793**	.056	.121
TI101	-.092	-.065	.194	-.001	-.030	.253	.089	**.659**	.103	-.114
TI201	.043	.256	.278	-.023	.078	.156	.038	.230	**.738**	.092
TI202	.016	.203	.363	.135	.087	.171	.116	.134	**.659**	.088
EI204	.001	-.017	.090	-.033	.313	.350	-.062	.257	**-.476**	.036
UN106	.450	.296	.139	.180	.130	.004	.066	-.037	.134	**.599**
UN105	.380	.246	.176	.048	-.054	.117	.106	.109	.041	**.593**

Table 24 – 8th EFA Run – 7th Item Removed

	Component									
	1	2	3	4	5	6	7	8	9	10
UN204	**.946**	.098	.073	.142	.142	.015	.024	-.042	-.004	.011
UN202	**.937**	.064	.055	.142	.163	.008	.024	-.051	.022	-.003
UN201	**.923**	.094	.079	.159	.205	-.016	.049	-.016	-.002	.021
UN205	**.922**	.119	.087	.128	.191	-.029	.049	-.069	-.017	-.035
UN203	**.904**	.144	.042	.159	.140	.024	-.012	-.059	-.009	.024
UN106	**.517**	.306	.140	.181	.112	.030	.065	-.047	.216	.430
UN105	**.455**	.258	.177	.046	-.070	.137	.110	.101	.143	.380
UN304	.163	**.861**	.105	.004	.109	.004	.037	-.005	.150	.005
UN303	.069	**.848**	.097	-.041	.045	-.050	.084	-.148	.027	.004
UN302	.085	**.844**	.148	.094	.008	.005	.016	-.113	.039	-.016
UN305	.103	**.805**	.084	.041	.119	.152	.098	.003	-.010	.037
UN301	.161	**.711**	.150	.006	.009	.153	.040	.060	.122	.060
UN501	.022	.192	**.853**	.049	-.012	.034	.018	.046	.123	-.071
UN504	.069	.079	**.852**	.018	.020	.088	-.011	.125	.019	.076
UN503	.075	.081	**.796**	.074	.105	.117	-.009	.122	.010	.135
UN502	.035	.115	**.790**	-.031	.058	.131	-.003	.091	.122	-.048
UN402	.170	.103	**.762**	-.048	-.001	-.027	-.077	-.095	.073	-.003
EI104	.178	.050	-.013	**.865**	.149	.141	.033	.066	.004	-.208
EI103	.195	.047	.037	**.837**	.131	.118	.049	.037	-.002	-.237
EI102	.149	.035	.003	**.776**	.338	.021	.108	-.075	.087	.212
EI101	.197	.015	.010	**.767**	.316	.057	.065	-.038	.120	.190
EI203	.149	-.027	.045	**.644**	.245	-.035	.206	-.112	-.078	.245
EI403	.289	.053	.057	.206	**.769**	.173	.137	-.228	.033	-.079
EI402	.257	.054	.053	.199	**.760**	.132	.185	-.284	.099	-.049
EI401	.172	.071	.051	.272	**.751**	-.022	-.101	.146	-.131	.011
EI405	.241	.152	.007	.255	**.746**	.159	.118	-.204	.169	.015
EI404	.109	.074	.060	.322	**.689**	-.002	-.142	.218	-.070	.121
EI303	.035	.100	.177	.108	.158	**.797**	.074	.024	-.011	.266
EI302	-.019	.042	-.002	.113	-.016	**.779**	.046	.052	.079	-.176
EI304	.004	.131	.175	.044	.185	**.772**	.056	-.023	.046	.262
EI301	.037	.016	.059	-.001	-.010	**.710**	.056	.295	.070	-.288
EI201	.047	.094	-.104	.156	.000	.187	**.741**	.017	.159	-.031
EI202	.056	.146	.020	.013	.075	.223	**.691**	-.074	.160	-.220
TI106	.110	-.054	-.061	.282	-.012	-.093	**.667**	-.026	-.040	.287
TI105	.006	.003	.059	-.084	.062	.010	**.646**	.188	.031	.173
TI103	-.036	.177	-.021	.108	-.035	-.141	**.577**	.112	-.328	-.199
TI104	-.079	-.128	.096	-.039	-.147	.070	.122	**.791**	.072	.134
TI101	-.105	-.074	.201	-.004	-.016	.232	.093	**.665**	.096	-.174
TI201	.053	.266	.278	-.017	.069	.143	.040	.236	**.731**	.043

TI202	.021	.209	.364	.141	.080	.164	.116	.139	**.646**	.059
EI204	.010	-.017	.086	-.035	.306	.361	-.065	.259	**-.456**	.078

Table 25 – 9th EFA Run – 8th Item Removed

	Component								
	1	2	3	4	5	6	7	8	9
UN204	**.944**	.099	.071	.154	.143	.014	.025	-.051	-.003
UN202	**.936**	.066	.052	.155	.161	.009	.024	-.062	.023
UN201	**.925**	.096	.076	.171	.205	-.018	.050	-.024	.008
UN205	**.921**	.122	.083	.141	.185	-.026	.048	-.080	-.020
UN203	**.903**	.144	.040	.170	.143	.021	-.010	-.067	-.003
UN105	**.458**	.250	.203	.044	-.032	.120	.131	.104	.152
UN304	.162	**.862**	.105	.008	.107	.013	.039	-.011	.142
UN303	.066	**.848**	.099	-.039	.044	-.047	.086	-.150	.022
UN302	.083	**.845**	.149	.096	.005	.008	.017	-.115	.036
UN305	.105	**.804**	.085	.041	.124	.152	.100	.000	-.002
UN301	.168	**.711**	.153	.008	.013	.154	.043	.057	.127
UN504	.072	.077	**.854**	.017	.029	.088	-.010	.129	.027
UN501	.019	.194	**.849**	.052	-.024	.050	.013	.043	.104
UN503	.079	.077	**.800**	.072	.121	.111	-.005	.127	.029
UN502	.037	.116	**.784**	-.029	.051	.143	-.010	.089	.116
UN402	.167	.103	**.763**	-.044	-.004	-.021	-.078	-.097	.060
EI104	.159	.054	-.021	**.874**	.119	.163	.028	.050	-.040
EI103	.173	.051	.029	**.848**	.097	.142	.043	.021	-.055
EI102	.150	.031	.009	**.773**	.355	.003	.123	-.066	.137
EI101	.197	.011	.015	**.766**	.330	.042	.078	-.031	.162
EI203	.144	-.034	.059	**.639**	.268	-.055	.223	-.102	-.045
EI401	.166	.072	.048	.280	**.751**	-.017	-.098	.136	-.126
EI403	.280	.055	.052	.219	**.749**	.186	.134	-.250	.015
EI402	.246	.056	.050	.211	**.741**	.145	.184	-.304	.080
EI405	.233	.152	.006	.264	**.735**	.169	.120	-.220	.163
EI404	.106	.072	.062	.326	**.701**	-.003	-.134	.212	-.054
EI302	-.024	.042	-.012	.117	-.037	**.794**	.032	.033	.042
EI303	.048	.088	.183	.098	.191	**.769**	.081	.028	.042
EI304	.019	.120	.179	.034	.217	**.744**	.062	-.017	.105
EI301	.029	.020	.046	.008	-.044	**.743**	.037	.266	-.003
EI201	.039	.094	-.100	.156	-.015	.206	**.741**	.007	.121
TI106	.118	-.062	-.050	.270	.019	-.115	**.682**	-.008	.015
EI202	.043	.152	.017	.022	.036	.260	**.681**	-.097	.085
TI105	.017	-.001	.060	-.094	.083	.004	**.651**	.200	.072
TI103	-.040	.178	-.036	.105	-.049	-.130	**.565**	.115	-.329
TI104	-.064	-.128	.096	-.048	-.125	.073	.124	**.799**	.095

TI101	-.106	-.068	.191	-.001	-.034	.265	.081	**.653**	.052
TI201	.061	.272	.273	-.017	.062	.166	.039	.234	**.732**
TI202	.024	.212	.359	.140	.075	.182	.116	.139	**.650**
EI204	.006	-.024	.095	-.034	.322	.353	-.062	.249	**-.470**

Table 26 – 10th EFA Run – 9th Item Removed

	Component								
	1	2	3	4	5	6	7	8	9
UN204	**.948**	.157	.079	.112	.133	.024	.032	-.041	.009
UN202	**.939**	.158	.061	.079	.152	.018	.031	-.052	.034
UN201	**.927**	.174	.084	.109	.197	-.008	.057	-.015	.017
UN205	**.925**	.144	.090	.135	.177	-.017	.055	-.069	-.006
UN203	**.906**	.173	.048	.157	.133	.031	-.003	-.057	.008
EI104	.163	**.868**	-.026	.057	.119	.163	.026	.058	-.022
EI103	.176	**.842**	.023	.054	.098	.142	.041	.030	-.035
EI102	.148	**.782**	.010	.039	.349	.010	.115	-.067	.117
EI101	.196	**.773**	.016	.020	.324	.049	.071	-.031	.145
EI203	.141	**.651**	.057	-.025	.262	-.048	.212	-.108	-.077
UN504	.057	.018	**.857**	.073	.027	.088	-.009	.123	.016
UN501	.008	.044	**.850**	.187	-.027	.048	.017	.043	.109
UN503	.067	.079	**.802**	.080	.116	.114	-.007	.123	.010
UN502	.022	-.031	**.785**	.113	.051	.140	-.007	.088	.119
UN402	.160	-.049	**.757**	.102	-.002	-.022	-.071	-.089	.085
UN304	.154	.007	.107	**.855**	.112	.016	.043	-.007	.153
UN303	.058	-.033	.096	**.851**	.047	-.043	.084	-.146	.026
UN302	.079	.101	.145	**.849**	.003	.012	.017	-.108	.041
UN305	.095	.048	.084	**.807**	.123	.154	.100	.002	-.002
UN301	.150	.019	.152	**.714**	.015	.159	.038	.051	.109
EI403	.283	.224	.050	.059	**.752**	.186	.130	-.242	.015
EI402	.248	.217	.049	.059	**.745**	.146	.179	-.297	.078
EI401	.180	.282	.048	.076	**.743**	-.017	-.097	.145	-.122
EI405	.231	.270	.006	.155	**.739**	.170	.115	-.216	.155
EI404	.107	.331	.063	.076	**.696**	-.003	-.136	.212	-.063
EI302	-.023	.107	-.012	.036	-.035	**.792**	.037	.038	.059
EI303	.038	.116	.180	.100	.186	**.772**	.072	.025	.007
EI304	.013	.051	.178	.133	.210	**.750**	.054	-.018	.070
EI301	.024	.002	.042	.019	-.037	**.740**	.040	.273	.021
EI201	.028	.156	-.100	.092	-.005	.203	**.737**	.008	.142
EI202	.028	.008	.022	.135	.045	.251	**.685**	-.101	.107
TI106	.109	.289	-.051	-.048	.012	-.107	**.671**	-.012	-.003
TI105	.011	-.097	.068	-.011	.079	.004	**.654**	.192	.071
TI103	-.026	.097	-.036	.175	-.063	-.132	**.576**	.125	-.306

