2015

# Sustainability of Enterprise Resource Planning (ERP) Benefits Postimplementation: An Individual User Perspective

Mohamed Abdalla Mohamed Badreldin Lotfy
*Walden University*

# Walden University

College of Management and Technology

This is to certify that the doctoral dissertation by

Mohamed Abdalla Mohamed Badreldin Lotfy

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Anthony Lolas, Committee Chairperson, Management Faculty
Dr. Leila Halawi, Committee Member, Management Faculty
Dr. Howard Schechter, University Reviewer, Management Faculty

Chief Academic Officer
Eric Riedel, Ph.D.

Walden University
2015

Abstract

Sustainability of Enterprise Resource Planning (ERP) Benefits Postimplementation:

An Individual User Perspective

by

Mohamed Abdalla Mohamed Badreldin Lotfy

MS, Military Technical College, Cairo, Egypt, 1988

BE, Military Technical College, Cairo, Egypt, 1981

BS, Military Technical College, Cairo, Egypt, 1981

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Applied Management and Decision Sciences

Walden University

August 2015

Abstract

Although there is research about the use of enterprise resource planning (ERP) from a management perspective, the research is not clear as to whether the ERP benefits justify the costs, not only in dollars, but also in effort, from the end user's perspective. Using the theory of diffusion of innovation (DOI), the purpose of this quantitative research was to identify the set of postimplementation sustainability factors that maximized ERP user value, which are major issues for management, and measured their relative significance. The study's structural model incorporated the technology-organization-environment (TOE) framework, which is a conceptualization of the theory of diffusion of innovation, to predict the postimplementation sustainability factors from the ERP user's point of view. The partial least squares structure equation modeling (PLS-SEM) approach provided the needed explanatory analysis to test the predictive power of the structural model. The target population was organizational employees who had used an operational ERP system for at least 4 years in the state of Colorado. A convenience sample of 163 cases responded to the online questionnaire. Hypotheses testing indicated that the independent variables of ERP information quality, ERP system quality, ERP knowledge and learning, shared beliefs, job relevance, and coordination significantly impacted the dependent variable ERP user value. The positive social change implications of this study include a better understanding of ERP postimplementation sustainability factors from the users' perspectives and their social impact on organizational performance, which could lead to increased employee effectiveness, productivity, efficiency, and individual satisfaction due to ERP usage.

Sustainability of Enterprise Resource Planning (ERP) Benefits Postimplementation:

An Individual User Perspective

by

Mohamed Abdalla Mohamed Badreldin Lotfy

MS, Military Technical College, Cairo, Egypt, 1988

BE, Military Technical College, Cairo, Egypt, 1981

BS, Military Technical College, Cairo, Egypt, 1981

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Applied Management and Decision Sciences

Walden University

August 2015

## Dedication

I would like to dedicate this study to my late mother and father. In addition, I would like to dedicate this study to my wife, Sherin; my daughter, Menna; and my son, Abdelrahman.

# Acknowledgments

First, I want to thank GOD, the most beneficent, and the most merciful, who has taught (the writing) by the pen, has taught man that which he knew not.

I am so grateful to Dr. Anthony Lolas, chairperson of my dissertation committee and my faculty mentor, for all his guidance, encouragement, and support throughout this long academic journey. I am also grateful to Dr. Leila Halawi, committee member, for her support and assistance in this endeavor. I would like to thank Dr. Howard Schechter, the university reviewer, for providing important recommendations for this study.

I am forever grateful to all those at Walden and Regis Universities, and to everyone else whom I did not mention but who contributed in some fashion to the successful completion of this dissertation. Most of all, I am thankful for my wife, Sherin; my daughter, Menna; and my son, Abdelrahman, who have helped me reach this point in my academic career.

Table of Contents

List of Tables

List of Figures

# Chapter 1: Introduction to the Study

Since the early 1990s, large enterprises replaced their legacy IT systems with enterprise systems (ES) that enabled them to integrate different business functions and processes. ES systems allow the organization to integrate financial services, accounting, human resource management, production management, sales, supply-chain management (SCM), knowledge management, decision support systems, and e-business functionality. Enterprise resource planning (ERP), the most complex and largest ES system, is the core business process management software for organizations, providing cost savings, improved planning and operations, and organizational growth. Currently, many small, medium-sized, and large organizations use some form of an ERP system in their operations (Magal & Word, 2012; Tsai, Chen, Hwang, & Hsu, 2010). The following paragraphs are a historical review of the development of ERP systems to the current orientation.

Historically, ERP systems evolved from materials requirement planning (MRP) in the early 1970s. In the 1980s, manufacturing resources planning (MRPII) provided production as well as tactical and strategic decision-making functionality, and were used as decision support systems (DSS) and executive information systems (EIS). In the 1990s, ERP systems provided financial services, accounting, human resource management, production management, and sales functionality in an integrated business suite. Since the turn of the century, extended ERP or ERPII systems have provided functionality across the supply chain, including warehouse management systems (WMS), transportation management systems (TMS), advanced planning systems (ADS), analytics, business intelligence (BI), supplier relationship management (SRM) systems, customer relationship management (CRM) systems, and e-business (Koh, Gunasekaran, & Goodman, 2011; Magal & Word, 2012).

An important characteristic of ERP systems is their modular design, where each module represents distinct business functionality as well as analysis and optimization tools, adaptability, and integration capabilities (Koh et al., 2011). ERP systems allow for seamless flow of real-time information between the modules, thus creating information visibility in the organization and the supply chain (Jenatabadi, Huang, Ismail, Satar, & Radzi, 2013; Li, 2012; Seethamraju & Krishna Sundar, 2013). The modular and integrative characteristics of ERP systems make them a critical factor and enabler in establishing an efficient and effective organization, where ERP systems' capabilities and functionality are used throughout the organization to provide better products and services (Jenatabadi et al., 2013). Through the use of the ERP system capabilities, knowledge (skills and expertise) leverage is achieved by capitalizing on the competencies and expertise of the system users (workers), partners, and participants in the organization supply chain (Beheshti & Beheshti, 2010). Coordination among the different units in the organization, through the ERP system and the streamlined IT infrastructure, is critical to create a differential business advantage that is flexible and responsive to diverse and changing customer needs (Nikookar, Yahya Safavi, Hakim, & Homayoun, 2010; Su & Yang, 2010a, 2010b).

As each ERP module provides the organization with a set of flexible best practice business processes with an integrated set of functions, the ERP system allows the organization the opportunity to improve and optimize current business processes through reengineering the current business processes (Nikookar et al., 2010). ERP adopting organizations should benefit from the business process change and should extend the benefits to the supply chain network (Su & Yang, 2010a, 2010b). By reengineering the current business processes and using the provided best practices business processes in the ERP system, the adopting enterprise can achieve a business advantage and enhance its market share due to cost reductions, integration of resources, efficient information sharing, flexibility, agility, and improved performance (Kwahk & Ahn, 2010; Seethamraju & Krishna Sundar, 2013). Organizations can achieve optimum performance in ERP application by using an integrated and balanced approach that includes strategic management, process improvement, ERP system deployment, project organization, and organizational change management (Beheshti & Beheshti, 2010; Yang & Su, 2009; Yeh & Xu, 2013). Using an integrated transformational approach to the ERP application that includes a networked and integrated infrastructure with a holistic business process change, the organization should experience a competitive advantage (Nikookar et al., 2010; Seethamraju & Krishna Sundar, 2013). With the change in adaptability, including mobile platforms, and customization of ERP solutions, small and medium enterprises (SMEs) are adopting ERP systems and cloud-based ERP solutions (Haddara & Elragal, 2013; Ifinedo, 2012; Shahawai & Idrus, 2011). Due to the planning and optimization functionality in current ERP systems, which include strategic, demand, supply, distribution, production, and transportation planning capabilities and functionality, supply chains are implemented using ERP systems that provide effective and efficient management of the supply chain (Ince, Imamoglu, Keskin, Akgun, & Efe, 2013, Li, 2012).

Despite the benefits, ERP implementation has some disadvantages and challenges for the adopting organization. ERP implementation can be complex and expensive due to business processes reengineering (Azevedo, Romão, & Rebelo, 2012; Velcu, 2010). Implementing an ERP system forces the adopting enterprise to change its business processes and use the provided best practice business processes, which can prove to be costly, and leads to organizational change (Azevedo et al., 2012). ERP implementations are also time consuming; implementation can take a year or more (Amid, Moalagh, & Zare Ravasan, 2012). The adopting organization might need to upgrade its systems and networking infrastructure (Kini & Basaviah, 2013). ERP implementation costs can be in the millions of dollars, which include the price of software, consulting fees, and any vendor support (Azevedo et al., 2012; Snider, da Silveira, & Balakrishnan, 2009).

A 2013 Gartner Inc. ERP market share analysis report showed that the ERP market size reached $24.5 billion in 2012, demonstrating 2.2% growth compared to 2011 (Pang, Dharmasthira, Eschinger, Motoyoshi, & Brant, 2013). Gartner's second-quarter forecast predicted that the ERP market size would reach $26.03 billion in 2013. According to the Gartner Inc. 2013 forecast report, ERP spending worldwide would grow from $26.03 billion in 2013 to $34.3B in 2017. The forecast report predicted that the annual growth in the forecast period 2013-2017 would be 6% to 7% (Wurster et al., 2013). In addition, the SME ERP adoption and market share will continue to grow (Azadeh, Afshari–Mofrad, & Khalojini, 2012; Kini & Basaviah, 2013).

According to Velcu (2010), the ERP system lifecycle consists of three phases: the project, shakedown, and onward-and-upward phases. Law, Chen, and Wu (2010) defined the ERP project lifecycle as consisting of four phases: adaptation, acceptance, routinization, and infusion. Within the definitions of the ERP lifecycle presented above, ERP postimplementation consists of the shakedown phase (routinization) and the onward-and-upward phase (infusion). In the *shakedown* or *routinization* phase, after the ERP system goes live or is implemented, the ERP system is performance tuned and integrated for normal use. In the *onward-and-upward* phase or *infusion* phase, the organization uses the ERP system for the day-to-day organizational operations in addition to using it effectively to its maximum potential (Law et al., 2010; Velcu, 2010).

The remaining parts of this chapter introduce the research problem's background and the need for the study. The emphasis then shifts to the purpose of the study, the research questions and hypotheses, the theoretical framework for the study, and the research structural model. The next sections in the chapter provide a discussion regarding the nature of the study, the definitions of terms used in this study, assumptions, scope, and limitations. The chapter ends with an examination of the significance of the study.

## Background of the Study

Nearly 25 years ago, Tornatzky and Fleischer (1990) posited that people "use process technologies to make or improve other product technologies" and that "process technologies usually involve larger aggregates of tools, machines, people, and social systems than do product technologies" (Tornatzky & Fleischer, 1990, pp. 20-21). According to Tornatzky and Fleischer (1990),

> Process technologies tend to include individuals, and more stakeholder groups, and thus require much more difficult system change. Moreover, the people are themselves part of the system. Therefore, implementation requires the involvement of tightly knit groups of players in an organizational context, as in the case of advanced manufacturing technologies. (p. 21)

In the above definition by Tornatzky and Fleischer (1990), the ERP system components, as a process technology, are the people, the technological tools (ERP systems capabilities and functionality), and the organizational context. According to Koch (2011), ERP systems provide a holistic view of the business with the ERP technology infrastructure as the core that supports the strategy, organization, people, and business environment. Stephenson and Sage's (2007) ERP architectural model identified the technology, processes, and the people as the core components of the ERP environment, as shown in Figure 1. From the previous ERP environment definitions, people (ERP users) are an integral part of the ERP environment and can influence the success or failure of the ERP system (Dery, Grant, Harley, & Wright, 2006; Koch, 2011).

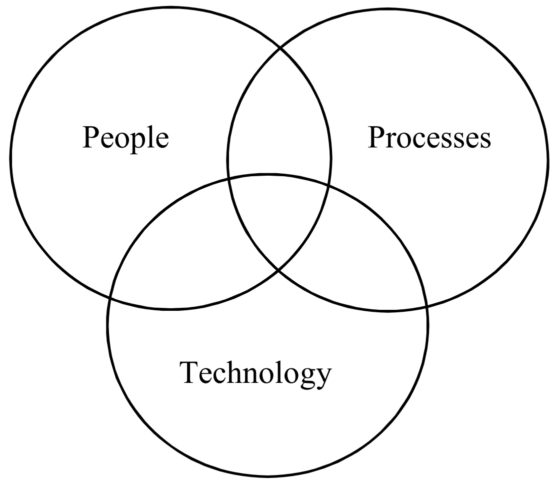


*Figure 1.* ERP core components. Adapted from "Architecting for Enterprise Resource Planning," by S. V. Stephenson and A. P. Sage, 2007, *Information, Knowledge, Systems Management*, *6*(1), p. 91. Copyright 2007 by IOS Press. Adapted with permission.

In Barney's (1991) resource-based-view (RBV), "the firm resources (assets, human capital, capabilities, processes, knowledge, information, etc.) can only be a source of competitive advantage or sustained competitive advantage when they are valuable" (p. 106). Barney further stated, "resources are valuable when they enable a firm to conceive or implement strategies that improve its efficiency and effectiveness" (p. 106). The value in the RBV is determined by the firm's internal resources contributing to profit (endogenously) and by the market (exogenously; Barney, 2001; Kraaijenbrink, Spender, & Groen, 2010). Financial performance and the ability to create economic value are some of the measures of competitive advantage (Taher, 2012). Sustaining above-normal financial performance or economic value creates a sustained competitive advantage (Taher, 2012). Barney defined sustained competitive advantage in terms of improved efficiency (reducing cost) and effectiveness (increasing value). Organizational leaders need to understand the sources of sustaining a competitive advantage and to view competitive advantage from the point of view of sustainability (Barney, 2001; Johansson & Newman, 2010).

ERP implementation is a strategically approached, complex process of technology innovation as well as organizational and process change management that affects the entire organization (Aloini, Dulmin, & Mininno, 2012). The purpose of ERP implementation is to permit the organization to assimilate the information systems throughout the organization, thus allowing the organization to use the ERP system capabilities to seek a long-term sustainable competitive advantage (Johansson, 2013; Rahrovani & Pinsonneault, 2012). Achieving a competitive advantage requires successful planning and implementation of the ERP system, refinement of the business process, and alignment of the organization’s strategic direction with the ERP system performance postimplementation (Hsu, 2013b). In addition, competitive advantage from the ERP end user’s perspective relates to the ability of the ERP system to support the end user’s business processes and “deliver increased performance” (Johansson & Newman, 2010, p. 90). Althonayan and Papazafeiropoulou (2013) asserted, “Individual performance is an essential indicator of organizational performance” (p. 4076). They further stated that “studying the impact of ERP systems on stakeholders’ performance is a significant way to assess the utility of this software and how it contributes to performance efficiency and effectiveness” (p. 4076). According to Althonayan and Papazafeiropoulou (2013), the ERP system’s value lies in increased productivity, quality, and organizational competitiveness, and the ERP system affects not only the organization, but also the individuals within it.

Despite implementing and having a functional ERP system, the organization needs to measure the impact of the ERP technology on the organization, supply chain partners, and ERP users postimplementation. Esteves's (2009) study showed that "the dimensions of ERP benefits are interconnected, and the realization of ERP benefits is a continuum cycle along the ERP postimplementation axis" (p. 25). Other ERP users, organization units, divisions, and partners use the information entered by individual ERP users. In addition, the expectations of both management and peers might affect ERP user use behavior, which could influence the use and usefulness of the ERP system (Chang, Cheung, Cheng, & Yeung, 2008). McCubbrey and Fukami's (2009) study pointed out that there is a relationship between how users react to the ERP system and ERP success. Understanding employee reactions to the ERP system should help in assessing why some ERP implementations are more successful than other implementations (Dery et al., 2006).

Users' perceptions of the benefits of usefulness and usability of the ERP system affect the behavioral intention to use the ERP system (Calisir, Gumussoy, & Bayram, 2009). Wu (2011) posited that user' perceptions of ERP benefits impact ERP implementation success; thus, identifying these benefits from the user's perspective is important, critical, and imperative. Wu (2011) further stated, "The significance of ERP users' perceived benefits must continue to be the focus of exhaustive and regular research and adjustment" (p. 6947). Youngberg, Olsen, and Hauser (2009) argued for the importance of the end users' view about the usefulness of the ERP system and how this view affects system usage.

The question of the ERP system's value to the organization and end users is and has been a key issue (Ramdani, 2012). Uwizeyemungu and Raymond (2012) defined *ERP business value* as "the value added by automational, informational and transformational effects of ERP capabilities upon the firm's operational and managerial processes" (p. 69). Ruivo, Oliveira, and Neto (2014) showed that ERP use along with collaboration and analytics are important factors that affect ERP value. Boztepe (2007) argued, "User value is created as a result of the harmonious combination of product properties and what users and their local contexts bring to the interaction with the product" (p. 61). The ERP system should deliver value to the user through the user's experience with the ERP system and the benefits derived from using it (Ruivo, Johansson, Oliveira, & Neto, 2012). The ERP value to the user should depend not only on the ERP system's functionality, but also on the tangible and intangible benefits of the user's experience in using the system (Hsu, 2013a, 2013b).

Moon's (2007) meta-analysis of ERP research identified the following questions: "Is an ERP system of any value to an organization? What values an ERP system brings to an organization? How do we measure the value of an ERP system?" (p. 244). Addo-Tenkorang and Helo's (2011) research showed that some ERP studies raised the same questions raised by Moon (2007) regarding ERP value. In addition, according to Grabski, Leech, and Schmidt (2011), "there is a relative lack of attention given to the social context, that is, user acceptance, in determining the organizational consequences of ERP systems" (p. 48). Kwak, Park, Chung, and Ghosh (2012) raised a similar question: "Did the ERP system add value to an organization in terms of business performance?" (p. 274).

## Problem Statement

Enterprise resource planning (ERP) is the core business process management software for organizations, providing cost savings, improved planning and operations, and organizational growth. ERP software allows an organization to use a system of integrated applications to manage the business, improve the business process, and automate many administrative functions related to technology, services, and human resources. ERP software integrates all facets of a business operation, including product planning, development, manufacturing, sales, and marketing. ERP provides managers with a wide range of information that aids in the decision-making process for competitive advantage. Because of the intended integration of all facets of a business operation, the ERP system can be costly, complex, and time consuming, not only in the development phase, but also during the maintenance phase, especially in the entry, processing, and retrieval of information. Initially, only large organizations could afford the costs to develop, implement, and maintain ERP systems.

Since 2000, more mid-level organizations have implemented ERP systems to be able to compete with large organizations, especially in providing quality products and services. The problem that was the focus of this study was that many organizations have not realized the benefits to justify the costs in implementing an ERP system as well as the resources necessary to sustain the system in a rapidly changing business environment. In addition to implementing and having a functional ERP system, the organization needs to measure the ERP benefits that provide sustained competitive advantage and value in the onward-and-upward phase (Addo-Tenkorang & Helo, 2011; Grabski et al., 2011; May, Dhillon, & Caldeira, 2013).

Although there is research about the use of ERP from a management perspective, the research is not clear as to whether the ERP benefits justify the costs, not only in dollars, but also in effort, from the end user's perspective. In addition, the critical sustainability factors in the onward-and-upward phase that maximize the value of ERP from the user's point of view remain unidentified. McCubbrey and Fukami's (2009) study of a public sector organization in the state of Colorado indicated that there are mixed points of view regarding the value of the installed ERP system between management and end users. McCubbrey and Fukami (2009) showed that the users' perspectives regarding the benefits of an ERP system are unrecognized, as well as how the users of the ERP system view the ERP benefits after implementation. It was, therefore, important to conduct a quantitative study to determine the sustainability factors that maximize the value of the implemented ERP system in the onward-and-upward phase postimplementation from the user's point of view. In addition, there was a need for a study to investigate how these factors, which provide ERP user value, affect ERP user productivity, effectiveness, and internal efficiency, which are major issues for management regarding implementing and maintaining ERP systems.