TI104	-.078	-.041	.095	-.125	-.117	.075	.120	**.791**	.085
TI101	-.110	.000	.186	-.064	-.034	.263	.080	**.661**	.061
TI201	.045	-.030	.285	.258	.064	.161	.050	.234	**.742**
TI202	.017	.127	.367	.203	.071	.179	.125	.145	**.664**
EI204	.008	-.041	.100	-.031	.312	.348	-.053	.241	**-.479**

Table 27 – 11th EFA Run – 10th Item Removed

	Component								
	1	2	3	4	5	6	7	8	9
UN204	**.947**	.155	.112	.079	.139	.024	.033	-.040	.011
UN202	**.939**	.157	.078	.060	.156	.016	.032	-.053	.038
UN201	**.926**	.175	.108	.083	.198	-.012	.058	-.019	.029
UN205	**.924**	.140	.135	.092	.187	-.013	.055	-.062	-.014
UN203	**.906**	.173	.156	.047	.136	.029	-.003	-.061	.019
EI104	.163	**.862**	.059	-.023	.132	.171	.023	.070	-.039
EI103	.176	**.834**	.058	.028	.118	.155	.038	.049	-.069
EI102	.148	**.782**	.040	.006	.349	.004	.116	-.071	.116
EI101	.195	**.777**	.018	.010	.316	.037	.073	-.046	.165
EI203	.141	**.662**	-.031	.050	.246	-.060	.211	-.132	-.018
UN304	.153	.001	**.858**	.107	.120	.019	.042	.004	.131
UN303	.057	-.040	**.856**	.100	.062	-.033	.082	-.124	-.016
UN302	.080	.103	**.848**	.142	.001	.011	.015	-.112	.054
UN305	.095	.045	**.806**	.084	.129	.159	.095	.008	.008
UN301	.151	.030	**.706**	.141	-.004	.144	.037	.018	.186
UN504	.057	.016	.072	**.857**	.030	.091	-.010	.125	.044
UN501	.008	.048	.185	**.845**	-.035	.041	.019	.032	.147
UN503	.067	.078	.078	**.802**	.117	.116	-.009	.123	.044
UN502	.021	-.035	.114	**.785**	.057	.143	-.006	.095	.122
UN402	.160	-.049	.103	**.756**	-.002	-.024	-.069	-.090	.091
EI403	.279	.214	.061	.055	**.766**	.190	.131	-.224	-.003
EI401	.177	.274	.070	.050	**.755**	-.006	-.104	.156	-.092
EI405	.228	.262	.156	.007	**.749**	.168	.118	-.206	.138
EI402	.245	.213	.060	.049	**.749**	.140	.183	-.293	.076
EI404	.105	.330	.066	.060	**.695**	-.002	-.142	.206	-.002
EI302	-.024	.101	.034	-.011	-.026	**.797**	.037	.040	.067
EI303	.037	.111	.097	.181	.192	**.774**	.071	.025	.039
EI304	.011	.040	.133	.182	.228	**.760**	.054	-.002	.059
EI301	.024	.001	.014	.040	-.037	**.741**	.038	.265	.068
EI201	.028	.163	.090	-.108	-.016	.194	**.738**	-.008	.165
EI202	.028	.021	.129	.010	.024	.234	**.687**	-.133	.169
TI106	.109	.287	-.043	-.049	.019	-.102	**.670**	.002	-.040
TI105	.010	-.102	-.004	.072	.087	.008	**.655**	.212	.035

TI103	-.027	.088	.183	-.023	-.038	-.108	**.568**	.167	-.357
TI104	-.078	-.047	-.124	.097	-.111	.085	.117	**.804**	.085
TI101	-.110	-.002	-.069	.184	-.035	.268	.075	**.659**	.100
TI201	.046	-.019	.253	.263	.030	.125	.063	.184	**.790**
TI202	.018	.143	.198	.344	.032	.138	.138	.089	**.730**

Table 28 – 12th EFA Run – 11th Item Removed

	Component							
	1	2	3	4	5	6	7	8
UN204	**.946**	.151	.122	.083	.138	.028	.039	-.040
UN202	**.939**	.151	.093	.069	.154	.025	.040	-.050
UN201	**.927**	.167	.121	.089	.197	-.004	.067	-.015
UN205	**.925**	.135	.141	.089	.185	-.012	.059	-.063
UN203	**.908**	.166	.166	.050	.138	.032	.005	-.055
EI104	.145	**.873**	.045	-.032	.123	.157	.017	.052
EI103	.158	**.846**	.039	.012	.108	.137	.028	.026
EI102	.144	**.782**	.054	.025	.348	.016	.126	-.051
EI101	.191	**.776**	.036	.035	.317	.055	.084	-.025
EI203	.120	**.666**	-.043	.041	.247	-.070	.201	-.134
UN304	.155	.003	**.863**	.127	.120	.031	.056	-.013
UN303	.061	-.039	**.847**	.098	.062	-.041	.089	-.145
UN302	.094	.093	**.847**	.144	.007	.009	.028	-.114
UN305	.103	.044	**.803**	.079	.127	.143	.100	.013
UN301	.150	.036	**.716**	.164	-.009	.149	.042	.047
UN501	.013	.047	.193	**.855**	-.031	.046	.019	.022
UN504	.066	.016	.074	**.848**	.030	.076	-.016	.132
UN503	.054	.093	.072	**.799**	.112	.097	-.021	.126
UN502	.022	-.028	.119	**.791**	.052	.139	-.013	.099
UN402	.157	-.046	.103	**.758**	.003	-.019	-.073	-.115
TI201	.054	-.031	.332	**.387**	.037	.235	.098	.219
EI401	.201	.255	.073	.028	**.755**	-.020	-.091	.162
EI403	.274	.230	.058	.060	**.754**	.192	.125	-.245
EI405	.207	.281	.157	.030	**.740**	.186	.111	-.229
EI402	.224	.236	.055	.065	**.736**	.152	.171	-.321
EI404	.115	.317	.072	.051	**.704**	-.007	-.132	.213
EI302	-.019	.104	.043	-.002	-.030	**.800**	.029	.037
EI303	.054	.100	.108	.170	.205	**.756**	.062	.041
EI301	.002	.023	.008	.060	-.045	**.746**	.026	.221
EI304	.028	.030	.148	.177	.240	**.745**	.047	.023
EI201	.045	.153	.112	-.068	-.021	.227	**.748**	.002
EI202	.044	.016	.147	.050	.017	.269	**.690**	-.142
TI106	.128	.269	-.039	-.055	.023	-.103	**.672**	.027

TI105	.001	-.102	-.015	.086	.094	.029	**.651**	.151
TI103	-.026	.083	.136	-.094	-.032	-.163	**.552**	.133
TI104	-.071	-.054	-.112	.118	-.107	.097	.136	**.804**
TI101	-.103	-.004	-.056	.205	-.038	.276	.089	**.661**

Table 29 – 12th Item Removed - Final EFA

	Component							
	1	2	3	4	5	6	7	8
UN204	**0.946**							
UN202	**0.939**							
UN201	**0.927**							
UN205	**0.925**							
UN203	**0.907**							
EI104		**0.865**						
EI103		**0.841**						
EI102		**0.79**						
EI101		**0.785**						
EI203		**0.674**						
UN304			**0.859**					
UN302			**0.851**					
UN303			**0.85**					
UN305			**0.808**					
UN301			**0.714**					
UN501				**0.856**				
UN504				**0.851**				
UN503				**0.803**				
UN502				**0.79**				
UN402				**0.761**				
EI401					**0.766**			
EI403					**0.744**			
EI405					**0.729**			
EI402					**0.722**			
EI404					**0.715**			
EI302						**0.797**		
EI303						**0.765**		
EI304						**0.755**		
EI301						**0.751**		
EI201							**0.743**	
EI202							**0.69**	
TI106							**0.672**	
TI105							**0.658**	
TI103							**0.555**	

TI104								**0.795**
TI101								**0.646**
Variance Explained	24.52	11.9	9.247	7.679	6.37	5.444	4.104	3.146
Cronbach's Alpha	0.982	0.89	0.891	0.895	0.884	0.831	0.773	0.465

Mapping Factors to Constructs

The software training intervention construct is represented by the measurement items in factor 7; these items measure formal software training (TI101, TI103, TI105, TI106, EI201 and EI202) as well as experiential activities that are more formal in nature (reading ERP publications, and partnering with ERP resources outside of the organization). The business process-training intervention construct is represented by a single measurement item (TI202).

The software experiential intervention construct has two dimensions represented in the EFA. First, the items in factor 4 (EI401 – EI404) measure the respondents system activities as they relate to the expectations of co-workers. Second, items in factor 6 (EI301, EI303 and EI304) measures the manger's support for the respondent's experiential activities with the ERP system. The business process experiential intervention construct is represented by measurement items in factor 2. Measurement items EI101, EI103 and EI104 address actions the respondent takes individually to explore the use of ERP to address their job activities. EI203 also maps to this factor, but differs slightly in that the respondent is seeking help from colleagues to address this need.

The software-understanding construct is represented by factor 5 (UN501-UN505, & UN402). These items measure how well the organization is effectively leveraging and understanding ERP functionality. The business process-understanding construct is

represented by two factors. First, factor 1 (measurement items UN201-UN205) measure how well respondents understand the business processes for which they are responsible. Factor 3 (measurement items UN301-UN305) measures how the respondent's new business processes compare to their previous business processes.

Validity

The validity of these constructs can be assessed using convergent and discriminant validity (Huck, 2004). Convergent validity exists when measurement items are highly correlated with each other (Campbell & Fiske, 1959). In this study, factor correlations exceed 0.6 showing that the items are highly correlated within each factor. Discriminant validity ensures that constructs can be differentiated from each other (Kerlinger & Lee, 2000). In this study, the absence of cross loading items is indicative of discriminant validity. Additional Convergent and discriminant validity can be ascertained using the composite reliability and average variance extracted from confirmatory factor analysis (CFA) (Barclay et al., 1995; Komiak & Benbasat, 2006).

An SEM measurement model was constructed using Lisrel (Figure 5). The item mapping from the exploratory factor analysis was loaded into SEM and used to calculate the standardized loadings of the items onto their constructs. These standardized loadings were then used to calculate the average variance extracted and composite reliability (Figure 5. - SEM measurement model used for CFA.

Table 30). To be considered acceptable, AVE values should be greater than 0.5 (Hair et al., 1998); as shown in Figure 5. - SEM measurement model used for CFA.

Table 30, software training interventions, software experiential interventions and business process experiential interventions failed to achieve this minimum (.470, .467 and .466 respectively).

To address the less than sufficient AVE values, items with the lowest standardized loading scores were dropped and the AVE and composite reliability re-calculated. For software training interventions, TI104 was removed, when recalculated, the AVE for this construct was raised to a satisfactory AVE of .515 . Software experiential intervention required the removal of two items (EI302 and EI405) inorder to achive a satisfactory AVE of .507 . Item EI102 was removed from business process experiential intervention to raise its AVE to .508 . All constructs now exceed the minimum Average Variance Extracted (Table 31).

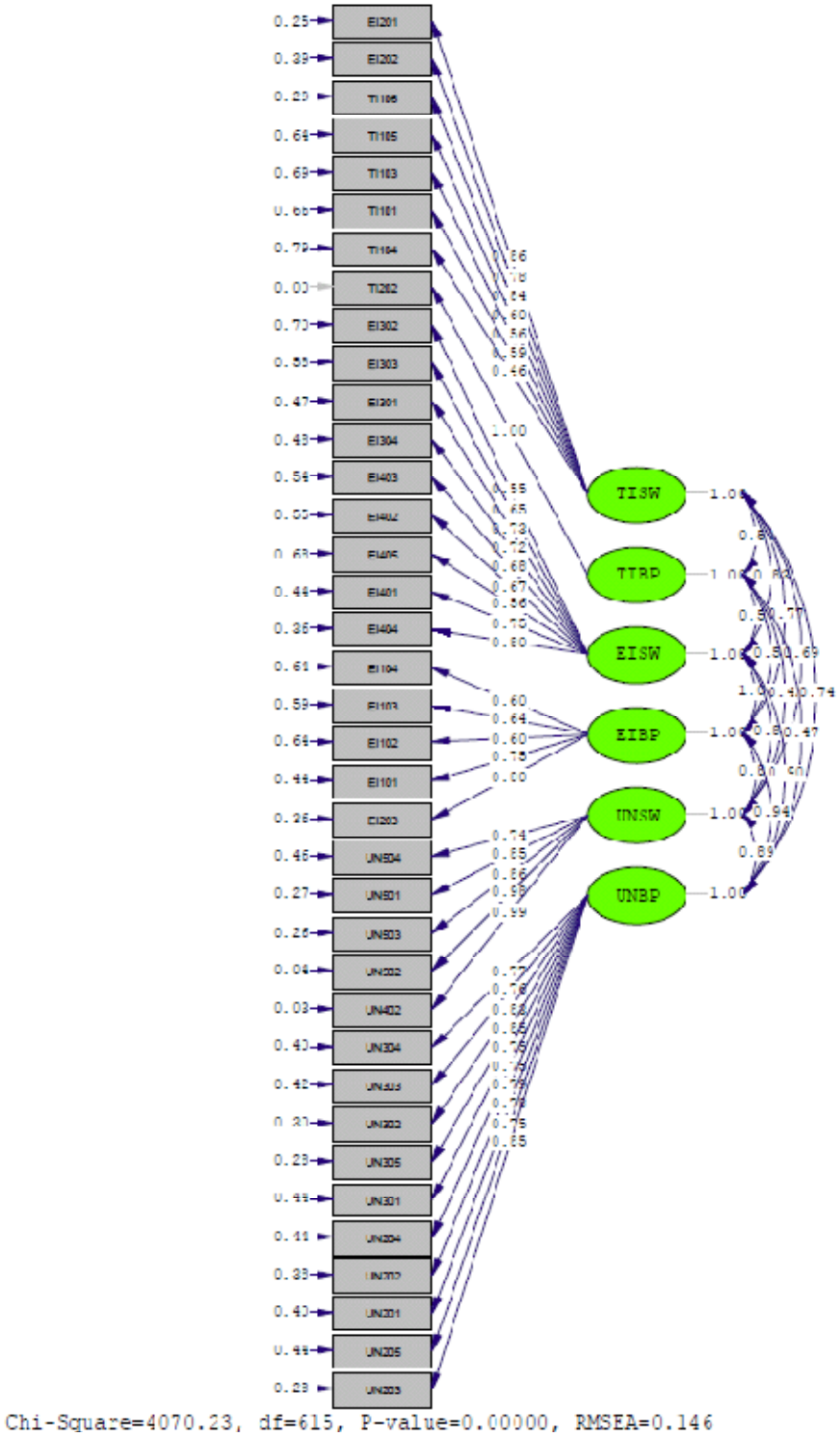

Figure 5. - SEM measurement model used for CFA.

Table 30 - Initial Confirmatory Factor Analysis

Construct and indicators	Standardized loading	Average variance extracted	Composite reliability
Software Training Intervension		**0.470**	**0.856**
EI201: I read publications about how other companies are using my ERP	0.86		
EI202: I talked to people in other companies about how they use my ERP	0.78		
TI106: I have read articles or books focused on my ERP or other ERP systems.	0.84		
TI105: I have used on-line or computer-based training modules provided by my ERP or an ERP user group (i.e. ASUG).	0.60		
TI103: I have attended formal training at my own expense	0.56		
TI101: Formal training offered 'in-house'.	0.59		
TI104: I have used on-line or computer-based training modules provided by my company	0.46		
Business Process Training Intervention		**1.000**	**1.000**
TI202: Overall, I feel that my training on how my job changed after my ERP was …	1.00		
Software Experiential Intervention		**0.467**	**0.886**
EI302: Encourages me to attend training sessions that address broader issues than the software itself	0.55		
EI303: Talks to me about how my ERP impacts my work processes or tasks.	0.65		
EI301: Allows me the time to attend in-house ERP training sessions.	0.73		
EI304: Talks to me about where my tasks fit in the "big picture" in the ERP environment	0.72		
EI403: Others in my area expect me to share with them new things I find in the ERP software	0.68		
EI402: Others in my area expect me to look for ways to improve our work processes using ERP	0.67		
EI405: e. My manager expects me to find new ways to use ERP	0.56		
EI401: Others in my area expect me to personally use the ERP software	0.75		
EI404: My manager expects me to personally use the ERP software.	0.80		
Business Process Experiential Intervention		**0.466**	**0.811**
EI104: I look for new ways to perform my business tasks.	0.60		
EI103: I look for new ways to do my business processes	0.64		
EI102: I talked to people in other companies about how they use ERP	0.60		
EI101: I experiment with ERP functionality beyond what is normally used to do my job.	0.75		
EI203: I found ways to do things in ERP that no one else seemed to know about	0.80		

Software Understanding		**0.922**	**0.949**
UN504: Regularly using the full extent of functionality	0.74		
UN501: Effectively leveraging current ERP functionality	0.85		
UN503: Actively using ERP by most end-users	0.86		
UN502: Exploring ways to gain new leverage from ERP	0.98		
UN402: Where on the ERP learning curve do you think your organization is	0.99		
Business Process Understanding		**0.624**	**0.942**
UN304: How does your new ... business processes compare ....Effectiveness of work process.	0.95		
UN303: How does your new ... business processes compare …Efficiency (throughput) of complete tasks.	0.96		
UN302: How does your new ... business processes compare …Ease of completed tasks	0.75		
UN305: How does your new ... business processes compare …Control I have over my work process	0.72		
UN301: How does your new ... business processes compare …Workflow transparency	0.84		
UN204:… your level of understanding of your own work processe… The tasks(s) that my task(s) feed into	0.81		
UN202:… your level of understanding of your own work processe… How the task(s) I do feed into the next task(s) in the work process	0.70		
UN201:… your level of understanding of your own work processe… How the task(s) I do feed into the next task(s) in the work process	0.71		
UN205:… your level of understanding of your own work processe… The overall work process that my task(s) is part of	0.72		
UN203:… your level of understanding of your own work processe… The task(s) that feed into the task(s) I do	0.71		

Table 31 - Final Confirmatory Factor Analysis

Construct and indicators	Standardized loading	Average variance extracted	Composite reliability
Software Training Intervension		**0.514**	**0.859**
EI201: I read publications about how other companies are using ERP	0.88		
EI202: I talked to people in other companies about how they use ERP	0.78		
TI106: I have read articles or books focused on ERP systems.	0.86		
TI105: I have used on-line or computer-based training modules provided by my ERP or an ERP user group (i.e. ASUG).	0.59		
TI103: I have attended formal training at my own expense	0.54		
TI101: Formal training offered 'in-house'.	0.57		
Business Process Training Intervention		**1.000**	**1.000**
TI202: Overall, I feel that my training on how my job changed after ERP was …	1.00		
Software Experiential Intervention		**0.507**	**0.877**
EI303: Talks to me about how ERP impacts my work processes or tasks.	0.62		
EI301: Allows me the time to attend in-house ERP training sessions.	0.70		
EI304: Talks to me about where my tasks fit in the "big picture" in the ERP environment	0.70		
EI403: Others in my area expect me to share with them new things I find in the ERP software	0.68		
EI402: Others in my area expect me to look for ways to improve our work processes using ERP	0.69		
EI401: Others in my area expect me to personally use the ERP software	0.77		
EI404: My manager expects me to personally use the ERP software	0.81		
Business Process ExperientialIntervention		**0.508**	**0.803**
EI104: I look for new ways to perform my business tasks.	0.59		
EI103: I look for new ways to do my business processes	0.65		
EI101: I experiment with ERP functionality beyond what is normally used to do my job.	0.77		
EI203: I found ways to do things in ERP that no one else seemed to know about	0.82		

Software Understanding		**0.920**	**0.949**
UN504: Regularly using the full extent of functionality	0.74		
UN501: Effectively leveraging current ERP functionality	0.85		
UN503: Actively using ERP by most end-users	0.86		
UN502: Exploring ways to gain new leverage from ERP	0.98		
UN402: Where on the ERP learning curve do you think your organization is	0.99		
Business Process Understanding		**0.625**	**0.943**
UN304: How does your new ... business processes compare ....Effectiveness of work process.	0.95		
UN303: How does your new ... business processes compare …Efficiency (throughput) of complete tasks.	0.96		
UN302: How does your new ... business processes compare …Ease of completed tasks	0.75		
UN305: How does your new ... business processes compare …Control I have over my work process	0.72		
UN301: How does your new ... business processes compare …Workflow transparency	0.84		
UN204:… your level of understanding of your own work processe… The tasks(s) that my task(s) feed into	0.81		
UN202:… your level of understanding of your own work processe… How the task(s) I do feed into the next task(s) in the work process	0.70		
UN201:… your level of understanding of your own work processe… How the task(s) I do feed into the next task(s) in the work process	0.71		
UN205:… your level of understanding of your own work processe… The overall work process that my task(s) is part of	0.72		
UN203:… your level of understanding of your own work processe… The task(s) that feed into the task(s) I do	0.71		

Composite reliability is used to assess internal consistency of the constructs in CFA. A reliability measure for each construct greater than 0.7 is desired (Barclay et al., 1995; Komiak & Benbasat, 2006). As shown in Table 32, all constructs have a composite reliability higher than 0.8, thus indicating internal consistency of the constructs. The mean and standard deviations for this final list of items is provided in Table 33.

In addition to the cross loading assessment done during EFA, discriminant validity is assessed by comparing the square root of the AVE associated with each construct to the correlations among the constructs (Chin, 1998). The value should be

greater than the correlations among constructs values. As seen in Table 33 the square root of the Average Variance extracted is greater than the correlation values. This indicates adequate discriminant validity.