## Purpose of the Study

The purpose of this study was to identify the different postimplementation sustainability factors, factors that provide sustained competitive advantage, in the onward-and-upward phase from the ERP user's point of view. In this study, the definition of the ERP user followed the definition of Dery et al. (2006). They defined the ERP end user as "anyone who is reliant on the ERP software in some operational sense, irrespective of their seniority within the organization" (p. 200). There was a need for this research because it addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value affects firm-achieved ERP benefits. The purpose of this research was to investigate the relationships between the sustainability factors that positively impact productivity, effectiveness, internal efficiency, and coordination, thus leading to maximization of the value of the ERP system from the ERP user's point of view, and how they correlate to ERP value postimplementation.

The results of this study provide much-needed insights into the relationship among the organizational management support systems already in place—mainly, organizational shared beliefs, employee ERP knowledge and learning, and job relevance—and how these support systems influence ERP user value. Insights from this study should aid IT professionals and those in organizational management in recognizing the set of ERP sustainability factors from users' perspectives and their impact on organizational performance. In addition, this research addressed the lack of a social change context in current ERP research identified by Grabski et al. (2011). Investigating ERP users' acceptance and perspectives regarding the value of the installed ERP system and measuring the impact of shared beliefs and users' self-efficacy on ERP user value in this study could lead to a positive social change in ERP-adopting organizations.

## Research Questions and Hypotheses

Review of the ERP success literature indicated that ERP information quality, ERP system quality, ERP service quality, shared beliefs, user self-efficacy, job relevance, ERP knowledge and learning, and coordination are the factors that affect ERP success. Within the research structural model (see Figure 2 below), these factors provide sustained competitive advantage and positively impact productivity, effectiveness, internal efficiency, and coordination, thus leading to maximization of the value of the ERP system from the ERP user's point of view in the onward-and-upward phase. Mapping these factors to the contexts of the TOE framework resulted in aligning ERP information quality, ERP system quality, and ERP service quality as the technological context constructs. While shared beliefs, job relevance, ERP knowledge and learning, and user self-efficacy map to the organizational context, coordination is the environmental context construct. Three dimensions—impact on business, impact on internal efficiency, and impact on coordination—manifest the second-order construct ERP user value (dependent variable) in the model. The research hypothesis was that the independent variables of the technological, organizational, and environmental contexts impact ERP user value and affect ERP success.

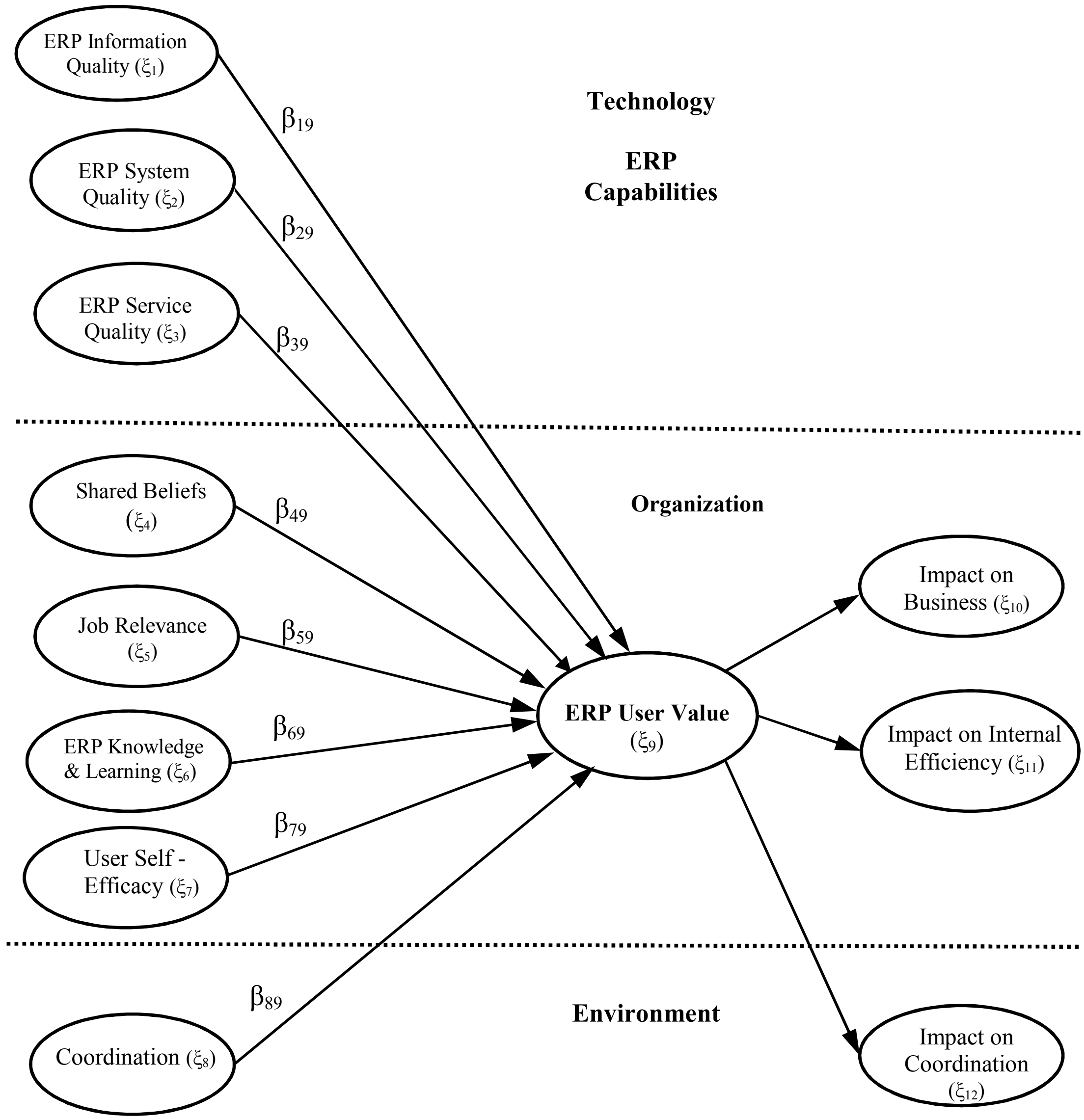


*Figure 2.* The research structural model.

## Research Questions

The following were the research questions:

**Research Question 1.** From an ERP user's point of view, what were the sustainability factors that maximized the value of an ERP system for the user in the onward-and-upward phase?

**Research Question 2.** Which postimplementation sustainability factors in the onward-and-upward phase maximized the value of an ERP system from the user's point of view, and how significant were those factors?

## Research Hypotheses

From the research structural model, see Figure 2 above, the following were the research hypotheses:

**Hypothesis 1 (H1).**

*$H_0 1$:* The ERP information quality does not impact ERP user value ($\beta_{19} = 0$).

*$H_a 1$:* The ERP information quality impacts ERP user value ($\beta_{19} \neq 0$).

**Hypothesis 2 (H2).**

*$H_0 2$:* The ERP system quality does not impact ERP user value ($\beta_{29} = 0$).

*$H_a 2$:* The ERP system quality impacts ERP user value ($\beta_{29} \neq 0$).

**Hypothesis 3 (H3).**

*$H_0 3$:* The ERP service quality does not impact ERP user value ($\beta_{39} = 0$).

*$H_a 3$:* The ERP service quality impacts ERP user value ($\beta_{39} \neq 0$).

**Hypothesis 4 (H4).**

*$H_0 4$:* ERP workers and peers' shared belief in the benefits of the ERP system does not impact ERP user value ($\beta_{49} = 0$).

*$H_a 4$:* ERP workers and peers' shared belief in the benefits of the ERP system impacts ERP user value ($\beta_{49} \neq 0$).

**Hypothesis 5 (H5).**

*$H_0$5:* The extent to which employees felt the ERP system is relevant for their jobs does not impact ERP user value ($\beta_{59} = 0$).

*$H_a$5:* The extent to which employees felt the ERP system is relevant for their jobs impacts ERP user value ($\beta_{59} \neq 0$).

**Hypothesis 6 (H6).**

*$H_0$6:* ERP user's knowledge and learning of the ERP system do not impact ERP user value ($\beta_{69} = 0$).

*$H_a$6:* ERP user's knowledge and learning of the ERP system impact ERP user value ($\beta_{69} \neq 0$).

**Hypothesis 7 (H7).**

*$H_0$7:* ERP user's self-efficacy does not impact ERP user value ($\beta_{79} = 0$).

*$H_a$7:* ERP user's self-efficacy impacts ERP user value ($\beta_{79} \neq 0$).

**Hypothesis 8 (H8).**

*$H_0$8:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers does not impact ERP user value ($\beta_{89} = 0$).

*$H_a$8:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers impacts ERP user value ($\beta_{89} \neq 0$).

$\beta_{ij}$ is the path coefficient linking the $i^{th}$ latent variable to the $j^{th}$ endogenous variable in the structural model.

## Theoretical Foundation

Nearly 50 years ago, Rogers's (1962) theory of diffusion of innovation (DOI) provided a framework for understanding the attributes of how an innovation affects and changes the function and structure of an organization or a social system. DOI theory, which is a meta-theory, describes the adoption of an innovation and then its diffusion among a population. DOI "helps us understand how and why an innovation diffuses over time" (Wolfe, 1994, p. 412). Innovation attributes, adopter characteristics, environmental characteristics, the nature of the social system and social network, the process by which an innovation is communicated (the communication channels), and the characteristics of those who are promoting an innovation influence the adoption and diffusion process (Rogers, 2003). Individual, organizational, technological, and environmental contexts influence the diffusion of the technological innovation (Cua, 2012).

Tornatzky and Fleischer's (1990) technology, organization, and environment (TOE) framework is a conceptualization of the theory of diffusion of innovation regarding diffusion of technological innovation, as shown in Figure 3 below. The TOE framework provided an environmental context to the technology and organizational context as measures of IT performance success (Baker, 2012). In many studies, as shown in Tables 5 and 6 in Chapter 2, researchers have tested and empirically validated the TOE framework. Since the TOE framework addressed the three aspects of diffusion of innovation—the technology, the organizational characteristics, and the environment—many studies have incorporated it to investigate different types of information system innovations (Baker, 2012, Zhu, Li, Wang, & Chen, 2010). The TOE framework provided a generic theory of technology diffusion to model and study information systems technology diffusion. Researchers have also incorporated it to study ERP and e-commerce success (Baker, 2012; Wen & Chen, 2010; Zhu et al., 2010).

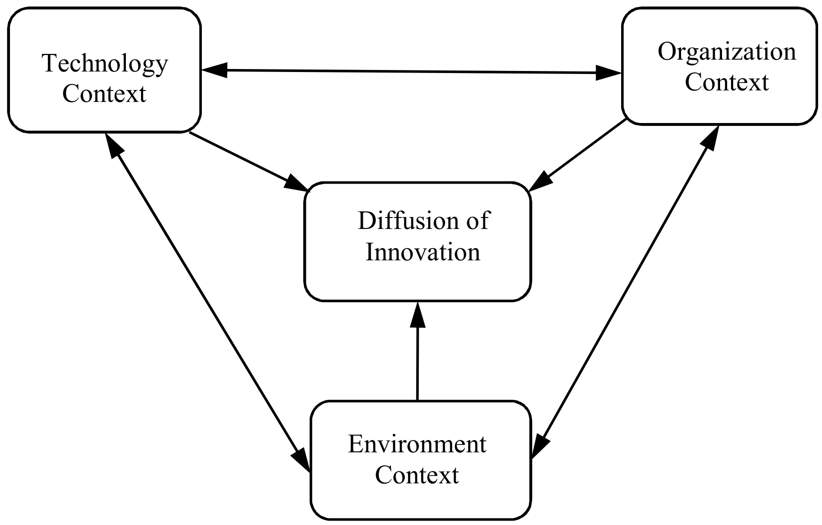


*Figure 3.* The technology-organization-environment (TOE) framework. Adapted from *The Processes of Technological Innovation*, by L. G. Tornatzky and M. Fleischer, 1990, p. 153, Lexington, MA: Lexington Books. Copyright 1990 by Rowman & Littlefield. Adapted with permission.

The TOE framework, which is an analytical approach to studying the relationship between the contexts of ERP implementation success, has enabled the measurement of ERP value from multiple perspectives including management, IT professionals, and IT users (Oliveira & Martins, 2011; Wen & Chen, 2010). The research model in this study incorporated the TOE framework to predict the postimplementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. The TOE model investigated the impact of the ERP technology, organizational, and environmental contexts on the success of the ERP system in the onward-and-upward phase and measured their causal effect on ERP user value.

## Nature of the Study

The research design for this study was a nonexperimental quantitative research approach. I used an online survey instrument to collect the data. The target population for the study was organizational employees who had used an implemented and operational ERP system for at least 4 years. A representative sample frame of the study target population included multiple firms, higher education institutions, government entities, and local ERP and supply-chain management user groups in the Denver, CO metropolitan area. As the research sample frame was large, using random sampling techniques to identify the sample was not feasible, given that the different entities and firms did not provide their member lists. The different entities and firms that participated in the study were the mechanism to disseminate the invitation to participate in the study to their members. Following the recommendations of other researchers, as discussed in Chapter 3, and the suggested 107 minimum sample size assuming a 0.15 medium effect size, 0.80 statistical power, and 0.05 significance level, from Faul, Erdfelder, Buchner, and Lang's (2009) G*Power statistical software, a convenience sample of 325 or more respondents was an adequate sample size for this study.

The partial least squares structural equation modeling (PLS-SEM) approach, a statistical approach to test multivariate models, helped in explaining the interactions and relationships between the different factors in the structural model (independent variables) and their causal effect on the ERP user value (dependent variable, a second-order latent variable). As the structural research model investigated the impact of the ERP technology, organizational context, and environmental context on the success of ERP postimplementation, the PLS-SEM approach provided the needed explanatory analysis to test the structural model. In addition, the PLS-SEM methodology allowed for testing the hypotheses statistically. The PLS-SEM analysis pinpointed the postimplementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. I discuss the study's methodology in more detail in Chapter 3.

## Definitions

Working definitions for key terms used in this study were as follows:

*Coordination improvement*: The capability of adapting to changing conditions, coordinating, and synchronizing among different organizational units (S. Chou & Chang, 2008).

*ERP information quality*: The characteristics of the ERP system output (produced reports) with respect to timeliness, relevance, availability, usefulness, understandability, and so forth (DeLone & McLean, 1992, 2003; Häkkinen & Hilmola, 2008; Ifinedo, Rapp, Ifinedo, & Sundberg, 2010).

*ERP system quality*: The performance characteristics of the ERP system, including ease of use, reliability, flexibility, customization, integration, and so forth (Abugabah & Sanzogni, 2010; Häkkinen & Hilmola, 2008; Ifinedo, 2011d; Ifinedo et al., 2010).

*ERP user*: “Anyone who is reliant on the ERP software in some operational sense, irrespective of their seniority within the organization” (Dery et al., 2006, p. 200).

*ERP user value*: The set of sustainability factors that maximize the value of ERP from the ERP user’s point of view.

*Job relevance*: The extent to which employees feel that the ERP system is useful for their jobs, promotes increased productivity, and is responsive to their changing job demands (Amoako-Gyampah, 2004).

*Knowledge and learning*: ERP user willingness to learn, the existence of the opportunity to learn, and the acquisition of ERP knowledge (H. W. Chou, Chang, Lin, & Chou, 2014).

*Shared beliefs*: Beliefs about the overall impact of the ERP system on the organization: extent of workers’ belief in the benefits of the ERP system, extent of management team’s belief in the benefits of the ERP system, and peers’ belief in the benefits of the ERP system (Amoako-Gyampah & Salam, 2004).

*User self-efficacy*: “Users’ perceived abilities regarding how to use the ERP system to perform their daily work” (H. W. Chou, Chang, et al., 2014, p. 271).

**Assumptions**

The following were the assumptions of this study:

1. In this study, the definition of the ERP end user followed the definition of Dery et al. (2006): “anyone who is reliant on the ERP software in some operational sense, irrespective of their seniority within the organization” (p. 200).

2. The target population for the study was organizational employees who had used an implemented and operational ERP system for at least 4 years.

**Scope and Delimitations**

The scope of the study was to predict the postimplementation sustainability factors that maximized the value of an ERP system from the ERP user's point of view and their impact on the overall ERP benefits for the organization, as well as how user acceptance of ERP value affects the firm's achieved ERP benefits. This nonexperimental quantitative study involved the use of an online survey instrument to collect data on the relationship between the ERP technology capabilities, user's job relevance, user's ERP knowledge and learning, organizational support systems and processes already in place, and organizational shared beliefs, and how these factors impact ERP user value. As this research was of an exploratory nature, the analysis used a PLS-SEM path-modeling approach rather than a covariance-based structure analysis approach.

To ensure that the respondents were in the onward-and-upward phase of the ERP life cycle, the target population for the study was organizational employees who had used an implemented and operational ERP system for at least 4 years. This delimitation was critical because the ERP system shakedown (routinization) phase takes between 1 and 3 years to be completed (Law et al., 2010; Velcu, 2010). As the target population for the study was so large, I delimited the target population to the state of Colorado. In addition, the sample frame of the study target population only included multiple firms, higher education institutions, government entities, and local ERP and supply-chain management user groups in the Denver, CO metropolitan area. Using random sampling techniques to identify the sample was not feasible because the identified entities did not provide their employee and member lists; thus, the sampling approach used in this study was limited to a convenience sample approach.

**Limitations**

Due to the use of self-reported rating to measure all the constructs, method variance might exist and might have contributed to part of the correlation between the constructs. Performing the study in the Denver, CO metropolitan area represented a potential limitation, thus limiting generalizations beyond the identified geographic region. As the sampling procedure used in this study was convenience sampling instead of random sampling, the sampling procedure prevented the generalization of the study findings to all ERP users. Even though the obtained 163 cases met many sample size recommendations by other researchers and exceeded the G*Power statistical software computed minimum sample size of 107 assuming a 0.15 medium effect size, 0.80 statistical power, and 0.05 significance level, the study sample size represented a potential limitation.

The study participants' length of experience using the ERP technology could have affected individual responses. In addition, factors such as ethnicity, nationality, religion, the composition of ERP users and teams, and the business type or business relationships that serve the organization and its supply chain were not part of the analysis. Although the findings of this study might contribute to a better understanding of the sustainability factors of implemented ERP systems, due to the heterogeneous nature of the ERP systems, the study did not control for the different types of ERP packages used by the participants, which might be problematic.

**Significance of the Study**

This study is significant because the obtained results may help organizations adopting ERP systems to maximize the value of their functional ERP systems. In recent years, there has been an increased interest in postimplementation ERP research, but the research "still lack[s] insight into human factors that are prevalent in the system" (Singh, Singh, & Pereira, 2010). McCubbrey and Fukami's (2009) study pointed out that there is a relationship between how users react to the ERP system and ERP success. Their study of a public sector organization in the state of Colorado indicated that there were mixed points of view regarding the value of the installed ERP system between management and end users. The outcomes of this study filled a gap in ERP research because it investigated the relationship between ERP technology capabilities, user's job relevance, user's ERP knowledge and learning, organizational support systems and processes already in place, and organizational shared beliefs, and how these factors impact ERP user value. This study went beyond merely identifying how ERP systems can benefit an organization in that a postimplementation study was carried out to ascertain the real efficiencies, from the ERP user's point of view, that can sustain the ERP competitive advantage. This research partially filled a void in scholastic literature where research on ERP value postimplementation is at best fragmentary.