Table 32 - Inter-Construct Correlations: Consistency and Reliability Tests

	Composite Reliability	AVE (Average Variance Explained	Training Initiatives - Software	Training Initiatives – Business Process	Experiential Initiatives - Software	Experiential Initiatives – Business Process	Understanding - Software	Understanding – Business Process
Training Initiatives - Software	0.859	0.514	**0.717**					
Training Initiatives - Business Process	1.000	1.000	.303	**1.000**				
Experiential Initiatives - Software	0.877	0.507	.258	.300	**0.712**			
Experiential Initiatives - Business Process	0.803	0.508	.206	.158	.427	**0.713**		
Understanding - Software	0.949	0.920	.091	.415	.267	.034	**0.959**	
Understanding - Business Process	0.943	0.625	.126	.250	.346	.286	.285	**0.791**

Square root of the AVE on the diagonal

Table 33 – Item and Construct Means

Items and Constructs	Mean	Std Dev	Construct mean
Software Training Intervention			**2.323**
EI201: I read publications about how other companies are using ERP	2.77	1.036	
EI202: I talked to people in other companies about how they use ERP	2.86	1.080	
TI106: I have read articles or books focused on ERP systems.	2.86	1.173	
TI105: I have used on-line or computer-based training modules provided by my ERP or an ERP user group (i.e. ASUG).	1.90	1.083	
TI103: I have attended formal training at my own expense	1.27	0.752	
TI101: Formal training offered 'in-house'.	2.30	1.251	
Business Process Training Intervention			**3.234**
TI202: Overall, I feel that my training on how my job changed after ERP was …	3.23	1.124	
Software Experiential Intervention			**3.695**
EI303: Talks to me about how ERP impacts my work processes or tasks.	2.74	1.242	
EI301: Allows me the time to attend in-house ERP training sessions.	2.91	1.302	
EI304: Talks to me about where my tasks fit in the "big picture" in the ERP environment	2.82	0.858	
EI403: Others in my area expect me to share with them new things I find in the ERP software	4.34	0.866	
EI402: Others in my area expect me to look for ways to improve our work processes using ERP	4.36	0.060	
EI401: Others in my area expect me to personally use the ERP software	4.37	0.867	
EI404: My manager expects me to personally use the ERP software	4.40	0.828	
Business Process Experiential Intervention			**3.928**
EI104: I look for new ways to perform my business tasks.	4.14	0.819	
EI103: I look for new ways to do my business processes	4.08	0.869	
EI101: I experiment with ERP functionality beyond what is normally used to do my job.	3.80	1.165	
EI203: I found ways to do things in ERP that no one else seemed to know about	3.66	0.925	

Items and Constructs	Mean	Std Dev	Construct mean
Software Understanding			**2.882**
UN504: Regularly using the full extent of functionality	2.40	1.126	
UN501: Effectively leveraging current ERP functionality	2.75	1.039	
UN503: Actively using ERP by most end-users	2.98	1.014	
UN502: Exploring ways to gain new leverage from ERP	2.97	1.127	
UN402: Where on the ERP learning curve do you think your organization is	3.26	1.049	
Business Process Understanding			**3.911**
UN304: How does your new ... business processes compare ....Effectiveness of work process.	3.67	1.117	
UN303: How does your new ... business processes compare …Efficiency (throughput) of complete tasks.	3.48	1.129	
UN302: How does your new ... business processes compare …Ease of completed tasks	3.30	1.226	
UN305: How does your new ... business processes compare …Control I have over my work process	3.34	1.267	
UN301: How does your new ... business processes compare …Workflow transparency	3.76	1.157	
UN204:… your level of understanding of your own work process… The tasks(s) that my task(s) feed into	4.30	0.899	
UN202:… your level of understanding of your own work process… How the task(s) I do feed into the next task(s) in the work process	4.34	0.844	
UN201:… your level of understanding of your own work process… How the task(s) I do feed into the next task(s) in the work process	4.34	0.869	
UN205:… your level of understanding of your own work process… The overall work process that my task(s) is part of	4.33	0.878	
UN203:… your level of understanding of your own work process… The task(s) that feed into the task(s) I do	4.34	0.926	

Hypotheses Testing and Results

Two types of regression are used to test the hypotheses in this study. Hypotheses 1 through 5 use Ordinary Least Square (simple) Regression. Due to their binary dependent variables, Hypotheses 6_a through 8_b use logistic regression. Listwise missing data procedure was used to ensure that only complete observations were used for analysis. A summary of the hypotheses and the statistical tests performed are provided in Table 34.

Table 34 - Summary of Hypotheses

Hypotheses	Statistical test
H_1: The greater the software training intervention, the greater the perceived software understanding.	$swun= \beta_0+\beta_1 swti+\beta_2 swei+\varepsilon$
H_2: The greater the business process training intervention, the greater the perceived business process understanding.	$bpun= \beta_0+\beta_1 bpti+\beta 2 bpei+\varepsilon$
H_{3a}: Software understanding from software training interventions is moderated by business process training interventions.	$swun= \beta_0+\beta_1 swti+\beta_2 swei+\beta_3 bpti+\beta_4 (swti*bpti)+\varepsilon$
H_{3b}: Business process understanding from business process training interventions is moderated by software training interventions.	$bpun= \beta_0+\beta_1 swti+\beta_2 swei+\beta_3 bpti+\beta_4 (swti*bpti)+\varepsilon$
H_4: The greater the software experiential interventions, the greater the perceived software understanding.	$swun= \beta_0+\beta_1 swti+\beta_2 swei+\varepsilon$
H_5: The greater the business process experiential interventions, the greater the perceived business process understanding	$bpun= \beta_0+\beta_1 bpti+\beta_2 bpei+\varepsilon$
H_{6a}: The greater the software understanding, the greater the required task and required feature utilization.	$rtrf= \beta_0+\beta_1 swun+\varepsilon$
H_{6b}: The greater the software understanding, the greater the optional task and required feature utilization.	$otrf= \beta_0+\beta_1 bpun+\beta_2 swun+\varepsilon$
H_{7a}: The greater the business process understanding, the greater the required task and optional feature utilization.	$rtof= \beta_0+\beta_1 bpun+\varepsilon$
H_{7b}: The greater the business process understanding, the greater the optional task and required feature utilization.	$otrf= \beta_0+\beta_1 bpun+\beta_2 swun+\varepsilon$
H_{7c}: The greater the business process understanding, the greater the optional task and optional features utilization	$otof= \beta_0+\beta_1 bpun+\varepsilon$
H_{8a}: Optional task and optional feature utilization from business process understanding is moderated by software understanding.	$otof= \beta_0+\beta_1 bpun+\beta_2 swun+ \beta_3 (bpun*swun)+\varepsilon$
H_{8b}: Optional task and required feature utilization from software understanding is moderated by business process understanding.	$otrf= \beta_0+\beta_1 bpun+\beta_2 swun+ \beta_3 (swun*bpun)+\varepsilon$

swti = Software training intervention
bpti = Business process training intervention
swei = Software experiential intervention
bpei = Business process experiential intervention
swun = Software understanding
bpun = Business process understanding
rtrf = Required Task, Required Feature
rtof = Required Task, Optional Feature
otrf = Optional Task, Required Feature
otof = Optional Task, Optional Feature

Hypothesis 1 proposes that software understanding is positively associated with software training intervention. However, the relation was found not significant

(β=0.023, p=0.708) (Table 35). Therefore, Hypothesis 1 was not supported. Hypothesis 2 proposes that business process interventions have a positive influence on business process understanding. This relationship is significant (β=0. 206, p=0.001), therefore Hypothesis 2 is supported.

Hypotheses 3a and 3b focus on the moderating effect that software and business process training interventions have on understanding. Specifically Hypothesis 3a posits that the effect of software training interventions upon software understanding is positively moderated by business process training interventions. When in the presence of business process training intervention, the relationship between software training intervention and software understanding is significant (β=-0.326, p=0.000), and the moderation provides for a much higher R^2 (0.188 vs 0.72). However, while the relationship is significant the negative coefficient contradicts the hypothesed relationship, thus Hypothesis 3a is not supported. Hypothesis 3b states that the effect of business process interventions upon business processes understanding is positively moderated by software training interventions. This relationship is not significant (β=0.003, p=0.127), thus Hypothesis 3b is not supported..

Hypotheses 4 and 5 address the impact of experiential interventions on understanding. Software experiential interventions has a positive effect on software understanding (β=0.261, p=0.000), thus Hypothesis 4 is supported. Similarly, business process experiential interventions has a positive effect on business process understanding (β=0.278, p=0.000), Hypothesis 5 is also supported.

As these Hypotheses have more than one predictor variable, it is important to assess the presence of multicollinearity. The Variance Inflation Factor (VIF) is used for

this assessment. For Hypotheses 1 through 5,, the VIF is well below 10 for each; this indicates that there is minimal multicollinearity among the predictor variables for these hypotheses (Knuter et al., 2004).

Table 35 - Linear Regression Hypotheses Details

	Variable	β	t-value	p-value	R^2	F-Change	Sig F Change	Supported?
H_1:	Software Training Intervention ➔ Software Understanding	0.023	0.375	0.708	0.072	9.891	0.000	No
	With moderation (H_{3a})	-0.326	-3.899	0.000	.188	20.263	0.000	No (see H_{3a})
H_2:	Business Process Training Intervention ➔ Business Process Understanding	0.206	3.441	0.001	0.131	19.658	0.000	Yes***
	With moderation (H_{3b})	0.204	1.921	.056	.127	13.052	.000	No (See H_{3b})
H_{3a}:	Business Process Training Intervention **(moderation)** on Software Training Intervention ➔ Software Understanding (H_1)	0.537	6.231	0.000	0.188	20.263	0.000	No
H_{3b}:	Software Training Intervention **(moderation)** on Business Process Training Intervention ➔ Business Process Understanding (H_2)	.003	.024	0.981	0.127	13.052	0.000	No
H_4:	Software Experiential Intervention ➔ Software Understanding	0.261	4.185	0.000	0.072	9.891	0.000	Yes****
H_5:	Business Process Experiential Intervention ➔ Business Process Understanding	0.278	4.636	0.000	0.131	19.658	0.000	Yes****
	* p<0.10, ** p<0.05, *** p<0.01, **** p<001							

To assess Hypotheses 6a through 8b, it is necessary to classify respondents into our four utilization scenarios, as described in chapter 3. Sixteen respondents (6 %) did

not provide responses necessary for classification and were not included in the mapping. Table 36 provides number of classified respondents (and percentage) by scenario. As would be expected, the RT/RF scenario is largest. The majority of end users are simply using the ERP system as mandated by their organization. Those users who are have the latitude to perform optional business tasks using optional software features was the smallest category.

Table 36 - Scenario Classification

		Business Process Tasks	
		Required Tasks (RT)	Optional Tasks (OT)
Software Features	Required Features (RF)	105 (42%)	76 (31%)
	Optional Features (OF)	47 (19%)	21 (8%)

Hypotheses 6_a and 6_b address the influence of software understanding on ERP utilization. Hypothesis 6_a proposes that as software understanding increase, so does the RT/RF (required task/required function) utilization. Results from logistic regression show that there is no significant relationship between software understanding and RT/RF utilization (β= -0.012, p=0.988), thus Hypothesis 6_a is not supported. Hypothesis 6_b posits that increased software understanding increases OTRF utilization. Results show that the relationship is significant (β=-0.550, p=0.001), thus Hypothesis 6_b is supported. A Homer and Lemeshow test was performed, this measures the non-fit of the variables to the regression model. A significant result for this test would indicate that the variables (software understanding, and OTRF) were not a good fit for the binary regression. The results were found to be not significant, indicating that the variables are

a good fit to the binary regression model. The regression model provides an overall prediction percentage of 70.3%, and has an odds ratio of 4.8 .

Hypotheses 7_a, 7_b and 7_c address the impact of business process understanding on ERP utilization. Hypothesis 7_a proposes that as business process understanding increases, so does RT/OF utilization. Results show that this relationship is significant (β=0.-550, p=0.012), However, the regression coefficient is negative, contrary to the hypothesized relationship, thus Hypothesis 7_a is not supported. Hypothesis 7_b posits that an increase in business process understanding has a positive effect on RT/OF utilization. This relationship was not found to be significant (β=0.183, p=0.372), therefore Hypothesis 7_b is not supported. Hypothesis 7_c proposes that as business process understanding increases, so does OT/OF utilization. Results show that this relationship is not significant (β=-0.500, p=0.156), thus Hypothesis 7_c is not supported.

Hypotheses 8_a and 8_b focus on the moderating effects that software and business process understanding can have on certain types of ERP utilization. Hypothesis 8_a proposes that increases in OT/OF utilization from business process understanding is moderated by software understanding. Results show that this relationship is not significant (β =0.023, p=0.919), thus Hypothesis 8a is not supported. Hypothesis 8_b posits that OT/RF utilization from software understanding is moderated by business process understanding. Results show that this relationship is not significant (β=0.002, p=0.973), thus Hypothesis 8_b is not supported.

Table 37 - Logistic Regression Hypotheses Detail

	Variable	β	t-value	p-value	R^2	Supported?
H_{6a}:	Software Understanding ➔ RTRF	-0.012	0.007	0.988	0.000	No
H_{6b}:	Software Understanding ➔ OTRF	0.550	10.241	0.001	0.044	Yes***
H_{7a}:	Business Process Understanding ➔ RTOF	-0.550	6.343	0.012	0.026	No
	With moderation (see H_{8b})	-0.248	0.137	0.771	0.044	No
H_{7b}:	Business Process Understanding ➔ OTRF	-0.183	0.798	0.372	0.026	No
H_{7c}:	Business Process Understanding ➔ OTOF	0.515	2.010	0.156	0.009	No
	With moderation (see H_{8b})	0.500	1.261	0.261	0.009	No
H_{8a}:	Software understanding **(moderation)** on Business process understanding ➔ OTOF	0.023	0.010	0.919	0.044	No
H_{8b}:	Business Process Understanding **(moderation)** on Software Understanding ➔ OTRF	0.002	0.063	0.973	0.009	No
	* p<0.10, ** p<0.05, *** p<0.01, **** p<001					

Summary

This chapter provides the data analysis and results of the study. Summaries of descriptive data, construct validity and reliability, regression analysis and assumption confirmation are presented. Table 38 summarizes the results of the hypotheses testing. Of the thirteen hypotheses, seven are supported, six are not supported. Generally, direct relationships between the formal training interventions, experiential interventions and understanding were supported, only Hypothesis 1 was not. In addition, while one of the moderating hypotheses was found to be significant, its negative impact on the main effect coefficient was contrary to the hypothesized relationship. Interestingly, neigther neither hypothesized moderating relationship was supported.

Utilization results are less clear. Only one of the seven utilization hypotheses was supported. It is likely that the RTRF hypotheses were not significant because ERP is a ‘mandated use’ environment and understanding does not influence the utilization of required tasks and feature. Similarly, OT/OF hypotheses were likely not significant because ERP end-users do not have the time to perform functions that they are not required to do. What is apparent is that understanding does help leverage required features or tasks to address optional features or tasks. By better understanding the required features, ERP users can better leverage the system to address optional tasks, and better understanding of the business processes allows for leveraging of optional system features.

Table 38 - Hypotheses Summary

Hypotheses	Evaluation
H_1: The greater the software training intervention, the greater the perceived software understanding.	Not Supported
H_2: The greater the business process training intervention, the greater the perceived business process understanding.	Supported ****
H_{3a}: Increased software understanding from software training interventions is moderated by increased business process training interventions.	Not Supported[1]
H_{3b}: Increased business process understanding from business process training interventions is moderated by increased software training interventions.	Not Supported
H_4: The greater the software experiential interventions, the greater the perceived software understanding.	Supported ****
H_5: The greater the business process experiential interventions, the greater the perceived business process understanding	Supported ****
H_{6a}: The greater the software understanding, the greater the required task and required feature utilization.	Not Supported
H_{6b}: The greater the software understanding, the greater the optional task and required feature utilization.	Supported ***
H_{7a}: The greater the business process understanding, the greater the required task and optional feature utilization.	Not Supported[1]
H_{7b}: The greater the business process understanding, the greater the optional task and required feature utilization.	Not Supported
H_{7c}: The greater the business process understanding, the greater the optional task and optional features utilization	Not Supported
H_{8a}: Optional task and optional feature utilization from business process understanding is moderated by software understanding.	Not Supported
H_{8b}: Optional task and required feature utilization from software understanding is moderated by business process understanding.	Not Supported
* p<0.10, ** p<0.05, *** p<0.01, **** p<001	

[1] While the relationship is significant, the coefficient is negative and contrary to the hypothesized relationship.

CHAPTER 5
DISCUSSION

This dissertation examines the relationship between training interventions, experiential interventions, understanding, and ERP utilization. This chapter presents a discussion of the findings, limitations, contributions to research, contributions to practice, and future research directions.

A framework for examining post adoptive ERP utilization was proposed and tested using a population of ERP end-users. The framework considers how software training interventions influence software understanding, and how business process training interventions influence business process understanding. It also considers how software experiential interventions influence software understanding and how business process experiential interventions influence business process understanding. Software understanding focuses on the features of the ERP system, and business process understanding focuses on the business tasks that the end-user is performing. ERP utilization scenarios are then explored using these two types of understanding.

Training Interventions and Understanding

Training interventions are coordinated activities used to provide end-users with software and business process skills (Jones et al., 2008). These interventions have the express intent of increasing understanding across part or all of the organization (Jones et al., 2008; Clark et al., 2009). Training intervention activities are explicitly managed by the organization. The interventions directly affect understanding where understanding is defined as an individual end-user's net reconciliation of training and experiences (Clark et al., 2009)

It is posited that software training interventions are positively associated with software understanding (Hypothesis 1), and that business process training interventions are positively associated with business process understanding (Hypothesis 2). These interventions are also posited to act as moderators for each other (Hypotheses 3_a and 3_b). Hypothesis 2, was supported, and Hypothesis 1, 3_a and 3_b were not (Table 39).

Table 39 – Summary of Hypotheses 1 – 3_b

	Variable	β	p-value	Supported?
H_1:	Software Training Intervention ➔ Software Understanding	0.023	0.708	No
	With moderation (H_{3a})	-0.326	0.000	(see H_{3a})[2]
H_2:	Business Process Training Intervention ➔ Business Process Understanding	0.206	0.001	Yes***
	With moderation (H_{3b})	0.204	.056	(see H_{3b})
H_{3a}:	Business Process Training Intervention **(moderation)** on Software Training Intervention ➔ Software Understanding (H_1)	0.537	0.000	No[2]
H_{3b}:	Software Training Intervention **(moderation)** on Business Process Training Intervention ➔ Business Process Understanding (H_2)	.003	0.981	No

The lack of support for the relationship between software training interventions and software understanding may seem incongruent at first, yet it is consistent with prior research. For example, Jones et al., (2008) suggest that business process training interventions appear more effective in improving software understanding than software training interventions. The lack of support of Hypothesis 1 may be further explained in light of Hypotheses 3_a that posits that business process training interventions moderate the relationship between software training interventions and software understanding. The hypothesis is statistically significant, yet the negative coefficient implies that as

[2] While the relationship is significant, the coefficient is negative and contrary to the hypothesized relationship.

business process training interventions increase, it moderates a decrease in software understanding. This should not be interpreted to mean that software training has no significant impact on software understanding. The respondents in this survey are fairly experienced ERP users, with over 68% having used SAP more than five years. Almost none (2.64%) had used SAP less than one year. When asked how much they initially relied on company sponsored training respondents, on average, indicated between 'somewhat' and 'quite a lot'. When asked how much they currently relied on company sponsored training, respondents indicated 'not much'. It can be reasonably assumed that respondents gained some level of software understanding from their initial training. Similarly, a related explanation could be that post-implementation software training is limited to only basic features, and thus cannot increase software understanding beyond the originally acquired.

Business process training interventions may provide the context necessary to better understand how individuals use the software to address a particular business task. Thus, while software training is necessary to establish initial software understanding, business process training may be critical to achieve additional understanding of the software. To further explore this relationship, a *post hoc* test was performed that investigated a main effects relationship between business process training interventions and software understanding. This relationship was found to be significant ($\beta=0.339$, $p<0.000$). Therefore, business process training interventions may be more effective in improving software understanding than software training interventions alone in experienced users. This suggests that companies should consider

investing more heavily in business process training than in software training for these end-users.

The relationship between business process training interventions and business process understanding (Hypothesis 2) was significant. However, the moderating effect of software training interventions on this relationship (Hypothesis 3_b) was not supported. While software training interventions did not moderate business process training interventions upon business process understanding, the findings of these four Hypotheses (H1, H2, $H3_a$ and $H3_b$) paint a complex picture of the interaction among software and business process training and the impact on user understanding of both software and their business processes. The implications go deeper than simply the importance of training to suggest that the mix of each over time may be key to leveraging training to foster deeper understanding.

Experiential Interventions and Understanding

Experiential interventions leverage the user's familiarity with ERP system capabilities and his/her understanding of the organizational business processes. Experiential interventions involve the exploration of functional and process capabilities of the ERP system by end-users in search of solutions to specific system or process issues (Clark et al., 2009; Jones et al., 2008; Jasperson et al., 2005). They are managed by the user, are often short lived, and often occur soon after a system or process changed has occurred (Tyre and Orlikowski, 1994). They are likely triggered by a perceived lack of understanding or when the user senses more can be done with the system (Jones et al., 2008). We hypothesized that software understanding is positively influenced by software experiential interventions (Hypothesis 4), and that business

process understanding is positively influenced by business process experiential interventions (Hypothesis 5). Findings support both of these hypotheses (Table 40).

Table 40 – Summary of Hypotheses 4 and 5

	Variable	β	p-value	Supported?
H_4:	Software Experiential Intervention ➔ Software Understanding	0.261	0.000	Yes****
H_5:	Business Process Experiential Intervention ➔ Business Process Understanding	0.278	0.000	Yes****
* p<0.10, ** p<0.05, *** p<0.01, **** p<001				

Research to date has not captured the extent to which experiential interventions occur. We found that many respondents consider it part of their everyday job to explore and experiment with new ways to use the ERP system and to perform their business process tasks. That both Hypothesis 4 and Hypothesis 5 are supported lends strength to the argument that user exploration of both software and business process related items in ERP are important to increased user understanding. One implication for this is the need for further research to help determine the extent to which this exploration occurs and the form it takes. There are several vehicles through which experiential intervention manifests itself (Jasperson et al., 2005), yet little is known about the motivators or effectiveness of them. There is some indication in our own findings that experiential interventions are as strongly related, or more so, to understanding than training interventions (Table 28). Thus, our findings also suggest that ERP managers and end-users may benefit from explicitly identifying ways to encourage and leverage experiential interventions.