Rogers (2003) defined a *social system* as "a set of interrelated units" (p. 26)—individuals, organizations, and so forth—"that are engaged in joint problem solving to accomplish a common goal" (p. 26). An organization or enterprise, as a social system, consists of working individuals collaborating through division of labor and a rank hierarchy to establish a set vision and goals and achieve a competitive advantage. Social change happens because of diffusion, adoption, or rejection of new ideas. Rogers asserted, "Diffusion is a kind of a social change, defined as the process by which alteration occurs in the structure and function of a social system" (p. 6).

Nearly 25 years ago, Tornatzky and Fleischer (1990) defined *technologies* as "tools or tool systems by which we transform parts of our environment, derived from human knowledge, to be used for human purposes" (p. 10). Tornatzky and Fleischer stated, "Any technology, as a knowledge-embedded tool, is a mixture of social/behavioral elements and physical elements" (p. 18). ERP systems are information technology tools developed by humans from human knowledge. Humans use ERP systems within an organizational setting to increase productivity and business process automation. The use of ERP systems could lead to change or transform the business process in the organization.

Tornatzky and Fleischer (1990) argued, "The social context may actually be more determining than the tools themselves" (p. 15). Tornatzky and Fleischer posited,

> The social context (work roles, social structure) of technology may be manipulated in ways that, in turn, lead to major changes in the overall system. Different social systems will influence how the tools are used, how different components of the technological system relate to one another, and how much end product is actually produced. (p. 15)

The findings of Chang et al. (2008) confirmed Tornatzky and Fleischer's assertion that social context and social factors influence technology use. Chang et al. found that social factors, as an organizational characteristic, had the strongest effect on ERP system usage. Chang et al. asserted,

> Social factor has become [*sic*] an important factor for IT applications that require cooperation among different parties to be successful. ERP system is one such system that connecting [*sic*] colleagues across functional areas to achieve better efficiency, and it is embedded into the social environment of the companies more deeply than those standalone applications. (p. 938)

The results of this study provide much-needed insights into the relationship among the organizational support systems already in place, shared beliefs, employee knowledge, and employee learning and how these factors affect ERP user value. Insights from this study could aid IT professionals and organizational management in understanding the set of ERP sustainability factors from users' perspectives and their impact on organizational performance. The positive social change implications of this study include a better understanding of ERP postimplementation sustainability factors from the users' perspectives and their impact on organizational performance, which could lead to increased employee effectiveness, productivity, efficiency, and individual satisfaction due to ERP usage. By recognizing ERP users' acceptance and perspectives, this study addressed the lack of social change context in current ERP research and aided in investigating the impact of job relevance and user self-efficacy on ERP user value. Investigating ERP users' points of view and perspectives regarding the impact of ERP user value in this study provided information that could lead to a positive social change context in current ERP research.

## Summary and Transition

Enterprise resource planning (ERP) systems, the most complex and largest ES system, is the core business applications for organizations, providing cost savings, improved planning and operations, and organizational growth. ERP implementation is a strategically approached, complex process of technology innovation and organizational and process change management that affects the entire organization (Aloini et al., 2012). The purpose of ERP implementation is to permit the organization to assimilate the information systems throughout the organization, thus allowing it use its capabilities to seek a long-term sustainable competitive advantage (Johansson, 2013; Rahrovani & Pinsonneault, 2012). The problem that was the focus of this study was that many organizations have not realized the benefits to justify the costs in implementing an ERP system as well as the resources necessary to sustain the system in a rapidly changing business environment. In addition to implementing and having a functional ERP system, organizations need to measure the ERP benefits that provide sustained competitive advantage and value in the onward-and-upward phase (Addo-Tenkorang & Helo, 2011; Grabski et al., 2011; May, Dhillon, & Caldeira, 2013). Although there is research about the use of ERP from a management perspective, the research is not clear as to whether the ERP benefits justify the costs, not only in dollars, but also in effort, from the end user's perspective. There is a need for research that identifies the user's perspective regarding the benefits of an ERP system and how the users of the ERP system view the benefits of an ERP system. As ERP users in the state of Colorado have mixed feelings about the value of implemented ERP systems, it was important to conduct a quantitative study to determine the sustainability factors that maximized the value of the implemented ERP system in the onward-and-upward phase postimplementation from the user's point of view—ERP user value.

The research methodology used in this study was a nonexperimental quantitative research approach. Based on DOI theory, the structural model in this study incorporated the TOE framework to predict the postimplementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. I used an online survey instrument to collect the data. The PLS-SEM approach provided the needed explanatory analysis to test the structural model. In addition, the PLS-SEM methodology allowed for testing the hypotheses statistically. This research addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value affects firm-achieved ERP benefits. The positive social change implications of this study include a better understanding of ERP postimplementation sustainability factors from the users' perspectives and their impact on organizational performance, which could lead to increased employee effectiveness, productivity, efficiency, and individual satisfaction due to ERP usage.

Chapter 2 provides a review of related ERP research work and compares, contrasts, and summarizes the TOE framework literature supporting this study. Chapter 3 contains a description of the quantitative research methodology, the SEM design for the structural TOE model for this study, the study population, data collection, and the analysis used. Chapter 4 presents the results of the PLS-SEM analysis. Finally, Chapter 5 presents an overall summary of this study, along with conclusions and recommendations for future research.

# Chapter 2: Literature Review

This chapter presents a review of the related research work, models, and frameworks supporting this study. The main objective of this literature review effort was to arrive at an understanding of the state of the art in ERP postimplementation success research, the use of the TOE framework in ERP studies, and the different dimensions and factors used to measure ERP success. There are four sections in this chapter. The first part of the chapter contains an explanation of the literature research strategy, process, and objectives. The review of the literature begins with an overview of the theoretical foundations including the different ERP success models, frameworks, and measurement approaches. The next section in the chapter contains a review of the conceptual framework, the TOE framework, and its use in different ERP studies. The emphasis then shifts to a review of the research that concerns ERP key variables and concepts including ERP postimplementation, the different success dimensions, and a review of the research that relates to the ERP end user. The chapter ends with a summary of the literature review effort.

## Literature Search Strategy

The supporting research and literature for the study included multiple sources encompassing books, journal articles, and dissertations. I reviewed and investigated 600 journal articles, dissertations, and books. The result of this effort was the sources used in this study. The selected sources provided significant support to the research problem and purpose of this study and provided essential information regarding the theories and frameworks used in ERP research.

The literature review effort involved the use of both Walden University and Regis University research libraries and the Google Scholar search engine. The sources for the literature review included full text peer-reviewed journal articles from the ProQuest databases (Dissertations and Theses, ProQuest Central, and Research Library), EBSCO databases (Academic Search Premier, Business Source Premier, Computers & Applied Sciences Complete, ERIC, and Information Science & Technology Abstracts), ACM and IEEE digital libraries, Science Direct, and SAGE Journals Online. Scholarly books by original authors contributed to the theoretical framework of the study and the research methodology. Academic and professional websites provided additional information on methodology, alternative viewpoints, and research articles not otherwise obtainable.

The main search terms for publications were *success*, *postimplementation*, and *ERP* in combination with *TOE* or *DOI* and *value*. The second search term for important publications for this research was *enterprise systems success*. The database searches used keywords alone and in various combinations, including *ERP critical success factors*, *ERP postimplementation*, *ERP success factors postimplementation*, *enterprise systems success*, *diffusion of innovation*, *the TOE framework*, *technology-organization-environment framework*, *ERP TOE*, *DOI theory*, *information technology/system success*, *information technology/system failure*, *structure equation modeling*, and *SEM*, among others.

In the first step of the literature review, I used the search terms to identify relevant sources. This effort led to the creation of an initial set of articles through the analysis and review of the abstract of each identified source. Further analysis and evaluation of the selected articles from the first step of the literature review resulted in the expansion of the sources for this literature review due to choosing additional publications on the subject of ERP success postimplementation from the reference lists of selected articles. Analyzing and evaluating the findings of the selected publications led to the identification of the current state of the field.

## Theoretical Foundation

ERP implementation is a strategically approached, complex process of technology innovation and organizational and process change management that affects the entire organization (Aloini et al., 2012). According to Kronbichler, Ostermann, and Staudinger (2010), ERP success can be "complex and difficult to measure" (p. 284); thus, measuring the success of the ERP system has been a focus of many ERP studies. A review of the ERP literature revealed that many ERP studies investigated the critical success factors (CSF) that often lead to a successful ERP implementation (Ahmad & Pinedo Cuenca, 2013; Azadeh et al., 2012; Basu & Lederer, 2011; Bernroider, Wong, & Lai, 2014; Farzaneh, Vanani, & Sohrabi, 2013; Hanafizadeh, Gholami, Dadbin, & Standage, 2010; Huang, 2010; Kini & Basaviah, 2013; Kronbichler, Ostermann, & Staudinger, 2009; Law et al., 2010; Liu, 2011; Ram & Corkindale, 2014; Ram, Corkindale, & Wu, 2013; Rotchanakitumnuai, 2010; Supramaniam & Kuppusamy, 2011; Tsai, Lee, Shen, & Yang, 2009). Although some ERP studies have used published information systems (IS) success frameworks to measure ERP success empirically, other studies have developed new models. In the remaining parts of this section, I provide a historical review of, discuss, compare, and contrast the different ERP success frameworks and models.

**The DeLone and McLean IS Success Model**

In their quest to improve research practices in the information systems field, DeLone and McLean (1992) provided a six-dimensional information systems (IS) success model, the D&M IS success model. The six interdependent measures of IS success are system quality, information quality, use, user satisfaction, individual impact, and organizational impact (DeLone & McLean, 1992). These six interdependent measures, identified from an extensive literature review of published IS articles between the years 1981 and 1988 by DeLone and McLean, form a process causal construct for IS success, as shown in Figure 4.

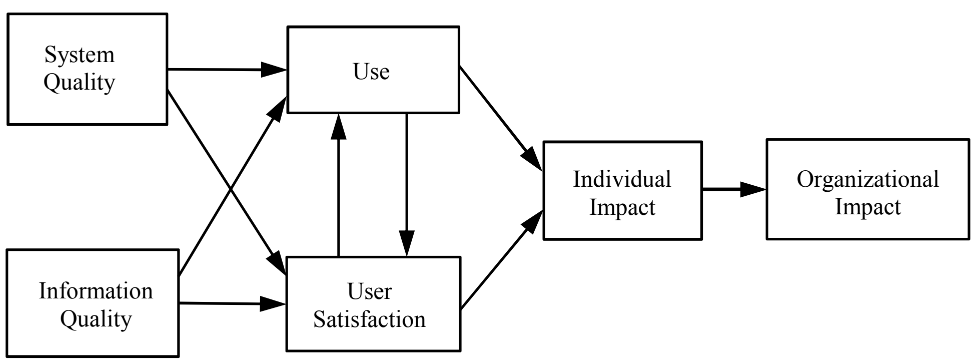


*Figure 4.* The DeLone and McLean IS success model. Adapted from "Information Systems Success: The Quest for the Dependent Variable," by W. H. DeLone and E. R. McLean, *Information Systems Research*, *3*(1), p. 12. Copyright 1992 by the Institute for Operations Research and the Management Sciences, 5521 Research Park Drive, Catonsville, Maryland 21228. Adapted with permission.

DeLone and McLean (2003) provided a revised model by adding a service quality dimension to the model, integrating the individual impact and organizational impact dimensions into a new dimension called *net benefits*, and adding the intention to use dimension, as shown in Figure 5. The addition of the service quality dimension to the revised model was due to organizational IS success research that identified it as a component of the IS success quality dimensions, system, and information. In addition, information systems affect not only the individual user or the organization, but also the work group, interorganizational units, intraorganizational units, consumers, and society. Using a net benefits dimension allows for the simplification of the model and encompasses all IS impacts.

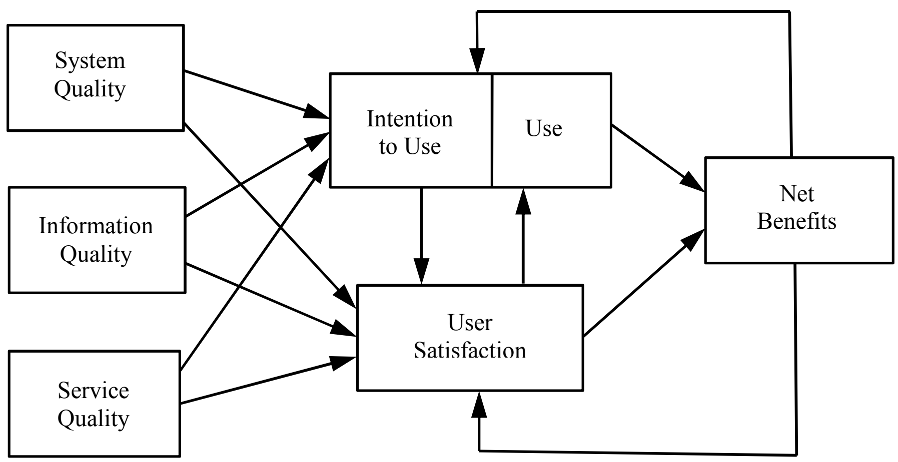


*Figure 5.* The revised DeLone and McLean IS success model. Adapted from *The DeLone and McLean Model of Information Systems Success: A Ten-Year Update,* by W. H. DeLone and E. R. McLean, 2003, p. 87. Copyright 2003 by M.E. Sharpe, Inc. All rights reserved. Not for reproduction. Adapted with permission.

The addition of the attitude dimension, intention to use, into the model was to clarify the causal relationship and to resolve the issues raised by Seddon (1997) that *use* is a behavioral dimension (DeLone & McLean, 2003; Kronbichler et al., 2010). Numerous IS publications empirically verified the DeLone and McLean IS success model (Petter, DeLone, & McLean, 2008; Petter & McLean, 2009; Urbach & Müller, 2012). Many ERP studies incorporated the DeLone and McLean IS success model to measure the success, performance, and net benefits of ERP adoption and implementation. Table 1 provides a summarization of recent ERP studies showing the DeLone and McLean IS success model factors used in each study and any other dimensions added to the model.

Table 1

*The Use of D&M Success Model in ERP Research*

| Author(s) | D&M dimensions | Additional dimensions |
|---|---|---|
| Bernroider (2008) | ERP system quality, information quality, service quality, and Net benefits. | Financial benefits. |
| Lin (2010) | ERP system quality, information quality, perceived usefulness, user satisfaction, and ERP system usage. | Top management support. |
| Ifinedo (2011d) | ERP system quality, information quality, perceived usefulness, system use, user satisfaction, individual impact, and organizational impact. | External expertise, business employees' computer/IT skills, and in-house IT professionals' knowledge. |
| Tsai, Shaw, Fan, Liu, Lee, and Chen (2011) | ERP system quality, information quality, individual impact, workgroup impact, and organizational impact. | The degree of satisfaction of the service quality of system providers, the degree of satisfaction of the service quality of consultants, and the achievement level of project management. |
| Tsai, Lee, Liu, Lin, and Chou (2012) | ERP system quality, information quality, system use, user satisfaction individual impact, and organizational impact. | ERP performance and earnings management. |
| J. S. Chou and Hong (2013) | ERP system quality, information quality, service quality, system use, user satisfaction. | Corporate benefits. |

**The Technology Acceptance Model**

Davis, Bagozzi, and Warshaw (1989) proposed the technology acceptance model (TAM) which is an adaptation of the theory of reasoned action to explain and predict actual information system use. TAM centered on the behavior of using new IS technologies, and provided an analysis of the effect of external factors on the attitudes, beliefs, and intentions of individuals (Davis et al., 1989). Davis (1989) proposed the use of perceived usefulness (PU) and perceived ease of use (PEOU) to measure user acceptance of an information system. Davis defined perceived usefulness as “the degree to which a person believes that using a particular system would enhance his or her job performance” and perceived ease of use as “the degree to which a person believes that using a particular system would be free of effort” (p. 320). Davis (1993) provided the structural equations of TAM which many empirical studies validated (e.g. Davis, 1993; Jan & Contreras, 2011; Jones, McCarthy, Halawi, & Mujtaba, 2010; Kim, Chun, & Song, 2009).

Many ERP researchers used TAM to measure the success of an ERP implementation. While some researchers validated the TAM dimensions to measure ERP system usage, other researchers integrated TAM in new models to measure ERP use and behavioral intention to use the ERP system. Table 2 provides a literature review of those studies.

Table 2

*The Use of TAM in ERP Research*

| Author(s) | ERP TAM focus and factors |
|---|---|
| Chung, Skibniewski, Lucas, and Kwak (2008) | The impact of user related variables (output, image, compatibility, job relevance, Result demonstrability, system reliability) and project related variables (Internal support, function, consultant support) on PU and ERP success. |
| Calisir et al., (2009) | Factors (subjective norms, compatibility, gender, experience, and education level) that affect behavioral intention to use an ERP system based on potential ERP users. |
| Shih and Huang (2009) | Behavioral intention and actual use as impacted by top management support, computer self-efficacy and computer anxiety. |
| Youngberg et al., (2009) | The impact of PEOU, results demonstrability, and subjective norms on PU and their impact on usage behavior. |
| Vathanophas and Stuart (2009) | Identify what factors (System type, system use, direct system use, university tenure, prior ERP, prior ERP use, computer expertise, educational background, active research, and Level of education) are associated with end user computing satisfaction, PU, and PEOU of University ERP systems. |
| Lee, Lee, Olson, and Chung (2010) | The impact of formal organizational support (training and education, work environment) and informal organizational support (communication) on original TAM factors. |
| Garača (2011) | The Impact of PEOU of ERP system, PU of ERP system, and computer anxiety in use of ERP system on the satisfaction with ERP system and its effect on the intention to use ERP system. |
| Pasaoglu (2011) | The effect of perceived benefit, PEOU, organizational culture, and using satisfaction (related to the attitude and intention factors towards ERP) on creating the intention to use, and if effective, to determine its degree of influence on the enterprise intend to use ERP. |

| Author(s) | ERP TAM focus and factors |
|---|---|
| Sternad, Gradisar, and Bobek (2011) | The impact of personal characteristics and information literacy (technological innovativeness, computer anxiety, computer self-efficacy, computer experience), system and technological characteristics (data quality, system performance, user manuals, ERP functionality), and organizational-process characteristics (business processes fit, social influence, ERP support, ERP communication, ERP training) on ERP usefulness and ERP EOU and their effect on the attitude to ERP system. |
| Kwak et al., (2012) | The impact of internal support, consultant support, and ERP functions on PU and PEOU and their effect along with subjective norm on the intention to use the ERP system. |
| Sternad, and Bobek (2013) | The impact of organizational- process characteristics, system and technological characteristics, and personal characteristics and information literacy on perceived ERP usefulness and perceived ERP ease of use and their effect on attitude to ERP system. |

Venkatesh and Davis (2000) extended TAM to TAM2 by identifying the factors that explain perceived usefulness. These factors were subjective norm, image, job relevance, output quality, result demonstrability, and two mediating factors experience and voluntariness. Venkatesh and Bala (2008) extended TAM2 to TAM3. TAM3 added the determinants of the perceived ease of use, which were computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment, and objective usability. Many IT studies provided an empirical validation of both TAM2 and TAM3 empirically.