Understanding and Utilization

For this dissertation, utilization is defined as the extent that software features and capabilities are used by end-users to perform a task. Although ERP system use is mandated by organizations, individual end-users have a great deal of discretion in ERP's actual use (Jasperson et al., 2005). Some tasks and software features are explicitly required, yet optional software features are often available to end-users to address various perceived needs. The various combinations of optional and required use are classified into four utilization scenarios. Business process tasks and software features are identified as either required or optional. Required tasks and features are those whose use is mandated and enforced by the organization. Optional tasks and features allow for the user's discretion in their use.

This combination of software feature utilization and business process task utilization is represented in the two-by-two matrix of utilization scenarios shown in Table 41. These four combinations identify the possible utilization scenarios we used to operationalized our definition of ERP utilization. These scenarios were used to frame our utilization Hypotheses (6_a, 6_b, 7_a, 7_b, 7_c). One of these hypotheses (6_b) is supported, the others are not.

Table 41 - Utilization Scenarios

		Business Process Tasks	
		Required Tasks (RT)	Optional tasks (OT)
Software Features	Required Features (RF)	**RT/RF:** Using prescribed SW features to address required business process task.	**OT/RF**: Using prescribed SW features to address an optional business process task.
	Optional Features (OF)	**RT/OF**: Use of optional SW features to address a required business process task.	**OT/OF**: Use of optional SW features to address an optional business process task.

Table 42 – Summary of Hypotheses 6_a – 7_c

	Variable	**β**	**p-value**	**Supported?**
H_{6a}:	Software Understanding ➔ RTRF	-0.012	0.988	No
H_{6b}:	Software Understanding ➔ OTRF	0.550	0.001	Yes***
H_{7a}:	Business Process Understanding ➔ RTOF	-0.550	0.012	No
	With moderation (see H_{8b})	-0.248	0.771	No
H_{7b}:	Business Process Understanding ➔ OTRF	-0.183	0.372	No
H_{7c}:	Business Process Understanding ➔ OTOF	0.515	0.156	No
	With moderation (see H_{8b})	0.500	0.261	No
H_{8a}:	Software understanding **(moderation)** on Business process understanding ➔ OTOF	0.023	0.919	No
H_{8b}:	Business Process Understanding **(moderation)** on Software Understanding ➔ OTRF	0.002	0.973	No
	* p<0.10, ** p<0.05, *** p<0.01, **** p<001			

Software Understanding and Utilization

Software understanding is posited to positively influence the two required feature (RF) utilization scenarios (Hypothesis 6_a and Hypothesis 6_b). The relationship between

software understanding and the required task/required feature scenario (RT/RF) was not supported (Hypothesis 6_a). One possible explanation for this may arise from the mandated use aspect of the scenario. End-users are expected to know enough about the software features to execute the required business process tasks. As mentioned above, these end-users are fairly experienced, so it is likely that they have achieved a substantive baseline of software understanding to do their jobs. Because the RT/RF scenario consists of required tasks and features, additional software understanding does not increase usage. They have no choice but to use the software to perform the tasks in the way this scenario is defined. The relationship between software understanding and the optional task/required feature scenario (OT/RF) was supported (Hypothesis 6_b). This result suggests that by better understanding the software features, end-users can better leverage the software to perform business process tasks that are not necessarily mandated by the organization to be performed in ERP. This finding, taken in light of the results for H_{6a}, suggests that software understanding is positively related to use of ERP for optional tasks. The application of required features illustrates a deeper understanding of the software and provides for a deeper level of utilization by individuals. Examples may include the automation of previously manual business processes, or the application of more thorough data and process edits.

Business Process Understanding and Utilization

The business process understanding hypotheses explore the impact of business process understanding on optional tasks and features. Hypothesis 7_a examines the relationship between business process understanding and RT/OF utilization. While significant, the regression coefficient is negative. This indicates that there is an inverse

relationship between business process understanding and RTOF utilization. This suggests that for processes that are well known to the end user, they do not explore or experiment with optional ERP features.

An alternative explaination is that these optional ERP features become so engrained in the end users repertoire of ERP skills, that they do not perceive it as optional feature utilization; it has become a defacto standard feature. . For example, a person might be required to submit purchase order requests using the ERP in order to buy materials (a required task in the purchasing process). Early in their ERP usage, they decide that they would like to use the system feature to review previous orders of unique or special order items prior to ordering them. This entails use of additional features in the purchase order module beyond what is required in the required processing of purchase orders in ERP. Their understanding of the business process tasks may enable them to better explore what the software features can be used to do. Once found, these adopted optional features become 'standard' features to the end user. Thus, users are able to leverage greater flexibility in utilizing the software for required business process tasks.

Hypothesis 7_b proposes that business process understanding has a positive relationship on the OT/RF utilization scenario. Somewhat surprisingly, this relationship was not supported. Better understanding of business processes does not appear to translate into increased performance of non-required business process tasks. One possible explanation is that optional tasks are not typically sought out by end-users; by definition, they are optional activities. While better process understanding may improve business task performance, it does not necessarily increase the end-users desire to

seek out ways to perform additional tasks beyond those they are required to do. Hypothesis 7_c posits that business process understanding is positively related to the OT/OF utilization scenario. This relationship was also not supported. This hypothesis shares the same possible explanation as hypothesis 7_b. Greater business process understanding may not influence the user's predilection to seek optional features, and therefore the optional task/optional feature scenario may be largely moot. Note that less than 8 percent of our respondents fall into this scenario.

Moderation of Utilization Scenarios

The next set of hypotheses address the moderation of understanding on optional task utilization scenarios. Hypothesis 8_a proposes that software understanding moderates the relationship between business process understanding and the OT/OF utilization scenario. Hypothesis 8_b proposes that business process understanding moderates the relationship between software understanding and the OT/RF utilization scenario. The results do not support either hypothesis. The common element in both Hypotheses 8_a and 8_b is again the optional task component. As with Hypotheses 7_b and 7_c, business process understanding has no influence on optional task hypotheses.

In summary, although software training interventions are important in some hypotheses dealing with understanding, it is the business process training intervention that seems to provide the greater effect. However, when applying understanding to utilization scenarios, software understanding and business process understanding each provide support to the mixed (required/optional) utilization scenarios. In those scenarios where tasks and features were both required or optional, understanding did not support the stated hypotheses.

Limitations

This study is subject to several possible limitations in terms of internal and external validity. Survey research is susceptible to sampling errors introduced when the study respondents do not adequately reflect the desired sample population (Braverman, 1996). This study sampled ERP end-users from a prominent ERP user group. While respondents from this group represented a broad range of industries and organizations, respondents were limited to United States and Canadian English speakers. While some international organizations may have been represented, the sample population represented a single geographic region and culture. Caution is needed when generalizing these results to other areas of the globe.

Similarly, respondents were selected from the user group of a single ERP vendor, specifically SAP. While SAP provides a broad range of system features and task capabilities that are representative of other ERP software products, it is possible that end-users of other ERP software could have responded differently. Thus, caution is needed when generalizing to other ERP vendor products.

Because a single survey instrument was used to collect data, common methods bias (CMB) may also exist. CMB is assessed in two ways: the Harmon's one-factor test and the average variance extracted (AVE) test in confirmatory factor analysis. The Harmon's one-factor test is performed by reviewing the un-rotated solution of the principle components factor analysis. A single factor or the first factor explaining more variance than all the other factors is indicative of CMB (Podsakoff & Organ, 1986). The initial un-rotated factor analysis identified 11 factors, the first of which explained 24 percent of the variance and the remaining factors explained 48 percent. No single

factor was dominate, this satisfies the Harmon's one-factor test and indicates that CMB is not present. The second test compares the square root of the AVE from the confirmatory factor analysis. As was shown in Table 32 the square root of the AVE exceeds the correlation of the associated constructs. This indicates that CMB is not present (Bock, Sabherwal & Qian, 2008). Together, the Harmon's one-factor test, and the AVE test suggests that common methods bias was not a significant issue in this study.

Contributions to Research

ERP research that addresses post adoptive ERP utilization is limited. Thus, this dissertation is an early contributor to this research stream. This study extends our understanding of ERP utilization, specifically the role of software and business process understanding on utilization itself. It also supports previous research on the types of training and experiential interventions that best supports understanding.

In addition, we have examined ERP utilization using a unique lens. Existing definitions of utilization address system and task use, while this dissertation has further refined these dimensions to include required and optional types of utilization. Investigating how system features are used and for what kind of business tasks, provides a new lens for researchers to view this complicated construct. We posit nine utilization scenarios and empirically test four of them. The model and scale developed for this dissertation may provide researchers with a starting point to assess other utilization research questions or related phenomena.

Contributions to Practice

This study provides significant insight for practitioners. The seemingly incongruent results from Hypothesis 1 suggest that software understanding is most effectively gained in the presence of business process training interventions. The lack of support for Hypothesis 3_b and the inverse support for hypothesis 3_a illustrates that effective training programs should not focus solely on ERP functionality. While basic software feature understanding is required for end-users, more experienced ERP end-users should focus on business process training. Training has long been listed as a critical success factor in ERP research, but this study supports the conclusion that certain types of training may provide greater value than others.

Software understanding is important when looking at system utilization for optional tasks. End-users who know the ERP system can more effectively leverage the system features to address optional/adhoc business process tasks. Similarly, business process understanding allows end-users to leverage optional system features to get more out of the ERP system for required tasks. This provides a certain flexibility that can translate into increased benefits to the organization. The key practitioner finding of this dissertation is that a balanced formal training scheme coupled with an operational environment that allows end-users to partake in experiential learning activities provides a good platform for flexible ERP utilization.

Future Research

A number of opportunities exist to build upon the research from this dissertation. First, while the software and business process experiential intervention provided the necessary granularity for this dissertation, the antecedents of these constructs will be of

particular value to both researchers and practitioners. Identifying specific experiential intervention activities will provide value to researchers and practitioners alike. Identifying the specific balance of user experience, software training and business process training will be of great value to practitioners. Increased utilization will positively affect their ERP returns.

Second, further refinement is needed of scale items used to identify the four utilization scenarios. The current scale is specific to ERP; future research should expand scale options for use in research for other utilization phenomena. Similarly, the original three-by-three matrix, which lead to our optional/required two-by-two matrix should be investigated and extended. While novel tasks and features may not be appropriate in an ERP research stream, likely other research areas could take advantage of all nine utilization scenarios.

Third, the inverse relationship between business process understanding and RTOF utilization hints at a potential adoption phenomenon by end users. Can software features discovered during experiential interventions become so ingrained into a users work habits that they are perceived as required features? Understanding the qualities of these features may provide insight into how software features are adopted by end users.

Concluding Remarks

This dissertation set out to provide a model for post adoptive ERP utilization. It looked at software and business process training interventions, software and business process experiential interventions, software and business process understanding, and four utilization scenarios. Hypotheses addressing the interaction of these constructs

were proposed and tested via an online survey. A sample of ERP end-users provided 265 viable responses that were used to evaluate the hypotheses. While the hypotheses have mixed results, the insight they provide is valuable to both research and practitioners.

By viewing utilization as a set of optional and required tasks/features, we were able to retrieve some interesting results. Software understanding is positively influenced by business process training. The better end-users understand software, the better they can leverage it for business process gains. These business process gains can have tangible impacts on the organization.

APPENDIX A

SURVEY INSTRUMENT

Dear Participant,
I would like to invite you to participate in this research project, which is being conducted as part of the requirements for me to earn my Ph.D. in Business Computer Information Systems from the University of North Texas. The project aims to measure ERP utilization by examining the fit between SAP training, SAP experimentation, and the impact these have on business process and software understanding within your organization.