**Gable, Sedera, and Chan ERP Systems Success Measurement Model**

Gable, Sedera, and Chan (2003) provided an ERP systems success (ESS) measurement model to measure ERP success. The model identified individual impact, organizational impact, information quality, and system quality as related dimensions that measure enterprise system success. While the impact dimensions—individual and organizational impact—assess at a certain point of time the benefits caused by the ERP system, the quality dimensions—information and system quality—show the potential of the ERP system. The four dimensions collectively provide a complete view of the enterprise system, and the level of success reached (Gable et al., 2003). Gable et al. (2003) built a priori model using the DeLone and McLean's (1992) IS model dimensions, excluding the use dimension, to measure ERP success. Gable et al. validated the priori model using a survey instrument as well as testing and validating the final model.

There are differences between the Gable et al. (2003) model and the DeLone and McLean (1992) IS success model. Gable et al. model is a measurement model not a causal/process model of success. Gable et al. treated satisfaction as the overall measure of success not a dimension of success. In addition, Gable et al. removed the use dimension from the model because the use of the ERP system is mandatory. In 2008, Gable, Sedera, and Chan provided the IS-impact measurement model to measure the success of information systems, which is a reconceptualization of their 2003 model. Gable et al. (2008) replaced satisfaction with the IS impact as the measure of IS success. Gable et al. (2008) and Ifinedo (2011a) verified and confirmed the IS-impact measurement model.

## The Extended ERP Systems Success Measurement Model

Ifinedo and Nahar (2006) proposed the extended ERP systems success measurement model. The proposed model added two new dimensions vendor/consultant quality and workgroup impact to the Gable et al.'s (2003) model. Ifinedo and Nahar argued that many ERP studies showed that vendor/consultant quality and workgroups (teams, sub-units, groups, and departments) influence and affect the success of an ERP system. Ifinedo and Nahar empirically validated the model as well as Ifinedo and Nahar (2009), and Ifinedo, Rapp, Ifinedo, et al. (2010), and Ifinedo (2011d).

## The Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh, Morris, Davis, and Davis (2003) provided a formulation of the united theory of acceptance and use of technology (UTAUT). The UTAUT is a model to measure the success of the introduction of new information technology. In the UTAUT model, age, gender, experience, and voluntariness of use moderated the constructs performance expectancy, effort expectancy, social influence, and facilitating conditions. Although the constructs performance expectancy, effort expectancy, and social influence impact behavioral intention, facilitating conditions and behavioral intention affect the use of the IT technology/system (Venkatesh et al., 2003). In their effort, Venkatesh et al. identified eight prominent user acceptance models through an extensive literature review then empirically compared them to identify the common constructs and dimensions that led to the formulation of the UATUT model. Venkatesh et al. (2003) and many other studies (Williams, Rana, & Dwivedi, 2012) provided an empirical validation of the UTUAT model. Venkatesh, Thong, and Xu (2012) extended UATUT to UATUT2 by adding hedonic motivation, price value, and habit as additional constructs. UATUT2 removed the mediating voluntariness of use construct from the model. Table 3 provides a review of the dimensions and dependent variables of the UATUT used in different empirical ERP studies.

Table 3

*The Use of UTAUT Model in ERP Research*

| Author(s) | Model constructs/dimensions | Dependent variable |
|---|---|---|
| Seymour, Makanya, and Berrangé (2007) | Independent Variables<br>• Performance expectancy<br>• Effort expectancy<br>• Social influence<br>• Facilitating conditions<br>• Training<br>• Project communication<br>• Shared belief<br><br>Moderators<br>• Gender<br>• Age | Behavioral Intention (Symbolic adoption) |
| Neufeld, Dong, and Higgins (2007) | Independent Variables<br>• Performance expectancy<br>• Effort expectancy<br>• Social influence<br>• Facilitating conditions<br><br>Moderators<br>• Gender<br>• Voluntariness of use | Behavioral intention and<br>Use behavior |
| Huang and Wang (2009) | Independent Variables<br>• Performance expectancy<br>• Effort expectancy<br>• Social influence | Behavioral intention and<br>Use behavior |

| Author(s) | Model constructs/dimensions | Dependent variable |
| --- | --- | --- |
| | • Facilitating conditions<br><br>Moderators<br>• Gender<br>• Age<br>• Experience<br>• ERP system | |
| Fillion, Braham, and Ekionea (2012) | Independent Variables<br>• Performance expectancy<br>• Effort expectancy<br>• Social influence<br>• Facilitating conditions<br>• Anxiety<br>• Self-efficacy<br><br>Moderators<br>• Gender<br>• Age<br>• Experience<br>• Voluntariness of use | Behavioral intention and<br>Use behavior |

**Other ERP Success Measurement Approaches**

To measure the success of the ERP system, researchers used different approaches. Some researchers investigated the benefits or success of the ERP system using financial indicators such as the return on investment (ROI), return on assets (ROA), and corporate/organizational performance (Galy & Sauceda, 2014; Nicolaou & Bhattacharya, 2008). Other studies used a balanced scorecard approach to measure the ERP system performance (Chang, Yen, Ng, Chang, & Yu, 2011; Gajic, Stankovski, Ostojic, Tesic, & Miladinovic, 2014, Velcu, 2010).

Another approach to measure ERP success is ERP performance evaluation (Chen & Wang, 2010). Some researchers investigated the ERP-driven business process change/outcomes and its organizational impact on the business value as a measure of success (Karimi, Somers, & Bhattacherjee, 2007a, 2007b). Dantes and Hasibuan (2011) used the operational performance as a measure of ERP success investigating the tactical impact of the ERP system, including—production, cost reduction, operational efficiency, effective resource management, and increased productivity— as measures of ERP system success. Other ERP studies utilized the task-technology-fit (TTF) theory constructs as measures of ERP success and integrated them with other models (Althonayan & Papazafeiropoulou, 2013; Sun, Bhattacherjee, & Ma, 2009; Wu, Wu, & Shih, 2010). Table 4 provides a review of the constructs and the dependent variable used in different ERP success studies.

Table 4

*Other Success Models in ERP Research*

| Author(s) | Model constructs/dimensions | Dependent variable |
|---|---|---|
| S. Chou and Chang (2008) | Customization<br>Organizational mechanism<br>- Strategic<br>- Operational<br>Coordination improvement<br>Task efficiency | Overall benefit |

| Author(s) | Model constructs/dimensions | Dependent variable |
|---|---|---|
| Chen, Chen, and Tsai (2009) | Organizational fit of ERP<br>- Data fit<br>- Process fit<br>- User fit<br>Contingency variables<br>- ERP adaptation level<br>- Process adaptation level<br>- Organizational resistance | ERP implementation success<br>- Cost<br>- Time<br>- Performance |
| Ifinedo and Nahar (2009) | IT assets<br>IT resources<br>Employees' general IT skills<br>Satisfaction with IT legacy systems | ERP system success<br>- System quality<br>- Information quality<br>- Vendor/consultant quality<br>- Individual effect<br>- Workgroup impact<br>- Organizational impact |
| Sun et al., (2009) | Perceived work compatibility<br>Perceived usefulness<br>Perceived ease of use<br>Perceived behavioral control<br>Subjective norm<br>Intention to use<br>IT usage | Individual performance |
| Yoon (2009) | Organizational citizenship behaviors<br>- Altruism<br>- Conscientiousness<br>- Courtesy<br>- Civic virtue<br>- Sportsmanship | ERP success<br>- Intention of IT innovation<br>- Information Quality<br>- Work Efficiency |
| Abugabah and Sanzogni (2010) | Task-technology fit<br>Perceived system quality<br>Perceived information quality<br>User characteristics | Perceived user's performance<br>- Efficiency<br>- Effectiveness<br>- Creativity |
| Shao, Feng, and Liu (2012) | Transformational leadership<br>Organizational culture<br>- development<br>- hierarchical<br>- group<br>- rational<br>ERP knowledge | ERP success |

| Author(s) | Model constructs/dimensions | Dependent variable |
| --- | --- | --- |
| Jeng and Dunk (2013) | Culture<br>- Collaboration<br>- Trust<br>- Learning<br>Structure<br>- Decentralization<br>- Low Formalization<br>IT Support<br>Knowledge Creation Processes | ERP success |
| Maldonado and Sierra (2013) | ERP ease of Use<br>ERP project implementation success<br>Formal communication program<br>ERP user satisfaction | ERP business improvement success |

**Conceptual Framework**

Rogers's (2003) theory of diffusion of innovation (DOI) provided a framework for understanding the attributes of how an innovation affects and changes the function and structure of an organization or a social system. DOI theory, which is a meta-theory, describes the adoption of an innovation and then its diffusion among a population. DOI "helps us understand how and why an innovation diffuses over time" (Wolfe, 1994, p. 412). DOI provides a framework for understanding the characteristics and attributes of how an innovation affects the function and structure of an organization or a social system (Rogers, 2003). The adoption and diffusion process is influenced by the innovation attributes, adopter characteristics, environmental characteristics, the nature of the social system and social network, the process by which an innovation is communicated (the Communication channels), and the characteristics of those who are promoting an innovation (Rogers, 2003; Baker, 2012). Tornatzky and Fleischer's (1990) technology, organization, and environment (TOE) framework is a conceptualization of the theory of diffusion of innovation regarding diffusion of technological innovation in organizations. The TOE framework addressed the three dimensions of diffusion of innovation, the technology, the organizational characteristics, and the environment. The TOE framework provided an environment context to the diffusion of innovation technology and organization contexts as measures of IT performance success as shown in Figure 3 (Baker, 2012).

Different factors affect each of the TOE contexts. The formal and informal linking structures, firm size, slack resources, the communication processes, and informal linkages between the employees are some of the organizational context factors. The environment context factors are variables that include the industry characteristics and market Structure, technology support infrastructure, and government regulations. The Internal and external characteristics of the information technology innovation are the factors of the technology context (Baker, 2012).

Since the TOE framework addressed the three aspects of diffusion of innovation—the technology, the organizational characteristics, and the environment—many studies argued its use for investigating different types of information systems innovations (Baker, 2012, Zhu et al., 2010). The TOE framework provides a generic theory of technology diffusion to model and study information systems technology diffusion. In addition, researchers have also incorporated it to study IT adoption, and IT implementation success in organizations (Ramdani & Kawalek, 2009; Wen & Chen, 2010; Zhu et al., 2010). In many studies, researchers have tested and empirically validated the TOE framework. Table 5 provides a list of those studies.

Table 5

*A Review of the Use of the TOE Framework*

| IT Adoption | References |
|---|---|
| Collaborative commerce | Chong, Ooi, Lin, and Raman (2009) |
| E-Business | Oliveira and Martins (2010a) |
| E-Business adoption | Oliveira and Martins (2010b) |
| E-business SME | Wen and Chen (2010) |
| E-Commerce B2C | Rodrıguez-Ardura and Meseguer-Artola (2010) |
| E-Commerce SME | Ghobakhloo, Arias-Aranda, and Benitez-Amado (2011)<br>Lip-Sam and Hock-Eam (2011) |
| E-Government and E-Business development | Srivastava and Teo (2010) |
| E-Markets, B2B | Banerjee and Ma (2011). |
| ERP | Bradford and Florin (2003)<br>Pan and Jang (2008)<br>Ramdani, Kawalek, and Lorenzo (2009)<br>Liu and Wang (2010)<br>Supramaniam and Kuppusamy (2010)<br>Zhu et al. (2010)<br>Shahawai and Idrus (2011)<br>Haddara and Elragal (2013)<br>Ruivo, Oliveira, et al. (2014) |
| eXtensible Business Reporting Language (XBRL) | Henderson, Sheetz, and Trinkle (2012) |
| Internet and e-business technologies | Ifinedo (2011b)<br>Ifinedo (2011c)<br>Ifinedo (2012) |
| Internet Web site e-commerce | Martins and Oliveira (2009) |

| IT Adoption | References |
|---|---|
| IT decision making processes | Bernroider and Schmöllerl (2013) |
| IT replacement intention | Furneaux and Wade (2011) |
| KMS | Lee, Wang, Lim, and Peng (2009) |
| Medical records system (MRS) adoption | Marques, Oliveira, Dias, and Martins (2011) |
| RFID | Wang, Wang, and Yang (2010) |
| Web site e-commerce | Oliveira and Martins (2009) |

The TOE framework provides an analytical approach to studying the relationship between the contexts on ERP implementation success. TOE enabled the measurement of ERP adoption from multiple perspectives including management, IT professionals, and IT users (Oliveira & Martins, 2011; Wen & Chen, 2010). Identifying the innovation attributes of the TOE contexts was the focus of recent ERP studies as shown in Table 6. TOE ERP research investigated the impact of ERP technological, organizational, and environmental contexts on the success of ERP adoption (Pan & Jang, 2008; Ramdani et al., 2009). In addition, TOE ERP research investigated the success of ERP implementation (Bradford & Florin, 2003), postimplementation (maturation stage) success and their causal effect on the ERP user satisfaction (Supramaniam & Kuppusamy, 2010; Zhu et al., 2010), and postimplementation ERP use and value (Ruivo, Oliveira, et al., 2014).

Table 6

*A Review of the Use of the TOE Framework in ERP Research*

| Reference | TOE contexts | | Method |
|---|---|---|---|
| Bradford and Florin (2003) | Technology | Technical compatibility;<br>Perceived complexity;<br>Business process reengineering. | Factor analysis and linear regression |
| | Organization | Top management support;<br>Organizational objectives consensus;<br>Training. | |
| | Environment | Competitive pressure. | |
| | Control Variables | Elapsed time;<br>Firm size. | |
| Pan and Jang (2008) | Technology | IT infrastructure;<br>Technology readiness. | Factor analysis and logistic regression |
| | Organization | Size;<br>Perceived barriers. | |
| | Environment | Production and operations improvement;<br>Enhancement of products and services;<br>Competitive pressure;<br>Regulatory policy. | |
| Ramdani et al. (2009) | Technology | Relative advantage;<br>Compatibility;<br>Complexity;<br>Trialability;<br>Observability. | Logistic regression |
| | Organization | Top management support;<br>Organizational readiness;<br>IS experience;<br>Size. | |

| Reference | TOE contexts | | Method |
|---|---|---|---|
| | Environment | Industry;<br>Market scope;<br>Competitive pressure;<br>External IS support. | |
| Liu and Wang (2010)* | Technology | IT/IS requirement degree;<br>Existing informationization degree;<br>IT/IS adoption capacity. | Case study using expert scoring method and fuzzy comprehensive evaluation |
| | Organization | Business strategy and IT strategy integration degree;<br>Resources preparing;<br>Organization change capacity;<br>Compatible with system capacity. | |
| | Environment | Industry pressure;<br>Government promotion. | |
| | Third-party advisory body | Training situation;<br>Planning capacities;<br>Coordinate ability with enterprise. | |
| Supramaniam and Kuppusamy (2010) | Technology | IT infrastructure;<br>Skilled human capital. | Partial least squares regression |
| | Organization | Top leadership involvement;<br>Perceived ease of use. | |
| | Environment | Environmental uncertainty;<br>Government support. | |
| Zhu et *al.* *(*2010) | Technology | Implementation quality (Second-order formative construct:<br>Project management<br>System configuration). | Partial least squares regression and SEM |

| Reference | TOE contexts | | Method |
|---|---|---|---|
| | Organization | Organizational readiness (Second order formative construct: Leadership involvement organizational fit). | |
| | Environment | External support. | |
| Shahawai and Idrus (2011)* | Technology | System compatibility; System complexity. | Case study, data reduction using thematic analysis technique. |
| | Organization | Decision making control; Organizational politics culture; Level of readiness (financial and technological); Cooperation among project team. | |
| | Environment | | |
| | Awareness towards ERP system | Perception of ERP system; Acceptance of change management. | |
| Haddara and Elragal (2013)* | Technology | Relative advantage; Compatibility; Complexity; Trialability; Observability. | Delphi, nominal and focus group techniques. |
| | Organization | Top management support; Organizational readiness; IS experience; Size. | |

| Reference | | TOE contexts | Method |
|---|---|---|---|
| | Environment | Industry;<br>Market scope;<br>Competitive pressure;<br>External IS support | |
| Ruivo, Oliveira, et al. (2014) | Technology | Compatibility;<br>Complexity;<br>Efficiency. | Partial least squares regression and SEM |
| | Organization | Training;<br>Best practices. | |
| | Environment | Competitive pressure. | |

*Note*. * Qualitative studies.

The ERP TOE studies covered many firm sizes from small and medium enterprises (SMEs) (Haddara & Elragal 2013; Ramdani et al., 2009; Ruivo, Oliveira, et al., 2014; Shahawai & Idrus, 2011;Supramaniam & Kuppusamy, 2010), multinational corporations (Supramaniam & Kuppusamy, 2010; Zhu et al., 2010), to a mixture of firm sizes (Bradford & Florin, 2003; Pan & Jang, 2008; Zhu et al., 2010). Some ERP TOE research studied specific industries like the Taiwanese communications industry (Pan & Jang, 2008), a Chinese discrete manufacturing firm (Liu & Wang, 2010), the Chinese retail industry (Zhu et al., 2010), and the Malaysian service sector and manufacturing related industry (Shahawai & Idrus (2011). Bradford and Florin (2003), Ramdani et al. (2009), Supramaniam and Kuppusamy (2010), and Ruivo, Oliveira, et al. (2014) studied a wide range of industries. All ERP TOE studies reviewed in Table 6 focused on the points of view of the different levels of managers. Table 7 lists the respondents for each of the ERP TOE studies reviewed in Table 6.

Table 7

*TOE ERP Studies Respondents*

| Reference | Study respondents |
|---|---|
| Bradford and Florin (2003) | Functional managers |
| Pan and Jang (2008) | Senior management |
| Ramdani et al. (2009) | Owner/manager or the IS manager |
| Liu and Wang (2010) | Senior and middle managers |
| Supramaniam and Kuppusamy (2010) | Managers |
| Zhu et *al. (*2010) | Chief information officers or IT departments managers |
| Shahawai and Idrus (2011) | Unspecified |
| Haddara and Elragal (2013) | ERP consultants, vendors, implementation partners' representatives, and implementation project managers. |
| Ruivo, Oliveira, et al. (2014) | Executives, operating managers, and functional managers. |

## Literature Review

### ERP Postimplementation

From the different definitions of the ERP lifecycle, the ERP postimplementation phase consists of the shakedown phase (routinization) and the onward-and-upward phase (infusion). In the shakedown or routinization phase, after the ERP system goes live, the ERP system is performance tuned and integrated for normal use. In the onward-and-upward phase or infusion phase, the organization uses the ERP system for the day-to-day organizational operations in addition to using it effectively to its maximum potential

(Law et al., 2010; Velcu, 2010). Despite implementing and having a functional ERP system, the organization needs to measure the impact of the ERP technology on the organization postimplementation. Esteves's (2009) study showed, "the dimensions of ERP benefits are interconnected, and the realization of ERP benefits is a continuum cycle along the ERP postimplementation axis" (p. 25).

Although a rich and extensive body of research exists on the adoption and implementation success of ERP systems (Addo-Tenkorang & Helo, 2011; Grabski et al., 2011; Haddara & Zach, 2011; Moon, 2007; Schlichter & Kraemmergaard, 2010; Xu et al., 2008), some studies examined the postimplementation phase. Most of the postimplementation studies the literature review identified investigated the factors impacting ERP success, ERP efficiency, ERP effectiveness and benefits, organizational performance and structure, organizational culture, benefits and knowledge, ERP assimilation, ERP usage, risk factors, job and computing satisfaction. The remaining parts of this section provide a summary of these studies.

**Factors impacting ERP success.** Ifinedo, Rapp, Ifinedo, et al. (2010) tested the relationships between the constructs of the extended ERP systems success measurement model in an organizational context postimplementation. Ifinedo, Rapp, Ifinedo, et al. showed that the constructs of system quality, service quality, individual impact, workgroup impact, and organizational impact are strongly relevant in measuring ERP success postimplementation. Law et al. (2010) showed that maintenance and support activities in the postimplementation phase are critical factors for ERP success, and organizations should plan for them in the ERP implementation phase. Zhu et al. (2010)

developed an integrative model using the TOE framework to explain ERP postimplementation success from the technological (implementation quality), organizational, and environmental (external support) aspects. Zhu et al. results indicated that ERP implementation quality (project management and system configuration) and organizational readiness (leadership involvement and organizational fit) significantly influenced postimplementation success.

**ERP efficiency, effectiveness, and benefits.** Karimi et al. (2007a) and (2007b) indicated that ERP systems provide better process efficiency leading to more effectiveness and flexibility, which could improve profitability, earnings valuation, and competitiveness. Häkkinen and Hilmola (2008) examined the differences between user evaluations of ERP system success in the shakedown and the onward-and-upward phases postimplementation. Federici (2009) assessed ERP outcomes (economic results, management control, and operating efficiency) as measures of ERP success in the shakedown phase postimplementation. Madapusi and D'Souza (2012) showed that the ERP system in the onward-and-upward phase allowed the organization to achieve overall operational performance enhancement including information quality, inventory management, and on-time delivery enhancements. Rich and Dibbern (2013) investigated the moderating effects of cross-functional collaboration on ERP integration solution changes and their impact on the ERP integration benefits (process quality, system quality, and information quality) postimplementation. Rich and Dibbern found that cross-functional collaboration influence ERP benefits postimplementation. Kanellou and

Spathis (2013) indicated that the ERP system provided operational accounting benefits in terms of cost and time reduction in addition to increased flexibility.

**Organizational performance and structure.** Bendoly and Cotteleer (2008) investigated how organizations and employees react to rule-structures that accompany ERP implementation. Bendoly and Cotteleer suggested that if a task-technology misfit existed, managers and users might circumvent the ERP system rule-structures. S. Chou and Chang (2008) examined managerial interventions that affected ERP performance postimplementation. S. Chou and Chang indicated that the customization and organizational mechanisms significantly affected intermediate ERP postimplementation benefits, which affected the overall ERP benefits.

Yoon (2009) studied the organizational citizenship behaviors of employees (altruism, conscientiousness, courtesy, civic virtue, and sportsmanship) and their effect on organizational performance (information quality and work efficacy). Yoon showed that employees' organizational citizenship behaviors significantly influenced ERP success and operational success. Chen and Wang (2010) developed a model to measure the effect of ERP system on the firm's performance postimplementation. Velcu (2010) tested the interrelations between strategic alignment, management of the ERP implementation, process changes, and the business performance of organizations that implemented ERP systems. Velcu found that in the postimplementation phase, the use of the ERP system improved organizational efficiency, which affected the financial performance. Gallagher and Gallagher (2010, 2012) studied the organizational support structures postimplementation. They found that the postimplementation support structures are either a centralized cross-functional team structure or a distributed hybrid structure.

Kallunki, Laitinen, and Silvola (2011) investigated the mediating effect of the formal and informal management control systems on firm performance. Kallunki et al. demonstrated that the ERP systems and formal management control systems jointly improved the firm performance. Cao, Nicolaou, and Bhattacharya (2013) examined in a longitudinal study the influence of observed performance benefits, active management interventions, and timing considerations as performance enhancing measures postimplementation. Ha and Ahn (2013) studied the impact of organizational support (top management support, competency of the internal ERP team, user training, and inter-department collaboration and communication) and continuous improvement efforts (continuous process improvement and continuous systems integration/extension) on ERP performance postimplementation. Ha and Ahn indicated that continuous improvement efforts, and on-going organizational support positively influence ERP performance postimplementation. They further stated that "top management support was found to have continuous significant importance in the postimplementation stage influencing user training, communication and collaboration between departments" (Ha & Ahn, 2013, p. 11). Ram et al. (2013) reported that training, education, and system integration significantly influenced ERP system performance postimplementation. Galy and Sauceda (2014) showed that ERP postimplementation practices, increased technological competence, relationships with outside experts, top management support, and information sharing between departments, positively impacted the financial performance, but long-range planning negatively affected the earnings.

**Organizational culture, benefits, and knowledge.** Seddon, Calvert, and Yang (2010) developed a model to measure organizational benefits of enterprise systems using the following factors, functional fit, overcoming organizational inertia, integration, process optimization, improved access to information, and on-going major enterprise systems business improvement projects. Seddon et al. (2010) results indicated that the identified model factors are important for organizational benefits postimplementation. They found that the functional fit and overcoming organizational inertia are the key factors for achieving organizational benefits in the shakedown phase and integration. In addition, process optimization, improved access to information, and on-going major enterprise systems business improvement projects drive the organizational benefits in the onward-and-upward phase (Seddon et al., 2010).

Shao et al. (2012) examined how organizational culture (development, hierarchical, group, and rational culture) and knowledge sharing (explicit and implicit) mediated the effect of transformational leadership on ERP success in the assimilation phase postimplementation. Shao et al. found "that group culture and rational culture have direct impact on tacit knowledge sharing, while hierarchical culture indirectly impacts explicit knowledge sharing" (p. 2410). They further stated that top management needs "to pay attention to ERP knowledge sharing even after the implementation has completed and the system has been devoted into daily use" (p. 2410).

**ERP assimilation.** Liang, Saraf, Hu, and Xue (2007) investigated the impact of top management on the assimilation of ERP technology postimplementation. The study results demonstrated that strong top management beliefs, role, and participation in the postimplementation assimilation efforts led to a higher extent of ERP assimilation in the organization (Liang et al., 2007). Jones, Zmud, and Clark Jr (2008) examined the difficulties associated with ERP assimilation (installed ERP system functionality and the extent of system usage) in the onward-and-upward phase postimplementation. Jones et al. (2008) provided a post-adoptive ERP system structure model identifying the relationships between software training interventions, work process training interventions, experiential interventions, software understanding, work process understanding, and installed ERP functionality and their impact on system usage and benefits.

**ERP usage.** Clark, Jones, and Zmud (2009) provided a dynamic information feedback post-adoptive ERP system structure model. The model identified the relationships between primary interventions (software training, work process training, and experiential, transitional outcomes (software systems understanding and work process understanding), intermediate outcomes (extent of features implementation and system usage), and system outcome (system benefits) to help organizations facilitate the ERP usage to enhance the business value. Saeed, Abdinnour, Lengnick-Hall, and Lengnick-Hall's (2010) longitudinal study explored preenterprise system adoption expectations and post-enterprise system adoption outcomes. Saeed et al. found that at the post-adoption stage user acceptance mediated the relationship between actual use and shared understanding. They also found “user acceptance at both pre and postadoption stages are critical factors when usage is mandatory” (pp. 659-660).

Lin (2010) developed a model that examined the effects of ERP information quality, system quality, and top management support on ERP system usage. Lin showed that while ERP information quality and ERP system quality impacted ERP system usage through user satisfaction and perceived usefulness, top management support directly impacted ERP system usage and indirectly through perceived usefulness. Chang, Chou, Yin, and Cecilia (2011) proposed a framework to measure the impact of ERP usage on individual performance (individual productivity, customer satisfaction, and management control). Chang, Chou, Yin, et al. investigated the mediating effects of decision support, work integration, and customer service on the impact of postimplementation learning on ERP usage.

**Risk factors.** Peng and Nunes (2009) provided taxonomy of the different ERP risks (operational, analytical, organizational, and technical) postimplementation. Peng and Nunes’ (2009) study identified that the organizational (processes and procedures) risks cause ERP system failure in the postimplementation phase. Tsai et al. (2009) studied the organizational risks that influence ERP performance improvement level postimplementation due to ERP implementation problems. Tsai et al. found that lack of top management participation, the firm’s policies and process, and the lack of organizational transformation are the top organizational environment risks that affect ERP performance post- implementation. Singh et al. (2010) studied the role of human-related risk factors (psychological, behavioral, incomplete training, and data entry human errors) on the success of an ERP system postimplementation. Singh et al. showed that users' resistance to technology change and applied change management techniques hinder ERP success. Peng and Nunes (2010) investigated the ERP postimplementation barriers (cultural, organizational, and system) and their impact on the operational, analytical, organizational, and technical risks. Peng and Nunes found that many ERP barriers and risks are interrelated and originated from the organizational barriers and risks. Pan, Nunes, and Peng (2011) found that the organizational change and human-related risks led to ERP failure postimplementation. Mathrani and Mathrani (2013) showed that there is a link between ERP data transformation processes and risk-mitigating benefits. López and Salmeron (2014a, 2014b) provided a model to identify and manage ERP maintenance project risks.

**Job and computing satisfaction.** Larsen (2009) investigated end user computing satisfaction during the shakedown phase postimplementation in ten subunits of an international manufacturing organization. Larsen found that "communication and decision-making patterns between users and experts locally, and communication with peers in organizational units other than the respondent's own – contributed more consistently to individual end user computing satisfaction" (p. 666). Larsen's (2009) study showed that "user training plays a role in explaining the users' perceptions of the relevance of the ERP project's business objectives for the organization and for their own jobs" (p. 666). Morris and Venkatesh (2010) developed a model to measure the impact of the ERP system on the relationship between employees' job characteristics (task significance, task identity, skill variety, autonomy, and feedback) and their job satisfaction postimplementation. The results indicated that “the ERP system implementation moderated the effects of skill variety, autonomy, and feedback on job satisfaction” and “task identity and task significance had direct positive effects on job satisfaction” (Morris & Venkatesh, 2010, p. 152).

**ERP End User**

“People are one of important variables in a winning ERP strategy” (p. 12) according to Peslak and Boyle (2010). Singh et al. (2010) argued that the ERP postimplementation research field still lacks insights regarding human factors. ERP usage changes the way people work and influence how people feel about the work they do. Wu (2011) posited that “we should not neglect the importance of the fact that users’ perceived benefits can be an imperative predictor for ERP implementations”; thus “discovering significant perceived benefits of ERP users arises here as a crucial issue” (Wu, 2011, p. 6943). “The significance of ERP users’ perceived benefits must continue to be the focus of exhaustive and regular research and adjustment” (Wu, 2011, p. 6947). Althonayan and Papazafeiropoulou (2013) asserted, “Individual performance is an essential indicator of organizational performance”; thus, "studying the impact of ERP systems on stakeholders’ performance is a significant way to assess the utility of this software and how it contributes to performance efficiency and effectiveness” (p. 4076).

Dery et al. (2006) noted, “User reactions to ERP and why some ERP implementations are seen as more successful than others are interrelated” (p. 210). Understanding employees’ reaction to ERP and the way they react “could be used to shed new light on why some ERP implementations are seen as more successful than others and to suggest ways of avoiding failure" (Dery et al., 2006, p. 210). Dezdar and Ainin (2010) found that the satisfaction of the ERP users with the implemented ERP system reliability, functionality, flexibility, and user friendliness features is necessary for the success of an ERP implementation. Morris and Venkatesh (2010) showed that the ERP system implementation moderated the relationships between job characteristics (skill variety, autonomy, and feedback) and the end user's job satisfaction. Maldonado and Sierra (2013) indicated that user satisfaction significantly influences ERP business improvement success.

ERP systems modular and integrative characteristics make them a critical factor and enabler of establishing an efficient and effective organization where the ERP systems capabilities and functionality provide better products and services throughout the organization (S. Chou & Chang, 2008). Organizations leverage the knowledge skills and expertise by using the ERP system capabilities and by capitalizing on the competencies and expertise of the system users (workers), partners, and participants in the organization's supply chain. Coordination among the different units in the organization through the ERP system and the streamlined IT infrastructure are critical in creating a differential business advantage that is flexible and responsive to the diverse and changing customer needs (Hsu et al., 2008). Peslak and Boyle (2010) found that ERP users should possess team and business skills.

Since other ERP users, organizational units, divisions, and partners use the information entered by individual ERP users in real time, many ERP studies investigated the role of the ERP user regarding usage of the ERP system, perceived ease of use, perceived usefulness, individual impact, and workgroup impact. Chang et al. (2008) stated, “Employees may be expected by their peers to use the ERP in order to make the ERP more useful” (p. 929). Hence “the expectation of both peers and top management may influence the behavior of the ERP users” (Chang et al., 2008, p. 929).Youngberg et al. (2009) argued, “equally important to the prediction of technology usage is the question of can we discover what perceptions end users have about the usefulness of specific systems and their components” (p. 138). Users’ perceived benefits of the usefulness and usability of the ERP system affected the behavioral intention to use the ERP system (Calisir et al., 2009; Chang, Chou, Yin et al., 2011; Lee et al. 2010). Hwang (2014) showed that user experience and personal innovativeness moderated perceived ease of use and perceived usefulness of the ERP system.

Many ERP studies focused on education, learning, and training because they are antecedents to ERP success and system usage. Nah, Islam, and Tan (2007) indicated that the presence of a learning environment in the organizational culture positively moderated the impact of enterprise-wide communication on the success of an ERP implementation. Lee et al. 2010 found “training and education have a positive effect on ERP perceived usefulness” (p. 280). Khoo, Robey, and Rao (2011) indicated that an essential cost in ERP systems upgrade is the costs of users’ learning. Chang, Chou, Yin et al. (2011) posited that postimplementation learning facilitated ERP usage and promoted individual performance. H. W. Chou, Lin, Lu, Chang, and Chou (2014) stated, “Users have to continue learning after implementation” (p. 19). They argued that despite training is a necessary condition for ERP postimplementation success, users’ knowledge and competencies enabled the adaptation between the ERP system and the users. Nwankpa and Roumani (2014) showed “organizational learning capacity and user satisfaction are important predictors of ERP system usage” (p. 231).

Chang et al. (2008) asserted that the social context and social factors influence technology use. Chang et al. (2008) study found that social factors, as an organizational characteristic, had the strongest effect on the ERP system usage. Häkkinen and Hilmola (2008) mentioned that “in the shakedown phase, most of the ERP end users largely relied on user support coming from their own key users” (p. 294). Bologa and Lupu (2014) indicated that social learning networks between peers and working groups in the organization enabled knowledge transfer and might shorten the learning time. H. W. Chou, Lin, et al. (2014) stated, “Knowledge sharing plays an important role in facilitating ERP system usage after ERP implementation” (p. 19). H. W. Chou, Chang, et al. (2014) found that “postimplementation learning, emphasizing informal communication and knowledge sharing among users, can facilitate ERP usage” (p. 274). They further stated that “social capital by virtue of social network ties, trust, and shared vision acts as the resource for ERP knowledge sharing and transfer, which thereby facilitate the conditions for ERP postimplementation learning” (p. 274). H. W. Chou, Lin, et al. (2014) argued that effective ERP system use postimplementation was through knowledge gained from other users. H. W. Chou, Lin, et al. (2014) revealed that user self-efficacy enabled employees to share knowledge. Sykes, Venkatesh, and Johnson (2014) showed that employee advice networks affect ERP postimplementation job performance.

**Summary and Conclusions**

ERP success can be “complex and difficult to measure” (Kronbichler, Ostermann, & Staudinger, 2010, p. 284); thus measuring the success of the ERP system has been a focus of many ERP studies. A review of the ERP literature revealed that many ERP success studies investigated the critical success factors (CSF) that led to a successful ERP implementation. Although some ERP success studies have used published IS success frameworks empirically to measure ERP success, other studies have developed new models and frameworks. Researchers used different approaches to measure the success of an ERP system. Some researchers investigated the benefits or success of an ERP system using financial indicators, corporate/organizational performance, service quality, and customer satisfaction as measures of ERP success. Other studies used balanced scorecard approaches, operational performance, operational efficiency, effective resource management, and increased productivity as measures of ERP system success. Some researchers investigated the ERP-driven business process change/outcomes and its organizational impact that led to increased business value as a measure of success. The ERP system affects not only the individual user or the organization but also the work group, interorganizational and intraorganizational units, and the consumers. The literature review identified the salient dimensions for measuring ERP success, which include information quality, system quality, service quality, self-efficacy, learning and training, ERP knowledge, individual impact, workgroup impact, organizational impact, and management support.

From the different definitions of the ERP lifecycle, the ERP postimplementation phase consists of the shakedown phase (acceptance phase) and the onward-and-upward phase (routinization and infusion). In the shakedown phase, the ERP system is performance tuned and integrated for normal use. In the onward-and-upward phase, the organization uses the ERP system for the day-to-day organizational operations, assimilating the ERP system in addition to using it effectively to its maximum potential. Despite implementing and having a functional ERP system, the organization needs to measure the impact of the ERP technology on the organization postimplementation. Esteves's (2009) study showed "the dimensions of ERP benefits are interconnected and the realization of ERP benefits is a continuum cycle along the ERP postimplementation axis" (p. 25). McCubbrey and Fukami's (2009) study of a public sector organization in the state of Colorado indicated that there are mixed points of views regarding the value of the installed ERP system between management and end users. McCubbrey and Fukami (2009) study showed that the organization need to recognize user's perspectives regarding the benefits of an ERP system and how the users of the ERP system view these benefits. In addition, McCubbrey and Fukami's (2009) study pointed out that there is a relationship between how users react to the ERP system and ERP success. Although a rich and extensive body of research exists regarding the adoption and implementation success of ERP systems, some studies examined the postimplementation phase. Most of the postimplementation studies the literature review identified, investigated factors impacting ERP success, ERP efficiency, effectiveness and benefits, organizational performance and structure, organizational culture, benefits, and knowledge, ERP usage, risk factors, and job and computing satisfaction.

The TOE framework addressed the three dimensions of diffusion of innovation, the technology, the organizational characteristics, and the environment. The TOE framework provides an analytical approach to studying the relationship between the contexts on ERP implementation success. TOE enabled the measurement of ERP adoption from multiple perspectives including management, IT professionals, and IT users (Oliveira & Martins, 2011; Wen & Chen, 2010). Identifying the innovation attributes of the TOE contexts was the focus of recent ERP studies. TOE ERP research investigated the impact of the ERP technology, organizational, and environmental contexts on the success of ERP adoption, postimplementation, and maturation, and their causal effect on the ERP user satisfaction. ERP TOE studies covered many firm sizes from small and medium enterprises (SMEs), multinational corporations, to a mixture of firm sizes. Although some ERP TOE research studied specific industries, other studies investigated a wide range of industries. The majority of ERP TOE studies reviewed focused on the points of view of the different levels of managers only.

The quantitative research approach using a nonexperimental survey design is the best research approach for exploratory and explanatory studies. Chapter 3 introduces the nonexperimental survey research design used in this study as well as a presentation of the dependent and independent variables for the study. The chapter includes a discussion of the sampling frame and the different sampling strategies used in the study. Finally, the chapter ends with a presentation and discussion about the data collection, data analysis, and validation procedures used in this research.

# Chapter 3: Research Method

A quantitative research methodology using a nonexperimental survey design is the best research approach for explanatory studies. Based on a nonexperimental quantitative research approach, this research incorporated the TOE framework to develop a model to predict the postimplementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. As ERP users in the state of Colorado have mixed feelings about the value of implemented ERP systems, the purpose of this research was to identify the sustainability factors and their relative significance that might maximize the value of the implemented ERP system in the onward-and-upward phase postimplementation from the user's point of view (ERP user value). There was a need for this research because it addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value impacts firm-achieved ERP benefits.