Your honest responses to each statement and question are extremely important to this project's outcome. You can be assured of complete confidentiality – no individual responses will be published and the raw information will be accessible only to me and the University of North Texas faculty on my dissertation committee. This survey contains sections addressing your SAP and business process training, your SAP and business process understanding, your SAP utilization and some information about yourself.

It will take you approximately 20 minutes to complete the survey. In addition, your participation is voluntary. You may decline to answer any particular question that you are uncomfortable with or feel is not appropriate. Submitting the survey will indicate that you have given your consent for us to use your data. The study has been reviewed and approved by the UNT Committee for the Protection of Human Subjects ([redacted]). If you have questions concerning this study, please feel free to contact me at [redacted] (email: [redacted]).

Thank you again for your consideration.

Sincerely,
Thomas McGinnis

For the purposes of this survey, please use the following definitions.

Business tasks: An activity meant to address a specific business need. For example, the receipt of goods into inventory.

Business process: A collection of business tasks that, when combined, complete a specific business workflow. For example, the procurement of raw material may require the creation of a purchase order, its delivery to the vendor, the receipt of material into inventory and the payment of invoice.

Functionality: The capabilities of the SAP software as implemented in your organization to address given business tasks and processes.

Code	Question	Source
	Demographic information	
Q1	1. What is your gender? (Mutually exclusive selections of 'Male', 'Female')	n/a
Q2	2. What is your functional area (Pull down box listing these values) a. General Management b. Corporate Communications c. Finance / Accounting / Planning d. Human resources / Personnel e. Information Technology f. Legal g. Manufacturing / Operations h. Marketing i. Sales j. Supply chain k. Other (please specify)	n/a
Q3	3. What kind of activities are you mostly involved with? a. Operational/Tactical b. Mid-level Management c. Upper-level Management/Strategic	n/a
Q4	4. What is the approximate number of employees in your organization? (Pull down box listing these values) a. Less than 100 b. 100-499 c. 500-999 d. 1,000-4,999 e. 5,000-9,999 f. 10,000-14,9999 g. 15,000 or more	n/a

Q5	5. What best describes your industry? (Pull down box listing these values) a. Manufacturing b. Finance c. Education d. Wholesale & retail trade e. Transportation f. Banking g. Manufacturing h. Utilities i. Government j. Insurance k. Other (please specify)	n/a
Q6	6. How long have you been using SAP? (Pull down box listing these values) a. Less than 1 year b. Between 1 year and less than 5 years c. Between 5 years and less than 10 years d. Between 10 years and less than 15 years e. 15 years or greater	n/a
Q7	7. What year did your organizational unit complete its initial SAP implementation? (text entry)	n/a
Q8	8. As a percent of total employees, how many SAP users does your organization have? (4 point likert: Less than 25%, 25% to less than 50%, 50% to less than 75%, 75% or more)	n/a
Code	**Question**	Source
	Utilization	
UTIL1xx	11. Of the SAP functionality you use, approximately how much of it is mandated (required for you to use)… (5 point Likert:Not applicable, less than 25%, 25% to less than 50%, 50% to less than 75%, 75% or more")	New
UTIL101	a. Financial Accounting & Controlling (FI/CO)	
UTIL102	b. Fixed Asset Management (AM)	
UTIL103	c. Project Systems (PS)	
UTIL104	d. Industry Solutions (IS)	
UTIL105	e. Sales and Distribution (SD)	
UTIL106	f. Materials Management (MM)	
UTIL107	g. Production Planning (PP)	
UTIL108	h. Quality Management (QM)	
UTIL109	i. Plant Maintenance (PM)	
UTIL110	j. Human Resources (HR)	

UTIL2	12 Approximately what percentage of the tasks you use SAP for are by your choice? (i.e. the tasks that you have the flexibility to perform outside of SAP but you choose to do inside the SAP system) (Interval scale: "Not applicable", "less than 25%", " 25% to less than 50%", " 50% to less than 75%" "75% or more")	New
Code	**Question**	**Source**
	Training Interventions	
TI1xx	13. How much have you relied on the following to help you use SAP within the last year? (5 point Likert: not at all, not much, somewhat, quite a lot, almost completely)	Jones et al. 2008
TI101	a. Formal training offered 'in-house'.	Jones et al. 2008
TI102	b. External formal training paid for by my company.	New
TI103	c. I have attended formal training at my own expense.	New
TI104	d. I have used on-line or computer-based training modules provided by my company.	New
TI105	e. I have used on-line or computer-based training modules provided by SAP or an SAP user group (i.e. ASUG).	New
TI106	f. I have read articles or books focused on SAP or ERP systems.	New
TI2xx	14. Please answer the following 2 questions with regard to how effective you feel your initial training was overall. (5 point Likert: Very ineffective, somewhat ineffective, neither, somewhat effective, very effective)	Jones et al. 2008
TI201	a. Overall, I feel that my training on how to use the SAP software was …	Jones et al., 2008
TI202	b. Overall, I feel that my training on how my job changed after SAP was …	Jones et al., 2008
	Questions 15, 16 and 17 are part of the survey, but not used in this dissertation.	
Code	**Question**	**Source**
	Experiential Interventions	
EI1xx	18. Beyond what you normally use as part of your everyday job … (5 point Likert: strongly disagree, disagree, neither, agree, strongly agree)	New
EI101	a. I experiment with SAP functionality beyond what is normally used to do my job.	New
EI102	b. I explore the SAP system beyond what is normally used to do my job.	New
EI103	c. I look for new ways to do my business processes.	New
EI104	d. I look for new ways to perform my business tasks.	New

EI2xx	19. How much have you relied on the following to help you use SAP in the last year? (5 point likert … not at all, not much, somewhat, quite a lot, almost completely.	Jones et al., 2008
EI201	a. I read publications about how other companies are using SAP	Jones et al., 2008
EI202	b. I talked to people in other companies about how they use SAP	Jones et al., 2008
EI203	c. I found ways to do things in SAP that no one else seemed to know about	Jones et al., 2008
EI204	d. I went to my colleagues for help solving problems or finding answers to questions about the SAP software	Jones et al., 2008
EI205	e. People in my area meet to discuss work process or task changes brought about by SAP	Jones et al., 2008
EI 3xx	20. Please respond to the following questions about your manager's support of SAP in the last year … (5 point likert … not at all, not much, somewhat, quite a lot, almost completely.)	Jones et al., 2008
EI301	a. Allows me the time to attend in-house SAP training sessions.	Jones et al., 2008
EI302	b. Encourages me to attend training sessions that address broader issues than the software itself.	Jones et al., 2008
EI303	c. Talks to me about how SAP impacts my work processes or tasks.	Jones et al., 2008
EI304	d. Talks to me about where my tasks fit in the "big picture" in the SAP environment .	Jones et al., 2008
EI305	e. Personally uses SAP software .	Jones et al., 2008
EI 4xx	21. Please indicate your level of agreement with the following: (5 point Likert: strongly disagree, disagree, neither, agree, strongly agree)	Jones et al., 2008
EI401	a. Others in my area expect me to personally use the SAP software .	Jones et al., 2008
EI402	b. Others in my area expect me to look for ways to improve our work processes using SAP.	Jones et al., 2008
EI403	c. Others in my area expect me to share with them new things I find in the SAP software.	Jones et al., 2008
EI404	d. My manager expects me to personally use the SAP software.	Jones et al., 2008
EI405	e. My manager expects me to find new ways to use SAP.	Jones et al., 2008
Code	**Question**	**Source**
	Perceived Understanding	
UN1xx	22. Please choose your level of understanding of the following: (5 point … almost none, some, just enough to do my job, more than enough to do my job, very high)	Jones et al., 2008
UN101	a. navigation of the SAP software.	Jones et al., 2008
UN102	b. what is meant by organizational units in the SAP software.	Jones et al., 2008
UN103	c. what is meant by master data in the SAP software.	Jones et al., 2008

UN104	d. performing transactions in the SAP software.	Jones et al., 2008
UN105	e. what is meant by workflow in the SAP software.	Jones et al., 2008
UN106	f. producing reports in the SAP software.	Jones et al., 2008
UN2xx	23. Please respond to the following questions about your level of understanding of your own work processes and tasks. I understand … (5 point … almost none, some, just enough to do my job, more than enough to do my job, very high)	Jones et al., 2008
UN201	a. How the task(s) I do feed into the next task(s) in the work process.	Jones et al., 2008
UN202	b. How the task(s) I do fit into the overall work process.	Jones et al., 2008
UN203	c. The task(s) that feed into the task(s) I do.	Jones et al., 2008
UN204	d. The tasks(s) that my task(s) feed into.	Jones et al., 2008
UN205	e. The overall work process that my task(s) is part of.	Jones et al., 2008
UN3xx	24. How does your new SAP enabled business processes compare with the previous business processes. (5 point … Much less in SAP, Somewhat less in SAP, about the same in SAP, somewhat more in SAP, much more in SAP)	New
UN301	a. Workflow transparency.	New
UN302	b. Ease of completed tasks.	New
UN303	c. Efficiency (throughput) of complete tasks.	New
UN304	d. Effectiveness of work process.	New
UN305	e. Control I have over my work process.	New
UN4xx	25. Where on the SAP learning curve do you think ... (5 point … Early, Still learning some basics, competent with most basics, exploring beyond basics, expert beyond basics)	New
UN401	a. You are.	New
UN402	b. Your organization is.	New
UN5xx	26. Overall, my organization is …. (5 point … not very well, somewhat, meeting organization expectations, somewhat beyond organization expectations, well beyond organizational expectations.)	New
UN501	a. Effectively leveraging current SAP functionality.	New
UN502	b. Exploring ways to gain new leverage from SAP.	New
UN503	c. Actively using SAP by most end-users.	New
UN504	d. Regularly using the full extent of functionality.	New

APPENDIX B

SOLICITATION E-MAIL

ASUG BENCHMARKING AND BEST PRACTICES

Factors Influencing Post-Adoptive SAP Utilization

Become part of a research study presented by ASUG and the University of North Texas to better understand the factors that influence SAP utilization long after the software has been implemented. Together we will investigate how SAP utilization is influenced by continued formal training in the software and business processes, along with individual users' experiences with the software and processes.

By participating in this 20 minute **survey**, you will help us compile best practices in these areas that will in turn benefit your organization. The results of this **survey** will be made available to the ASUG Benchmarking team in an anonymous and summarized fashion and we will share the report with you. To protect your privacy, no personal data will be stored with the questionnaire.

Investing a small amount of your time in the survey will provide you valuable insight into your organization's post-implementation utilization of SAP. Please **complete the survey** by October 15, 2010.

Thank you,

Richard Zepeda, ASUG Manager of Benchmarking
Thomas McGinnis, University of North Texas

REFERENCES

Alavi, M., and Henderson, J.C. (1981). An evolutionary strategy for implementing a decision support system. *Management Science, 27*(11), 1309-1322.

Al-Mashari, M. (2002). Enterprise resource planning (ERP) systems: a research agenda. *Industrial Management + Data Systems, 102*(3/4), 165-170.