In this chapter, I present the nonexperimental survey research design and the rationale for its use. The chapter includes a discussion of the population, the sampling frame, the different sampling strategies, and the dependent and independent variables for the study. In addition, the chapter includes a discussion of the operationalization of the variables, the scales of measurement, and the research measurement model, as well as the data collection, data analysis, and validation procedures used in this research. The chapter ends with a presentation and discussion of the different measures used in this research to ensure participants' rights as set forth by the Walden University Institutional Review Board.

## Research Design and Rationale

In a quantitative study, the researcher uses a postpositivist worldview, which is a deterministic, reductionist philosophy that relies on empirical observations, measurements, and theory verification. In a quantitative study, the data, in numerical format, are collected using experiments and survey research. In surveys, data are collected using face-to-face interviews, phone interviews, mailed questionnaires, and computer-assisted self-interviews. In quantitative research, the researcher is not the key instrument in data collection. Researchers performing quantitative data analysis use statistical tools (descriptive and inferential) to infer causal relationships and test hypotheses. In addition, the process of data analysis is deductive in nature (Singleton & Straits, 2010).

The purpose of quantitative research can be either descriptive (exploratory) or explanatory. Descriptive research involves describing a phenomenon and obtaining detailed information about its variables. Explanatory research involves examining and testing the relationships among variables, seeking answers to research questions, and testing research hypotheses. Both descriptive and explanatory research are structured and planned using quantitative methods with clearly selected and identified instruments and units of analysis (Singleton & Straits, 2010).

Because knowledge is fallible, there is a need to develop new theories and models to correct or improve knowledge. According to Sayer (2000), causation (causal powers) helps in understanding, gaining knowledge, and using judgment to understand the observed and the consequences/outcomes of events. To understand social phenomena, there is a need to understand the meanings of social practices. According to Sayer (2000), when studying social phenomena, there is a need to know “under what conditions, to what extent, and with what effects they have been used” (p. 28). In addition, the society members need to understand the actions, implications, and meaning of the social phenomena. As social phenomena such as actions, texts, and institutions will have different meanings and outcomes for the members of the society, they are concept dependent.

As the purpose of this study was to identify the different postimplementation sustainability factors in the onward-and-upward phase from the ERP user’s point of view and how user acceptance of ERP value impacts the firm’s achieved ERP benefits, testing the structural model required an empirical explanatory study. A quantitative research methodology using a nonexperimental survey design is the best research approach for explanatory studies. The quantitative research approach helped in explaining the interactions and relationships between the different factors in the hypothesized model and their causal effects. In addition, a quantitative research methodology allowed for testing the hypotheses statistically.

Quantitative research uses extensively nonexperimental questionnaires or surveys. Individuals are the unit of analysis in surveys. Surveys allow for the measurement of variables through asking questions and using the responses to examine the relationships among the measures. Survey topics and questions can cover a broader range of research topics than experiments. A survey can include many questions and topics, compared to an experiment, which addresses only one hypothesis or research question. Surveys are very efficient data-gathering techniques that can lead to unanticipated findings or new hypotheses. In addition, surveys can provide detailed and precise information about large heterogeneous populations. Using probability sampling, the responses to a sample survey can accurately describe the target population within the limits of the sampling error (Singleton & Straits, 2010).

There are some disadvantages to the use of surveys in quantitative research. Survey research measures variables at a single point in time; thus, "inferring cause-and-effect relationships cannot be established as easily in surveys as in experiments" (Singleton & Straits, 2010, p. 271). Surveys are more standardized, which makes them less adaptable than experiments. Surveys are difficult to alter after the study begins; in contrast, in an experiment, after testing a few subjects, the researcher can make modifications. Surveys are susceptible to subject reactivity (desirable responses to sensitive questions), which introduces systematic measurement errors. Surveys report behaviors rather than observations of behavior. In addition, a survey does not provide "a very good understanding of the context within which behaviors may be interpreted over an extended period of time" (Singleton & Straits, 2010, p. 271).

In computer-assisted self-interviews or online surveys, survey research is conducted using the Web. Online surveys require less time to implement and make available. In addition, they provide more flexibility in questionnaire design. Online surveys substantially reduce the cost of increasing the sample size and are less expensive than face-to-face interviews, telephone interviews, and mailed questionnaires. Like paper-and-pencil questionnaires, online surveys have a lower response rate than face-to-face and telephone survey methods (Singleton & Straits, 2010).

I used an online questionnaire instrument to collect the data. The scales in the questionnaire instrument, shown in Appendix A, incorporated the developed operationalized constructs from the sources in Table 8 below. The scale of measurement used in this survey was a 7-point Likert scale.

The nonexperimental survey research methodology was the best method to address the research questions in this study. To identify the possible relationships between the model indicators and constructs, the nonexperimental survey research method enabled the collection of the needed data for the structural equation modeling approach. In addition, the nonexperimental survey design allows for the replication of this study by other researchers to verify the obtained results.

**Structure equation modeling.** Structural equation modeling (SEM) is a statistical approach to test multivariate models. It allows for testing hypotheses about the relationships between observed (measured indicators) and latent variables (unobserved factors or constructs). In addition, SEM allows for estimating and testing the significance of the relationships between the constructs of the model. Further, it allows for estimating and correcting measurement errors. The SEM technique is a combination of multiple regression, factor analysis, and path analysis (Bagozzi & Yi, 2012; Hair, Ringle, & Sarstedt, 2011; Iacobucci, 2009, 2010; Weston & Gore, 2006).

An SEM model consists of a structural model (inner model) and a measurement model (outer model). The inner model specifies the hypothesized relationships between the independent and dependent latent variables only. The outer model allows for the evaluation of how well the measured (observed) indicators define the latent variables or constructs (Bagozzi & Yi, 2012; Hair et al., 2011; Iacobucci, 2009, 2010; Weston & Gore, 2006). Using the outer model, data-driven exploratory factor analysis (EFA) or theory-grounded confirmatory factor analysis (CFA) can be tested (Bagozzi & Yi, 2012; Byrne, 2005; Hair et al., 2011).

There are two approaches to SEM, a covariance-based approach (covariance structure analysis) and a partial least square approach (PLS-SEM path modeling). PLS-SEM focuses on the analysis of variance with no assumptions about the data distribution. In addition, it is suitable when little theory is available, accuracy in prediction is important, and the correct model specification is invalid. Many ERP studies used SEM to test the relationships between the variables of the proposed models (e.g. H. W. Chou, Chang, et al., 2014; Karimi et al., 2007a, 2007b, 2009; Ruivo, Oliveira, et al., 2014; Supramaniam & Kuppusamy, 2010; Zhu et al., 2010).

## Methodology

### Population

The target population “is the population to which the researcher would like to generalize the results“(Singleton & Straits, 2010, p. 155). Having a clear description of the target population is a critical first step in quantitative research.The target population for the study was organizational employees who used an implemented and operational ERP system for at least 4 years. In most cases, including the entire population in the study is unfeasible. The researcher needs to use sampling to identify a representative sample of the population. In order for the researcher to be able to create a sample from the population, a clearly defined sample frame, a list of all elements of the population needs to be identified. In addition, an adequate sample size enables the researcher to achieve valid generalizations (Singleton & Straits, 2010).

Identifying a feasible sample frame was important because the target population for this study was so large. Multiple private sector firms, higher education institutions, government entities (public sector), and local ERP and supply-chain management user groups in the Denver, CO metropolitan area were a good representative sample frame of the study target population. The identified sample frame enabled for the selection of an adequate sample size.

**Sampling and Sampling Procedures**

Sampling can be performed using probabilistic—random, systematic, and stratified—or nonprobability—convenience and purposive—methods. There is an equal chance of selecting each member of the population in random sampling. Random sampling, used on the entire sampling frame or stratified subsets of the sampling frame, eliminates investigator bias in elements selection. In addition, it allows the use of probability theory to compute the probability distribution of the elements of the sample and to estimate sample accuracy. An adequate random sample size enables the researcher to achieve valid generalizations because random assignment of subjects removes the regression to the mean and selection threats. Convenience sampling—where the samples picked accidentally or by self-selection—is the easier, quicker, and cheaper method of nonprobability sampling (Singleton & Straits, 2010).

Determining the sample size for the structural measurement model, shown in Figure 6 below, “depends on many factors, including the psychometric properties of the variables, the strength of the relationships among the variables considered, the complexity and size of the model, the amount of missing data, and the distributional characteristics of the variables considered” (Marcoulides & Saunders, 2006, p. iv). In Figure 6, the outer (measurement) model consisted of one latent endogenous variable and 11 exogenous variables that were measured using 65 indicators. The degrees of freedom (*df*) for the model were computed using equation (1) following Rigdon (1994)

$$df = m * (m + 1)/2 - 2 * m - \xi * (\xi - 1)/2 - g - b \qquad (1)$$

Where:

*m*: number of manifested variables.

*ξ*: number of exogenous constructs.

*g*: number of free items in the coefficient matrix *Γ* (effects of exogenous on endogenous constructs).

*b*: number of free items in the coefficient matrix *B* (effects of endogenous constructs on each other).

From (1)

$$df = 65 * (65 + 1)/2 - 2 * 65 - 8 * (8 - 1)/2 - 8 - 3 = 1976$$

Nearly 30 years ago, MacCallum, Browne, and Sugawara (1996) provided a procedure to compute sample size using power analysis for tests of fit. According to McCollum et al. (1996), a SEM model with 435 degrees of freedom, a desired statistical power of 0.80 (80%), and probability level of 0.05, the minimum sample size for a close fit is 53 cases. For a desired statistical power of 0.80 (80%) and probability level of 0.05, the minimum sample size for a close fit for a model with 2000 degrees of freedom is 23 cases. Since the degrees of freedom for the study outer model were 1976, the sample size should be between 53 and 23cases but more closer to 25 cases. MacCallum, Browne, and Cai (2006) argued that the sample size should at least be more that the number of indicators for SEM models with higher degrees of freedom. Since the number of indicator variables (manifested variables) in the outer (measurement) model was 65, following MacCallum et al. (2006), the minimum sample size for the study should be more than 65 cases.

Kim (2005) used the root mean square error of approximation (RMSEA), comparative fit index (CFI), McDonald's fit index, and Steiger's gamma to compute the sample size for SEM models to achieve a certain level of power. Running the RMSEA and Steiger's gamma formulas from Kim (2005) for the outer model on the IBM Statistical Package for the Social Sciences (SPSS) version 21 resulted in similar samples sizes as MacCallum et al. (2006). Westland (2010) developed a function using the ratio of indicator variables to latent variables to estimate the lower bound of the needed sample size. As the ratio of indicator variables to latent variables *r* in the study outer (measurement) model was 5.91 (65/11), substituting 5.91 in the Westland (2010) function resulted in a sample size (*n*) greater or equal to 187 cases.

Following Cohen's (1992) suggested usage of power analysis to compute the adequate sample size for multiple regression, for a 0.15 medium effect size, 0.80 statistical power, 0.05 significance, and an eight independent variables model, the minimum sample size needed was 107 cases. Using Faul et al. (2009) G*Power statistical software to compute the adequate sample size—for a fixed model using linear multiple regression with $R^2$ deviated from zero—for a 0.15 medium effect size, 0.80 statistical power, 0.05 significance, and four indicators per independent variables, the minimum sample size needed was 107 cases. For a 0.15 medium effect size, 0.95 statistical power, 0.05 significance, and four indicators per independent variables, the minimum sample size needed computed by G*Power was 129 cases.

Fabrigar, Porter, and Norris (2010) mentioned that “adequate sample size is defined as the number of observations needed to obtain estimates of the model's parameters that closely match the parameter values of the model in the population” (p. 223). According to Fabrigar et al. (2010), studies that followed the previous definition “indicated that the sample size needed is smaller when unique variances of measured variables are low and each latent variable is represented by at least 3 or 4 measured variables” (p. 223). Sample sizes around 100 cases may be adequate when optimal conditions are met but “under moderately less optimal conditions, it may be necessary to have a sample of at least 200” (Fabrigar et al., 2010, p. 223). Bagozzi and Yi (2012) suggested that a preferable sample size should be more than 200 cases. Since the outer (measurement) model for the study used more than three measures for each latent variable as suggested by Bagozzi and Yi (2012) and Fabrigar et al. (2010), the minimum sample size should be at least 200 cases.

Barclay, Higgins, and Thompson (1995) suggested the minimum sample size to be equal to ten times the maximum number of paths to a construct in the inner or outer model. From the outer model (see Figure 8), there are 11 paths from the independent variables to the dependent variables, thus, following Barclay et al. (1995) the minimum sample size was 110 cases. Bentler and Chou (1987) suggested that the minimum sample size could be as low as five observations (samples) per indicator in the structural model as long as the data distribution is normal and there are many latent variables with large factor loadings. Since there were 65 indicators in the outer (measurement) model, the minimum sample size should be 325 cases. Since the computed sample size for the outer (measurement) model varied from as low as greater than 23 to 325 cases, a minimum sample size of 325 or more participants was a good sample size for this study.

## Procedures for Recruitment, Participation, and Data Collection

As the research sample frame was the members of multiple private sector firms, higher education institutions, government entities (public sector), and local ERP and supply-chain management user groups in the Denver, CO metropolitan area, using random sampling to identify the sample was not feasible given that most organizations and user groups did not provide their member lists. The different entities and firms that participated in the study were the mechanism to disseminate the invitation to participate in the study to their members. Since the members self-selected to participate in the study if they met the characteristics of the study target population—top managers, middle managers, supervisors, staff, and users of ERP systems that had been implemented and operational for at least 4 years—the study sample was a convenience sample.

**Data collection procedures.** After gaining Walden University's Institutional Review Board approval (IRB approval #01-05-15-0118147), I contacted selected firms, government entities, higher education institutions, and local ERP and supply-chain management user groups in the Denver metropolitan area of the state of Colorado inviting them to participate in the study. I sent an e-mail to the different entities and firms that agreed to participate including an invitation to participate letter to their members explaining the purpose of the study, participants' rights, and a direct hyperlink to the informed consent page. The different entities and firms that agreed to participate in the study disseminated the invitation to participate in the study to their members.

I did not e-mail any participant directly inviting them to participate. The initial plan was to keep the online survey open for 4 weeks to allow for capturing the needed 325 responses. The online questionnaire included 65 statements using a 7-point Likert scale and four demographic questions (see Appendix A). The online survey statements were of a conceptual nature and only focused on participants' experiences using ERP systems and their working environment. In addition, the online survey statements were common to IT professionals and ERP users and focused on their perceptions. The demographic questions did not collect any personal identifying information.

The online survey landing-page, informed consent page, informed the participants about their rights before taking the research survey. The informed consent page advised the study participants that they can decline to participate, not answer any questions they feel uncomfortable to answer, and captured their consent. The online survey allowed for participant anonymity and confidentiality. In addition, the questionnaire did not collect the name of the organization where the participant worked. Since the online survey was anonymous, the collected data made it virtually impossible to associate the data responses with any participant identity or place of work. A secured Web server was the mechanism for collecting the participants' demographics and responses.

Coding is the assignment of numbers or symbols to the questions, choices, categories, and so forth. Before making the research questionnaire available for the study participants, I developed an HTML file that included the research questionnaire and programmed the code values for the Likert measurement scales in the survey as well as the demographics questions. Programming the questionnaire allowed for the collection of the coded responses from the online survey into a comma-delimited file. The online survey HTML file was then loaded on a secured Web server. Before opening the survey for the study participants, I checked the informed consent page as well as the online questionnaire for any typographical errors and insured that the captured codes were correct. After closing the survey I exported the comma delimited file, which included the anonymous coded data, from the secured Web server to an Excel spreadsheet for the editing phase of the data processing.

Data processing consists of editing, coding, entering, and scrubbing (cleaning) the collected data. In the editing phase, I checked the collected data for missing values, completeness, and readiness. The last step before analysis was the cleaning of the data file from any typographical and coding errors. After completing the cleaning phase, I imported the data file to IBM SPSS for statistical analysis and to SmartPLS 3.2 (Ringle, Wende, & Will, 2005) for PLS-SEM analysis. At the conclusion of data analysis, I transferred the research data to a compact disk for archival. The compact disk will be stored in a secure location for five years.

**Instrumentation and Operationalization of Constructs**

The design of the questionnaire (survey instrument) is a critical phase of survey research. In survey research, the questionnaire contains a combination of direct, indirect, close-ended, and open-ended questions, in addition to clear instructions and rationale for the purpose. Close-ended questions can be a combination of questions that have two possible responses (dichotomies), questions based on a measurement scale, or both. Close-ended questions based on a scale of measurement can use a nominal response format by placing a number beside each response or ordinal response format where respondents rank their answers. Another form of close-ended questions using a scale of measurement is the interval-level response like the Likert scale response format. In the Likert scale, which is used to measure attitudes, there is a neutral middle point, and opposite positions (strongly agree and strongly disagree) at the two ends of the scale (Singleton & Straits, 2010; Trochim & Donnelly, 2007). Adding structured questions to the survey instrument can help the researcher to capture demographics and other sensitive data.

The scales in the questionnaire instrument, shown in Appendix A, incorporated the developed operationalized constructs from the sources in Table 8 below as a foundation. I reworded the different scales from Table 8 to fit the identified ERP success factors and created a 7-point Likert scale of measurement after each statement—1 strongly disagree, 2 disagree, 3 somewhat disagree, 4 neither agree nor disagree, 5 somewhat agree, 6 agree, and 7 strongly disagree. Researchers tested and validated the selected constructs in Table 8 below, thus increasing the content validity of the developed questionnaire instrument.

Using the language effectively in writing the survey questions can prevent ambiguity, misunderstanding, and confusion. Replacing some of the words that might have different meaning to different respondents with statements that are more specific and have precise meaning to the respondents the researcher can prevent misunderstanding and incorrect responses. Breaking down double-barreled questions—questions mixing two issues—into two questions each addressing a single issue can reduce ambiguity. In addition, the elimination of leading questions—questions guiding the respondent to a possible answer—can cause bias in the collected responses (Singleton & Straits, 2010).

To determine if the language used in the survey questionnaire was collecting accurate responses, thus reducing the measurement error, I checked the survey drafts with colleagues and peers (peer review) to identify wording and meaning issues. In addition, six ERP experts reviewed the research questionnaire to identify wording problems, ambiguity, and different meanings of the statements thus increasing the accuracy of the survey. I incorporated the changes suggested by the six ERP experts into the research questionnaire before making it available to the study participants.

A variable is a unit of analysis characteristic that varies and changes over cases or time. Dependent and independent variables are two types of the variables that the researcher studies—the explanatory variables. In a relationship, the independent variable (or variables) is the cause of change in the dependent variable (Singleton & Straits, 2010). Extraneous variables are variables that are outside (external) from the explanatory set of variables—independent and dependent. If an extraneous variable occurs before both the independent and dependent variables, it is an antecedent (proceeding) variable. If an extraneous variable is an effect of the independent variable and a cause for the dependent variable it is called an intervening variable (Singleton & Straits, 2010).

The measurement process is an important stage in quantitative research. In the measurement stage, the concepts in hypotheses and theories are clarified—conceptualization. After conceptualization, the next step in the measurement process is identifying the variables that represent the concepts and the research operations necessary to allocate values to the variables—operationalization. Review of the ERP success literature indicated that ERP information quality, ERP system quality, ERP service quality, shared beliefs, user self-efficacy, job relevance, ERP knowledge and learning, and coordination are the factors that impact ERP success. From the TOE model, the research hypothesis posited that these independent factors were the set of sustainability factors that positively impact productivity, effectiveness, internal efficiency, and coordination, thus leading to maximization of the value of the ERP system from the ERP user's point of view in the onward-and-upward phase.

Mapping these factors to the contexts of the TOE framework resulted in aligning ERP information quality, ERP system quality, and ERP service quality as the technological context constructs. While shared beliefs, job relevance, ERP knowledge and learning, and user self-efficacy map to the organizational context, coordination was the environmental context construct. The ERP user value (dependent variable) was a second-order construct manifested by three dimensions, impact on business, impact on internal efficiency, and impact on coordination. The remaining parts of this section provide the definitions of the constructs and their measurement scales as well as the research measurement model.

**ERP information quality**. The ERP information quality construct measured the characteristics of the ERP system output (produced reports) with respect to timeliness, relevance, availability, usefulness, understandability, and so forth (Abugabah & Sanzogni, 2010; Häkkinen & Hilmola, 2008; Ifinedo, 2011d; Ifinedo & Nahar, 2009; Ifinedo, Rapp, Ifinedo, et al., 2010; Yoon, 2009).

**ERP system quality**. The construct ERP system quality measured the performance characteristics of the ERP system. The performance characteristics included ease of use, reliability, flexibility, customization, integration, and so forth (Abugabah & Sanzogni, 2010; Häkkinen & Hilmola, 2008; Ifinedo, 2011d; Ifinedo, Rapp, Ifinedo, et al., 2010).

**ERP service quality**. The ERP service quality construct measured the characteristics of the support provided by the ERP provider in regards to the reliability, dependability, quality of expertise, and the services provided by the ERP system (Ifinedo, Rapp, Ifinedo, et al., 2010).

**Shared beliefs**. The construct shared beliefs measured the extent of workers belief in the benefits of the ERP system, extent of management team belief in the benefits of the ERP system, and peers belief in the benefits of the ERP system (Amoako-Gyampah & Salam, 2004).

**Knowledge and learning**. The knowledge and learning construct measured the willingness to learn, the existence of the opportunity to learn, and the acquisition of ERP knowledge (H. W. Chou, Chang, et al., 2014).

**User self-efficacy**. The construct user self-efficacy measured “users’ perceived abilities regarding how to use the ERP system to perform their daily work” (H. W. Chou, Chang, et al., 2014, p. 271).

**Job relevance**. The job relevance construct measured the degree to which the individual perceived the applicability of the ERP system to the job and the capability of the ERP system to support the set of tasks within one’s job (Abugabah & Sanzogni, 2010; Chung et al., 2009; Chung, Skibniewski, Lucas, et al., 2008; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000).

**Coordination**. The coordination construct measured the ability of the ERP system to enable coordination and synchronization among the different units, departments, partners, and suppliers of the firm (S. Chou & Chang, 2008; Gattiker & Goodhue, 2005).

**Impact on business**. The construct impact on business measured the productivity, operational effectiveness, and operational flexibility due to the use of the ERP system. The reflective indicators productivity (PRD), operational effectiveness (EFT), and operational flexibility (FLX) measured the three areas of the impact on business construct (Karimi et al., 2007a, 2007b; Venkatesh & Davis, 2000).

**Impact on internal efficiency**. The construct impact on internal efficiency measured the impact of ERP use on operational efficiency and work efficiency within the organization. The reflective indicators operational efficiency (EFC) and work efficiency (WEF) measured the two areas of the impact on internal efficiency construct (Karimi et al., 2007a, 2007b; Yoon, 2009; Zhu, Dong, Xu, et al., 2006).

**Impact on coordination**. The construct impact on coordination measured the impact of ERP use on improving coordination and cooperation as well as reducing procurement and inventory costs (Yoon, 2009; Zhu, Dong, Xu, et al., 2006).

Table 8 below provides a summary of the research constructs.

Table 8

*The Research Constructs and their Measures*

| Construct | Measures (scales) | | Sources |
|---|---|---|---|
| ERP information quality | INFQ1 | Timely information. | Abugabah & Sanzogni, 2010; Häkkinen & Hilmola, 2008; Ifinedo, 2011d; Ifinedo & Nahar, 2009; Ifinedo, Rapp, Ifinedo, et al., 2010; Yoon, 2009. |
| | INFQ2 | Up-to-date information. | |
| | INFQ3 | Useful information. | |
| | INFQ4 | Relevant information. | |
| | INFQ5 | Availability of information. | |
| ERP system quality | SYSQ1 | Easy to use. | Abugabah & Sanzogni, 2010; Häkkinen & Hilmola, 2008; Ifinedo, 2011d; Ifinedo, Rapp, Ifinedo, et al., 2010. |
| | SYSQ2 | Reliability. | |
| | SYSQ3 | Flexibility. | |
| | SYSQ4 | Allows for customization. | |
| | SYSQ5 | Allows for data integration. | |
| | SYSQ6 | Allows for integration with other IT systems. | |
| ERP service quality | SRVQ1 | ERP has a Good Interface. | Ifinedo, Rapp, Ifinedo, et al., 2010. |
| | SRVQ2 | ERP has visually appealing features. | |
| | SRVQ3 | ERP system delivers prompt information. | |
| | SRVQ4 | ERP service provider provides the right solution to requests. | |
| | SRVQ5 | ERP service provider is dependable. | |
| | SRVQ6 | ERP service provider provides quality training and services. | |

| Construct | Measures (scales) | | Sources |
|---|---|---|---|
| Shared beliefs | BLF1 | I believe in the benefits of the ERP system. | Amoako-Gyampah & Salam, 2004. |
| | BLF2 | My peers believe in the benefits of the ERP system. | |
| | BLF3 | My management team believes in the ERP system benefits. | |
| | BLF4 | The different departments, units, partners, and suppliers believe in the ERP system benefits. | |
| Knowledge and learning | LRN1 | I can always learn ERP experience and knowledge from colleagues. | H. W. Chou, Chang, et al., 2014. |
| | LRN2 | Colleagues always try to share their expertise about ERP with me. | |
| | LRN3 | Willingness to exchange experience or know-how with colleagues. | |
| | LRN4 | Willingness to share ERP expertise with colleagues. | |
| | LRN5 | Ability to recognize the value of ERP knowledge I learned. | |
| | LRN6 | Assimilate ERP knowledge learned and turn it into own knowledge base. | |
| | LRN7 | Ability to learn the ERP know-how needed. | |
| Job relevance | JREL1 | ERP system is important. | Abugabah & Sanzogni, 2010; Chung et al., 2009; Chung, Skibniewski, Lucas, et al., 2008; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000. |
| | JREL2 | ERP system is relevant. | |
| | JREL3 | ERP system is pertinent to the various job-related tasks. | |
| | JREL4 | The ERP system meets my task requirements. | |
| User self-efficacy | SE1 | Ability to complete job using the ERP system when no one is around to help. | H. W. Chou, Chang, et al., 2014; Kamhawi, 2008; Kwahk & Ahn, 2010; Shih & Huang, 2009; Sykes et al., 2014; Venkatesh & Bala, 2008. |
| | SE2 | Ability to complete job using ERP system using reference manuals. | |
| | SE3 | Ability to complete job using ERP system using the built-in help. | |
| | SE4 | Ability to complete job using ERP system if could call someone for help. | |
| | SE5 | Ability to complete job using ERP system if had a lot of time. | |

| Construct | Measures (scales) | | Sources |
|---|---|---|---|
| Coordination | CRD1 | ERP helps to adjust to changing conditions among the different departments, units, partners, and suppliers. | S. Chou & Chang, 2008; Gattiker & Goodhue, 2005. |
| | CRD2 | ERP has improved the coordination among the different departments, units, partners, and suppliers. | |
| | CRD3 | ERP facilitates the integration of important information among the different departments, units, partners, and suppliers. | |
| | CRD4 | ERP helps to synchronize among the different departments, units, partners, and suppliers. | |
| Impact on business | PRD1 | Using the ERP system improved my performance. | Venkatesh & Davis, 2000. |
| | PRD2 | Using the ERP system improved my productivity. | |
| | PRD3 | Using the ERP system improved my effectiveness. | |
| | PRD4 | Overall, using the ERP system is very useful in my job. | |
| | EFT1 | Data provided by ERP add value to our operations. | Karimi et al., 2007a, 2007b. |
| | EFT2 | ERP implementation has improved timely access to corporate data. | |
| | EFT3 | The ERP system provides a high level of enterprise-wide data integration. | |
| | EFT4 | ERP implementation helps us make better sales forecasts than before. | |
| | EFT5 | The functionalities of ERP adequately meet the requirements of our jobs. | |
| | EFT6 | ERP implementation has improved our quality of operations. | |
| | FLX1 | ERP implementation has given us more ways to customize our processes. | Karimi et al., 2007a, 2007b. |
| | FLX2 | ERP implementation has made our company more agile. | |
| | FLX3 | ERP implementation has made us more adaptive to changing business environment. | |
| | FLX4 | ERP implementation has improved the flexibility of our operations. | |

| Construct | Measures (scales) | | Sources |
|---|---|---|---|
| Impact on internal efficiency | EFC1 | ERP implementation has improved our efficiency of operations. | Karimi et al., 2007a, 2007b. |
| | EFC2 | ERP implementation has lowered our costs of operation. | |
| | EFC3 | ERP implementation has reduced the amount of rework needed for data entry errors | |
| | WEF1 | Business transactions performed efficiently. | Yoon, 2009; Zhu, Dong, Xu, et al., 2006. |
| | WEF2 | Decisions made more quickly. | |
| | WEF3 | Internal processes more efficient. | |
| Impact on coordination | ICO1 | Coordination with suppliers and partners improved. | Yoon, 2009; Zhu, Dong, Xu, et al., 2006. |
| | ICO2 | Cooperation between departments and units facilitated. | |
| | ICO3 | Procurement costs decreased. | |
| | ICO4 | Inventory costs decreased. | |

*Note*. All measures use a 7-point Likert scale.

Figure 6 below shows the research outer (measurement) model. The model consisted of one latent endogenous variable (ERP user value) and 11 exogenous variables measured using 65 indicators. The ERP user value (dependent variable) was a second-order construct manifested by three dimensions: impact on business, impact on internal efficiency, and impact on coordination.

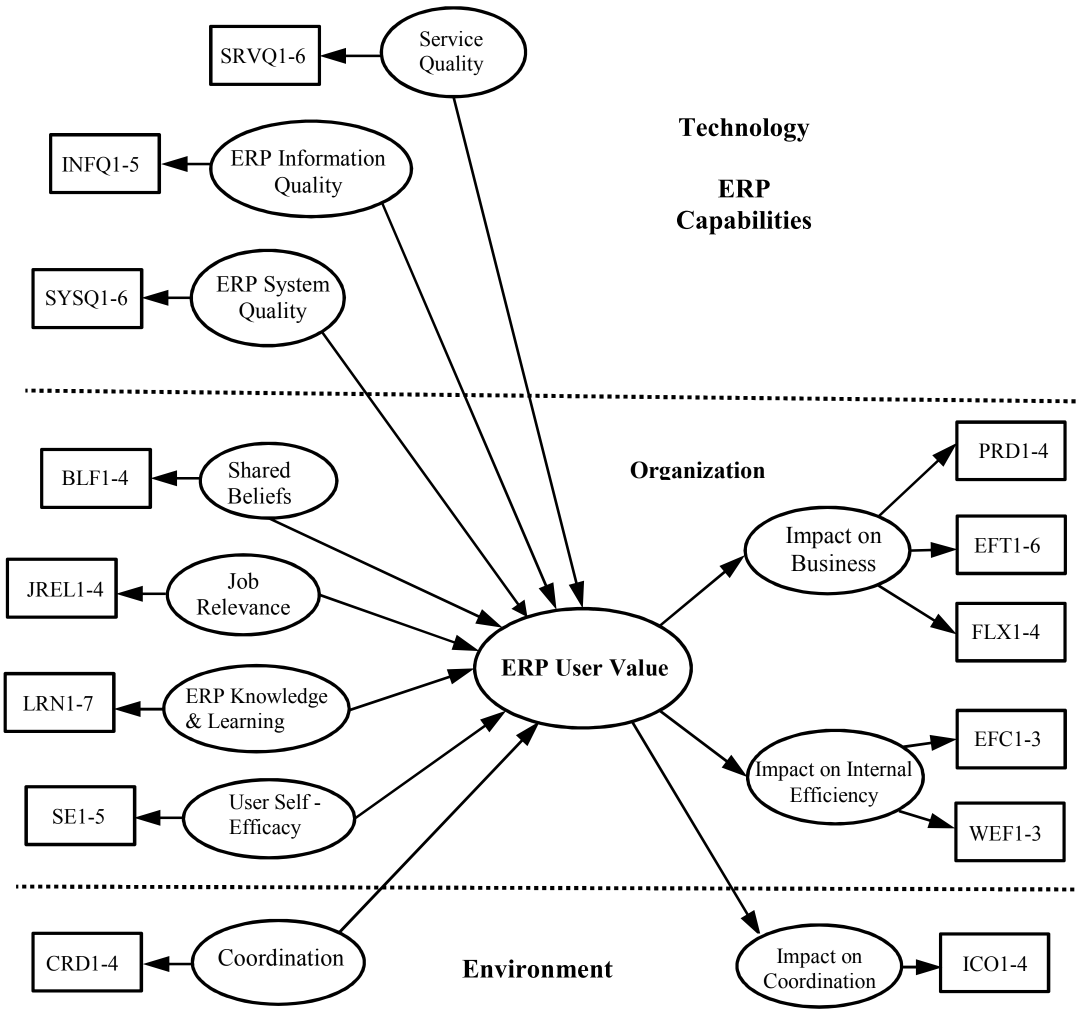


*Figure 6.* The research outer (measurement) model.

## Data Analysis Plan

Quantitative data analysis, which is deductive in nature, uses statistical tools to infer causal relationships and test hypotheses. Descriptive statistics describes the central tendency (mean, median, and mode), dispersion (range and standard deviation), and variability (variance) of a distribution of values. Inferential statistics describes the degree of relationship between the variables—correlation. Significance testing, analysis of variance (ANOVA and MANOVA), analysis of covariance (ANCOVA), regression analysis, and factor analysis are methods of inferential statistics. Regression analysis analyzes the effect of one variable on another variable. The "regression coefficient indicates the direction and amount of change in the dependent variable for each change of one unit in the independent variable" (Singleton & Straits, 2010, p. 529). The correlation coefficients describe the strength of the association between the dependent and independent variables. The goodness of fit (GoF) indexes—the Chi-square ($\chi^2$) statistic, *t*-statistic, RMSEA (root mean square error of approximation), the goodness of fit index (GIF), and the adjusted goodness of fit index (AGIF)—measure how the variables are related. Computing the Cronbach's alpha values or composite reliability values allow for estimating the reliability of the measures (Singleton & Straits, 2010).

Statistical significance is a measure expressed as a *p* value between 0 and 1. It indicates the degree or probability that the independent variable manipulation and change causes the change of the dependent variable and the change is not by chance or a random process. Low statistical significance values, like a *p* value of 0.05, allow the exclusion of rival explanations that uncontrolled differences in the subjects of the study were the cause to the observed results (Singleton & Straits, 2010).

In this study, I used the PLS-SEM approach to analyze the research structural model. PLS-SEM is a statistical approach to test multivariate models. PLS-SEM allowed for the analysis of variance with no assumptions about the data distribution (Hair et al., 2011). In addition, it is suitable when little theory is available, accuracy in prediction is important, correct model specification cannot be ensured, and both reflective and formative constructs are used in the model (Hair, Sarstedt, Pieper, & Ringle, 2012a).

PLS-SEM allowed for testing the hypotheses about the relationships between the observed (measured indicators) and latent variables (unobserved factors or constructs) in the research model. In addition, PLS-SEM allowed for estimating and testing the significance of the relationships between the constructs of the model and correcting measurement errors. The PLS-SEM measurement model allowed for the evaluation of how well the measured, observed, indicators defined the latent variable or construct in the research model (Bagozzi & Yi, 2012; Hair et al., 2011; Iacobucci, 2009, 2010; Weston & Gore, 2006). The PLS-SEM analysis in this study utilized the SmartPLS 3.2 (Ringle et al., 2005) software. The PLS-SEM data analysis followed the guidelines provided by Hair, Hult, Ringle, and Sarstedt (2014).

Review of the ERP success literature indicated that ERP information quality, ERP system quality, ERP service quality, shared beliefs, user self-efficacy, job relevance, ERP knowledge and learning, and coordination are the factors that affect ERP success. The research model (see Figure 6) posited that these factors provide sustained competitive advantage and positively impact productivity, effectiveness, internal efficiency, and coordination, thus leading to maximization of the value of the ERP system from the ERP user's point of view in the onward-and-upward phase. The ERP user value (dependent variable) was a second-order construct manifested by three dimensions, impact on business, impact on internal efficiency, and impact on coordination. The research hypothesis was that the independent variables of the technological, organizational, and environmental contexts impact ERP user value and affect ERP success.

**Research Questions**

The following were the research questions:

**Research Question 1**. From an ERP user's point of view, what were the sustainability factors that maximized the value of an ERP system for the user in the onward-and-upward phase?

**Research Question 2**. Which postimplementation sustainability factors in the onward-and-upward phase maximized the value of an ERP system from the user's point of view, and how significant were those factors?

**Research Hypotheses**

From the research structural model, see Figure 2, the following were the research hypotheses:

**Hypothesis 1 (H1).**

$H_0 1$: The ERP information quality does not impact ERP user value ($\beta_{19} = 0$).

$H_a 1$: The ERP information quality impacts ERP user value ($\beta_{19} \neq 0$).

**Hypothesis 2 (H2).**

$H_0 2$: The ERP system quality does not impact ERP user value ($\beta_{29} = 0$).

$H_a 2$: The ERP system quality impacts ERP user value ($\beta_{29} \neq 0$).

**Hypothesis 3 (H3).**

$H_0 3$: The ERP service quality does not impact ERP user value ($\beta_{39} = 0$).

$H_a 3$: The ERP service quality impacts ERP user value ($\beta_{39} \neq 0$).

**Hypothesis 4 (H4).**

*$H_0$4:* ERP workers and peers' shared belief in the benefits of the ERP system does not impact ERP user value ($\beta_{49} = 0$).

*$H_a$4:* ERP workers and peers' shared belief in the benefits of the ERP system impacts ERP user value ($\beta_{49} \neq 0$).

**Hypothesis 5 (H5).**

*$H_0$5:* The extent to which employees felt the ERP system is relevant for their jobs does not impact ERP user value ($\beta_{59} = 0$).

*$H_a$5:* The extent to which employees felt the ERP system is relevant for their jobs impacts ERP user value ($\beta_{59} \neq 0$).

**Hypothesis 6 (H6).**

*$H_0$6:* ERP user's knowledge and learning of the ERP system do not impact ERP user value ($\beta_{69} = 0$).

*$H_a$6:* ERP user's knowledge and learning of the ERP system impact ERP user value ($\beta_{69} \neq 0$).

**Hypothesis 7 (H7).**

*$H_0$7:* ERP user's self-efficacy does not impact ERP user value ($\beta_{79} = 0$).

*$H_a$7:* ERP user's self-efficacy impacts ERP user value ($\beta_{79} \neq 0$).

**Hypothesis 8 (H8).**

*$H_0$8:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers does not impact ERP user value ($\beta_{89} = 0$).

*$H_a8$:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers impacts ERP user value ($\beta_{89} \neq 0$).

$\beta_{ij}$ is the path coefficient linking the $i^{th}$ latent variable to the $j^{th}$ endogenous variable in the structural model.