Armstrong, J. S., and Overton, T. S. (1971). Brief vs. comprehensive descriptions in measuring intentions to purchase. *Journal of Marketing Research, 8*(1),114-117.

Bajwa, D. S., Carcia, J. E., & Mooney, T. (2004). An integrative framework for the assimilation of enterprise resource planning systems: phases, antecedents, and outcomes. *Journal of Computer Information Systems, 44*(3), 81-90.

Baron, R. M. and Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182.

Basi, R. K., (1999). WWW response rates to socio-demographic items. *Journal of the Market Research Society*, *41*(4), 397-401.

Baskerville, R., Pawlowski, S., & McLean, E. (2000). *Enterprise resource planning and organizational knowledge: patterns of convergence and divergence*. Proceedings of the 21st International Conference on Information Systems, Brisbane, Australia.

Beatty, R., and Williams, C., (2006). ERP II: Best practices for successfully implementing an ERP upgrade. *Communications of the ACM*, *49*(3), 105-109.

Benbasat, I., and Zmud, R., (2003). The identity crisis within the IS discipline: defining and communicating the discipline's core properties. *MIS Quarterly, 27*(2), 183-194.

Botta-Genoulaz, V., Millet, P., & Grabot, B. (2005). A survey on the recent research literature on ERP systems. *Computers in Industry, 56*, 510-522.

Bradley, J., & Lee, C. (2007). ERP training and user satisfaction: A case study. *International Journal of Enterprise Information Systems, 3*(4), 33-50.

Brazel, J., & Dang, L. (2008). The effect of ERP system implementations on the management of earnings and earnings release dates. *Journal of Information Systems, 2*(2), 1-21.

Burton-Jones, A. and D. W. Straub (2006). Reconceptualizing system usage: An approach and empirical test. *Information Systems Research, 17*(3), 228-246.

Burton-Jones, A. and M. Gallivan (2007). Toward a deeper understanding of systems usage in organizations: A multilevel perspective. *MIS Quarterly, 31*(4), 657-679.

Busemeyer, J. R. and Jones, L. E., (1983). Analysis of multiplicative combination rules when the causal variables are measured with Error. *Psychological Bulletin, 93*, 549-563.

Calvert, C. and Carroll, J. (2005). Training for ERP: *Does the IS training literature have value?* Proceedings of the 21st International Conference on Information Systems, Brisbane, Australia.

Campbell, D.T., and Fiske, D.W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 54*, 297-312.

Chin, W.W., (1989) Issues and opinions on structural equation modeling. *MIS Quarterly*, *22(1)*, vii – xvi.

Clark, T. D., M. C. Jones, R. W. Zmud. (2009). Post adoptive ERP use behaviors: A dynamic conceptualization*. International Conference on Systems Dynamics , Albuquerque N.M*. *July 26-30, 2009*: 1-54.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. (2nd ed.), Hillsdale, NJ: Erlbaum.

Compeau, D., Higgins, C., & Huff, S. (1999). Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly, 23*(2), 145-158.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*, 297-334.

Cumbie, B., Jourdan, Z., Peachey, T., Dugo, T., and Craighead, C. (2005). Enterprise resource planning research: Where are we now and where should we go from here? *Journal of Information Technology Theory and Application*, *7*(2) 21-36.

Davis, F.D., Bagozzi, R.P., Warshaw, P.R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

DeLone, W.H., and McLean, E.R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3*(1), 60-95.

Dillman, D. A. (2007). *Mail and Internet Surveys: The Tailored Design* (2nd ed.). New York, NY: John Wiley & Sons.

Equey, C. and Fragniere, E. (2008). Elements of perception regarding the implementation of ERP systems in Swiss SMEs. *International Journal of Enterprise Information Systems*, *4*(3), 43-51.

Esteves, J. (2007). An updated ERP systems annotated bibliography: 2001-2005. *Communications of the Association for Information Systems, 19*, 386-446.

Esteves, J. and Pastor, J. (2001). Enterprise resource planning systems research: An annotated bibliography. *Communications of the Association for Information Systems, 7*, 1-51.

Fichman, R. and Kemmer C., (1999). The Illusory Diffusion of Innovation: An examination of the assimilation gap. *Information Systems Research 10*(3), 255-275.

Gattiker, T., and Goodhue, D. (2002). Software-driven changes to business processes: an empirical study of impacts of enterprise resource planning (ERP) systems at the local level. *International Journal of Production Research, 40*(18), 4799-4814.

Gattiker, T., and Goodhue, D. (2004). Understanding the local-level costs and benefits of ERP through organizational information processing theory. *Information and Management, 41*, 431-443.

Gattiker, T., and Goodhue, D. (2005). What happens after ERP implementation: understanding the impact of inter-dependence and differentiation on plant-level outcomes. *MIS Quarterly, 29*(3), 559-584.

Gefen, D., and Ragowsky, A. (2005). A multi-level approach to measuring the benefits of an ERP system in manufacturing firms. *Information Systems Management*, 22(1): 18-25.

Griffith, T. (1999). Technology features as triggers for sensemaking. *Academy of Management Review, 24*(3), 472-488.

Henfridsson, O., & Soderholm, A. (2000). Barriers to learning: on organizational defenses and vicious circles in technology adaptation. *Accounting Management and Information Technologies, 10*, 33-51.

Hitt, L.M., Wue, D.J., and Zhou, X. (2002). Investment in enterprise resource planning: business impact and productivity measures. *Journal of Information Systems, 19*(1), 71-98.

Holsapple. C. and Seno, P. (2005). ERP plans and decision support benefits. *Decision Support Systems, 38*, 575-590.

Huck, S. W. (2004). *Reading Statistics and Research* (4th ed.), Boston, MA: Pearson Education Inc.

Hunton, J. E., Lippincott, B., & Reck, J. L. (2003). Enterprise resource planning systems: comparing firm performance of adopters and nonadopters. *International Journal of Accounting Information Systems, 4*, 165-118.

Jasperson, J., P. F. Carter, and R.W. Zmud (2005). A comprehensive conceptualization of the post-adoptive behaviors associated with IT-enabled work systems. *MIS Quarterly, 29*(3), 525-558.

Jones, M. C., R. W. Zmud, and T. Clark (2008). ERP in practice: A snapshot of post-installation perception and behaviors. *Communications of the Association for Information Systems, 23,* 437-462.

Kanuk, L. and Berenson, C. (1975). Mail surveys and response rates: A literature review, *Journal of Marketing Research, 12*, 440-453.

Karahanna, E., Straub, D.W., and Chervany, N.L. (1999). Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly, 23*(2), 183-213.

Karimi, J., Somers, T. and Bhattacherjee, A. (2007). The impact of ERP implementation on business process outcomes: A factor-based study. *Journal of Management Information Systems, 24*(1), 101-134.

Kerlinger, F.N. and Lee, H.B.(2000). *Foundations of Behavioral Research* (4th ed.), New York, NY: Thomson Learning.

Kline, R.B. (1997). *Principles and practice of structural equation modeling*, New York, NY: Guilford Press.

Kumar, K. and J. van Hillegerberg, (2000). ERP experiences and evolution. *Communications of the ACM*. *43*(4), 24-26.

Lassila, K. S. and Brancheau, J. C. (1999). Adoption and utilization of commercial software packages: Exploring utilization equilibria, transitions, triggers and tracks. *Journal of Management Information Systems, 16*(2), 63-90.

Liang, H., Saraf, S., Hu, Q., and Xue Y. (2007). Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management. *European MIS Quarterly*, *31*(1), 59-87.

McNurlin, B. (2001). Will users of ERP stay satisfied?, *Sloan Management Review*, *42*(2), 13.

Muscatello, J., & Parente, D. (2006). Enterprise resource planning (ERP): A post implementation cross-case analysis. *Information Resources Management Journal, 19*(3), 61-80.

Nah, F., Tan, X., & Teh, S. (2004). An empirical investigation on end-users' acceptance of enterprise systems. *Information Resources Management Journal, 17*(3), 32-53.

Nelson, R., & Cheney, P. (1987). Training end-users: An exploratory study. *MIS Quarterly, 11*(4), 547-559.

Nicolaou, A. (2004). Quality of post-implementation review for enterprise resource planning systems. *International Journal of Accounting Information Systems, 5*, 25-49.

Nicolaou, A., & Bhattacharya, S. (2006). Organizational performance effects of ERP systems usage: The impact of post-implementation changes. . *International Journal of Accounting Information Systems, 5*, 25-49.

Nunnally, J.C. and Bernstein, I.H., (1994). *Psychometric Theory,* New York, NY: McGraw-Hill.

Orlikowski, W. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science, 11*(4), 404-428.

Peslak, A., Subramanian, G., & Clayton, G. (2007). The phases of ERP software implementation and maintenance: A model for predicting preferred ERP use. *Journal of Computer information systems, 48*(2), 25-33.

Pinsonneault, A. and Kraemer, K.L. (1993). Survey research methodology in management information systems: An assessment. *Journal of Management Information Systems, 11*(2), 75-106.

Plant, R., & Willcocks, L. (2007). Critical success factors in International ERP implementations: A case research approach. *Journal of Computer Information Systems, 47*(3), 60-70.

Ranganathan, C. and Brown, C. (2006). ERP Investments and the market value of firms toward an understanding of influential ERP project variables. *Information Systems Research, 17*(2), 145-161.

Robey, D. Ross, J. and Bourdreau M. (2002). Learning to implement enterprise systems: An exploratory study of the dialectics of change. *Journal of Management Information Systems*, *19*(1), 17-46.

Ross, J. W. (1999). Surprising facts about implementing ERP. *IT Pro, July/August 1999*, 65-68.

Ryan, S.D., Harrison, D.W., and Schkade, L.L. (2002). Information-technology investment decisions: When do costs and benefits in the social subsystem matter? *Journal of Management Information Systems, 19*(2), 85-127.

Schuman, H., and Pressor, S. (1981). *Questions and Answers in Attitude Survey*, New York, NY: Academic Press.

Scott, J. E. (2005). Post-implementation usability of ERP training manuals: The user's perspective. *Information Systems Management, 22*(2), 67-77.

Seddon, P. (1997). A respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research, 8*(3), 240-253.

Shang, S. and Seddon, P. (2002). Assessing and managing the benefits of enterprise systems: the business manager's perspective. *Information Systems Journal, 12*, 271-299.

Stratman, J. (2007). Realizing benefits from enterprise resource planning: Does strategic focus matter? *Production and Operations Management*, *16*(2), 203-216.

Trice, A. and Treacy, M. (1988). Utilization as a dependent variable in MIS research. *database, Fall/Winter* 1988: 33-41.

Tyre, M., & Orlikowski, W. (1994). Windows of opportunity: temporal patterns of technological adaptation in organizations. *Organization Science, 5*(1), 98-118.

Venkatesh, V., Speier, C., & Morris, M. (2002). User acceptance enablers in individual decision making about technology: toward an integrated model. *Decision Sciences, 33*(2), 297-316.

Wang, E., Shih, S., Jaing, J., & Klein, G. (2008). The consistency among facilitating factors and ERP implementation success: A holistic view of fit. *Journal of Systems and Software, 8*(9), 1609-1621.

Wu, J., and Wang Y., (2006). Measuring ERP success: the ultimate users' view. *International Journal of Operations & Production Management*, *26*(8), 882-903.