Figures 7 and 8 below show the outer and inner model for this study. Since the indicator factors were reflective, the data analysis explained the endogenous variable variance, the inner model path coefficients and significance, and the outer model loadings (Hair, Sarstedt, Ringle, & Mena, 2012b). Running the PLS path-modeling estimation in SmartPLS 3.2 on the outer model provided the coefficient of determination ($R^2$) which explains the impact of the latent variables on the variance of latent dependent variable (user value). If $R^2$ was more than or equal to 0.75 (75%), then the independent latent variables substantially explains the variance in the dependent latent variable. Although an $R^2$ below 0.75 and greater than 0.5 meant that the independent latent variables moderately explains the variance in the dependent latent variable, an $R^2$ below 0.5 and greater than 0.25 weakly explains the variance (Hair et al., 2011; Wong, 2013).

To determine if a specific independent latent variable substantively impacted user value, Cohen's effect size ($f^2$) was calculated using the following formula:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}} \qquad (2)$$

where $R^2_{included}$ was the $R^2$ value when that specific latent variable was used in the model and $R^2_{excluded}$ was the $R^2$ value when it was omitted from the model. If $f^2$ is 0.02 then the effect of the latent variable on the model was small. Although an $f^2$ of 0.15 or more indicated that the latent variable had a medium effect, an $f^2$ of 0.35 or more indicated that the latent variable had a large effect on the model (Chin, 2010). The PLS-SEM path modeling estimation in SmartPLS 3.2 computed the variance inflation factor (VIF) values. A VIF value less than 5 indicated that there is no multicollinearity problem in the model (Wong, 2013).


*Figure 7.* The outer (measurement) model.

Running the PLS path-modeling estimation in SmartPLS 3.2 on the outer model provided the inner path coefficients. If an inner path coefficient was greater than 0.1, then the path was significant (Wong, 2013). A significant path in the outer model indicated that this latent variable predicted user value.

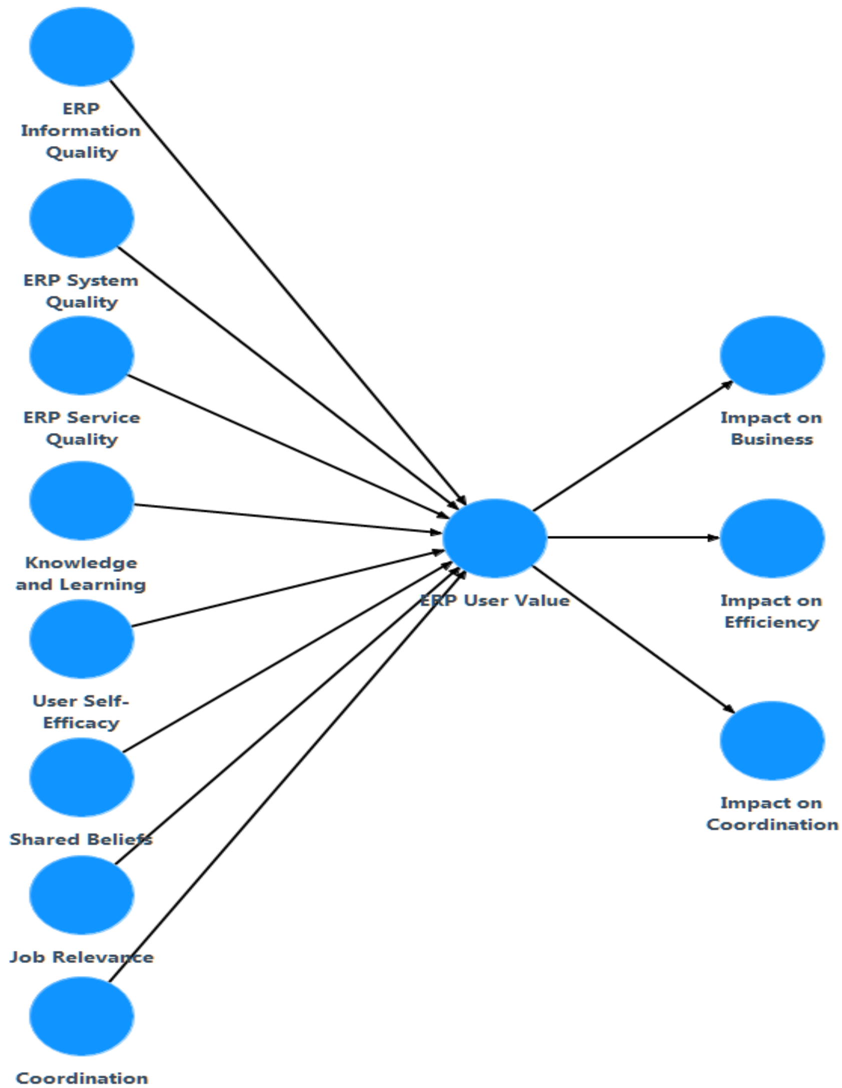


*Figure 8.* The inner model.

Analysis of the structural model (inner model, see Figure 8 above) included inspecting the computed cross-validated redundancy measure, Stone-Geisser's $Q^2$, computed by the blindfolding procedure in SmartPLS 3.2. Stone-Geisser's $Q^2$ values indicate the predictive relevance of the model. If the computed $Q^2$ values were greater than zero, then the exogenous constructs in the model had predictive relevance to the endogenous construct user value (Chin, 2010; Hair et al., 2011). In addition to computing $Q^2$, I computed the effect size for the predictive relevance $q^2$. The value of the effect size $q^2$ determined if a specific independent latent variable substantively predicted user value, using the following formula to compute $q^2$:

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}} \quad (3)$$

where $Q^2_{\text{included}}$ was the $Q^2$ value when that specific latent variable was used in the model, and $Q^2_{\text{excluded}}$ was the $Q^2$ value when it was omitted from the model. A $q^2$ equal or less than 0.02 indicated that this specific latent variable had a small effect in producing predictive relevance on user value. Although a $q^2$ of 0.15 or more indicated that the latent variable had a medium effect, a $q^2$ of 0.35 or more indicated that the latent variable had a large effect in producing predictive relevance on user value (Chin, 2010). In addition, performing the bootstrapping procedure in the SmartPLS 3.2 generated the *t*-values that were measures of the significance of the path coefficients of the inner model, which allowed for testing the research hypotheses.

## Threats to Validity

### External Validity

Validity is a way to verify the theories and hypotheses through the observed measures. External validity is the degree to which the results of the study holds true to other groups and populations other than the sample that participated in the study (Singleton & Straits, 2010). In order to achieve external validity, the sample size should be adequate (Singleton & Straits, 2010). Multiple private sector firms, higher education institutions, government entities (public sector), and local ERP and supply-chain management user groups in the Denver, CO metropolitan area were a good representative sample frame of the study target population. Due to the size of the organizations and user groups' membership, about 3500 ERP users and professionals, a convenience sample of 325 or more respondents would have allowed for the generalization of the study findings and reduced the sampling error and bias. Since the members self-selected to participate in the study if they met the characteristics of the study target population—top managers, middle managers, supervisors, staff, and users of ERP systems that had been implemented and operational for at least 4 years—"self-selection should permit reasonable generalizations to the target population" (Singleton & Straits, 2010, p. 487). In addition, to ensure external validity of the measurement, six ERP experts reviewed the questionnaire thus increasing the accuracy of the survey and reducing the measurement error.

**Internal Validity**

Internal validity means that the researcher is confident, or has evidence, that what observed as outcome is due to the manipulation of the independent variable that caused the observed changes in the dependent variable, and not due to the effects of extraneous variables. Internal validity is important because it indicates that there are no plausible alternative explanations to the observed differences in the dependent variable except the effect of the independent variable. The confounding effects between the extraneous variables and independent variables threaten the internal validity of a study (Singleton & Straits, 2010).

To check the reliability and validity of the measurement instrument and research model, I computed and analyzed the indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Squaring the PLS-SEM estimated indicator loadings (outer loadings numbers) provided the indicator reliability values. Although an indicator reliability value of 0.7 or higher was preferred, for exploratory research values higher than 0.4 were acceptable (Wong, 2013). Internal consistency reliability was measured using composite reliability. Composite reliability values of 0.7 or higher indicated reliable data analysis but for exploratory research values between 0.6 - 0.7 were acceptable measures of data analysis (Hair et al., 2011). The average variance extracted (AVE) was the measure of convergent validity. To indicate convergent validity of the measurement model, AVE values should be higher than or equal to 0.5 (Hair et al., 2011; Wong, 2013). To measure discriminant validity “the indicators loadings should be higher than all of its cross loadings” (Hair et al, 2011, p. 145) or use Fornell-Larcker criterion. According to the Fornell-Larcker criterion, discriminant validity existed if the square root of the AVE for each latent variable was higher than the correlations among the latent variables (Hair et al., 2011; Wong, 2013). In addition, computing the heterotrait-monotriat ratio of correlations (HTMT) allowed for confirming discriminant validity. According to Henseler, Ringle, and Sarstedt (2015), HTMT values less than 0.85 and HTMT confidence interval values less than 1.0 indicated discriminant validity. Abugabah and Sanzogni (2010), Amoako-Gyampah (2004), S. Chou and Chang (2008), Chung et al. (2009), Ifinedo (2011d), Karimi et al. (2007a, 2007b), Venkatesh and Davis (2000) and Zhu, Dong, Xu, et al. (2006) performed a pilot study to assess the internal validity of the survey instrument. In order to reinforce internal validity of the research instrument, the research questionnaire incorporated the tested and validated constructs in these sources as well as other validated operationalized constructs from Table 8. In addition, to ensure internal validity of the measurement, six ERP experts reviewed the questionnaire thus increasing the accuracy of the survey and reducing the measurement error.

**Construct Validity**

Construct validity is the extent to which the operational definition measures the intended concept. Construct validity means that the measuring instrument measures what it was designed to measure (MacKenzie, Podsakoff, & Podsakoff, 2011; Singleton & Straits, 2010; Trochim & Donnelly, 2007). Reliability is the consistency (dependability) of the operational definition in measuring the concept. Reliability means that the measuring instrument should give the same results when measuring the same construct.

Since construct validity depends on the measuring instrument working properly, it is necessary that the measuring instrument is reliable, that is, it measures accurately and consistently. Reliability of the measuring instrument is a necessary for validity but a reliable instrument does not mean that the instrument is measuring what it is supposed to measure (MacKenzie et al., 2011; Singleton & Straits, 2010; Trochim & Donnelly, 2007).

The relationship between validity and reliability is a follows, a valid measure is necessary reliable, which means that reliability is a necessary but insufficient condition for validity. In addition, a reliable measure may or may not be valid. Any measuring instrument measure an observed value, which is the sum of the true value in addition to a systematic error (inherent in the instrument) and random errors (temporary variations). Although a completely reliable measure is free from random errors but might have systematic errors, a completely valid measure is free from both systematic and random errors (MacKenzie et al., 2011; Singleton & Straits, 2010; Trochim & Donnelly, 2007). Assessing the reliability and validity of the operationalized construct enables the researcher to evaluate if it is a good measure of the concept. Improving the reliability and validity by removing the causes of errors and biases are important to reach valid inferences, interpretations, and generalizations about the concept.

Abugabah and Sanzogni (2010), Amoako-Gyampah (2004), S. Chou and Chang (2008), Chung et al. (2009), Ifinedo (2011d), Karimi et al. (2007a, 2007b), Venkatesh and Davis (2000) and Zhu, Dong, Xu, et al. (2006) used a purposive sample of experts to assess the construct validity of the measures. Amoako-Gyampah (2004), S. Chou and Chang (2008), Chung et al. (2009), Kamhawi (2008), and Karimi et al. (2007a, 2007b) used semi-structured interviews with a purposive sample of experts to assess the construct validity of the measures. In order to reinforce construct validity of the research instrument, the research questionnaire incorporated the tested and validated constructs in these sources as well as other validated operationalized constructs from Table 8. In addition, to ensure construct validity of the measurement, six ERP experts reviewed the questionnaire thus increasing the accuracy of the survey and reducing the measurement error.

Table 9 below provides the Cronbach's alpha and composite reliability for the scales used to develop the research questionnaire. A Cronbach's alpha 0.70 or greater indicated satisfactory reliability of the scale used to measure a construct, also, a satisfactory composite reliability should be 0.70 or greater (Bagozzi & Phillips, 1991; Bagozzi & Yi, 2012; MacKenzie et al., 2011; O'Leary-Kelly & Vokurka, 1998). The construct reliabilities of the validated measures incorporated in developing the study questions exceeded the 0.70 value indicating a reliable measurement instrument (see Table 9 below). In addition, I reassessed the reliability and construct validity of the study questionnaire instrument using the study-collected data.

Table 9

*Construct Reliability of Questionnaire Validated Measures*

| Source | Construct reliability | |
|---|---|---|
| Abugabah and Sanzogni (2010) | Cronbach's α 0.84 - 0.97 | Focus group and pilot test |
| Amoako-Gyampah (2004) | Cronbach's α 0.58 - 0.87 | Expert discussions and a pilot test |
| S. Chou and Chang (2008) | Cronbach's α 0.84 -0.97 | Interviews with managers and pilot test |
| H. W. Chou, Chang, et al. (2014) | Cronbach's α 0.84 -0.97 | |
| Chung, Skibniewski, Lucas, et al. (2008) | Cronbach's α 0.71 -0.94 | Interviews with managers and pilot test |
| Chung et al. (2009) | Cronbach's α 0.69 -0.96 | |
| Gattiker and Goodhue (2005) | Cronbach's α 0.86 -0.95 | |
| Häkkinen and Hilmola (2008) | Cronbach's α 0.740 - 0.944 | |
| Ifinedo (2011d) | Cronbach's α 0.89 -0.96 | Expert review and a pilot test |
| Ifinedo and Nahar (2009) | Cronbach's α 0.73 - 0.88 | |
| Ifinedo, Rapp, Ifinedo, et al. (2010) | Cronbach's α 0.801 -0.857<br>CR 0.856 - 0.894 | |
| Kamhawi (2008) | Cronbach's α 0.79 - 0.91 | Expert discussions |
| Karimi et al. (2007a) | CR 0.713 - 0.912 | Interviews with experts and pilot test |
| Karimi et al. (2007b) | CR 0.866 - 0.935 | Interviews with experts and pilot test |
| Kwahk and Ahn (2010) | CR 0.856 - 0.981 | . |
| Shih and Huang (2009) | CR 0.71 - 0.96 | |
| Sykes et al. (2014) | Cronbach's α 0.71 - 0.84 | |
| Venkatesh and Bala (2008) | CR 0.73 - 0.94 | |
| Venkatesh and Davis (2000) | Cronbach's α 0.80 - 0.98 | Focus group |
| Yoon (2009) | CR 0.872 - 0.942 | |
| Zhu, Dong, Xu, et al. (2006) | CR 0.752 - 0.893 | Expert opinion |

*Note*. CR: Composite reliability.

**Ethical Procedures**

This research study adhered to all the requirements to protect the participants' rights set forth by the Walden University Institutional Review Board (IRB) and followed sound research ethical principles. I obtained Walden University's IRB approval #01-05-15-0118147 before starting the data collection phase of the study and contacting any potential participant. This study followed the ethical principles of voluntary participation, informed consent, confidentiality, and anonymity set forth by Walden's University IRB. The informed consent letter contained advice to the study participants about their rights, and they had to agree to voluntary participation in the research before having access to the survey website (see Appendix B).

Since the sample frame for this study was the members of multiple private sector firms, higher education institutions, government entities, and local ERP and supply-chain management user groups in the Denver, CO metropolitan area, the firms and user groups' administration was the mechanism to disseminate the invitation to participate in the study. Thus, I did not have any access to the participants' contact information and e-mail addresses. The online survey allowed for participant anonymity and confidentiality. In addition, the research questionnaire did not collect the name of the organization where the participant worked. Since the online survey was anonymous, the collected data made it virtually impossible to associate the data responses with any participant identity or place of work. In addition, the reported results of this study were aggregated summaries.

The online survey questions were of a conceptual nature and only focused on participants' experiences using ERP systems and their working environment. In addition, the online survey questions were common to IT professionals and ERP users and focused on their perceptions. The online survey landing-page, informed consent page, informed the participants about their rights before taking the research survey. The informed consent page advised the study participants that they can decline to participate, not answer any questions they feel uncomfortable to answer, and captured their consent. A secured Web server was the mechanism for collecting the participants' demographics and responses. I stored the captured data in a password-protected folder. At the conclusion of data analysis, I transferred the research data to a compact disk for archival and will store it in a secure location for five years.

## Summary

This chapter presented the quantitative research methodology, the nonexperimental survey approach used in this study, and the rationale for its use. This research introduced a structural model based on the TOE framework to predict the postimplementation sustainability factors from the ERP user point of view and their impact on the overall ERP benefits for the organization. Since ERP users in the state of Colorado have mixed feelings about the value of the implemented ERP systems, the purpose of this research was to identify the sustainability factors and their relative significance that maximize the value of the implemented ERP system in the onward-and-upward phase postimplementation from the user's point of view—ERP user value. This study used a PLS-SEM approach to analyze the hypothesized TOE model. There was a need for this research because it addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value affects firm-achieved ERP benefits. Chapter 4 provides the PLS-SEM analysis and hypotheses testing results.

# Chapter 4: Results

The purpose of this study was to identify the different postimplementation sustainability factors, factors that provide sustained competitive advantage, in the onward-and-upward phase from the ERP user's point of view. In addition, this research investigated the relationships between the sustainability factors that positively impact productivity, effectiveness, internal efficiency, and coordination, thus leading to the maximization of the value of the ERP system from the ERP user's point of view. The research model posited that independent variables ERP information quality, ERP system quality, ERP service quality, shared beliefs, user self-efficacy, job relevance, ERP knowledge and learning, and coordination are the factors that affect the dependent variable ERP user value. ERP user value (dependent variable) was a second-order construct manifested by three dimensions: impact on business, impact on internal efficiency, and impact on coordination. The research hypothesis was that the independent variables of the technological, organizational, and environmental contexts impact ERP user value and affect ERP success.

The following were the research questions:

*Research Question 1*: From an ERP user's point of view, what were the sustainability factors that maximized the value of an ERP system for the user in the onward-and-upward phase?

*Research Question 2*: Which postimplementation sustainability factors in the onward-and-upward phase maximized the value of an ERP system from the user's point of view, and how significant were those factors?

The following were the research hypotheses:

*Hypothesis 1 (H1):*

*$H_0$1:* The ERP information quality does not impact ERP user value ($\beta_{19} = 0$).

*$H_a$1:* The ERP information quality impacts ERP user value ($\beta_{19} \neq 0$).

*Hypothesis 2 (H2):*

*$H_0$2:* The ERP system quality does not impact ERP user value ($\beta_{29} = 0$).

*$H_a$2:* The ERP system quality impacts ERP user value ($\beta_{29} \neq 0$).

*Hypothesis 3 (H3):*

*$H_0$3:* The ERP service quality does not impact ERP user value ($\beta_{39} = 0$).

*$H_a$3:* The ERP service quality impacts ERP user value ($\beta_{39} \neq 0$).

*Hypothesis 4 (H4):*

*$H_0$4:* ERP workers and peers' shared belief in the benefits of the ERP system does not impact ERP user value ($\beta_{49} = 0$).

*$H_a$4:* ERP workers and peers' shared belief in the benefits of the ERP system impacts ERP user value ($\beta_{49} \neq 0$).

*Hypothesis 5 (H5):*

*$H_0$5:* The extent to which employees felt the ERP system is relevant for their jobs does not impact ERP user value ($\beta_{59} = 0$).

*$H_a$5:* The extent to which employees felt the ERP system is relevant for their jobs impacts ERP user value ($\beta_{59} \neq 0$).

*Hypothesis 6 (H6):*

*$H_0$6:* ERP user's knowledge and learning of the ERP system do not impact ERP user value ($\beta_{69} = 0$).

*$H_a$6:* ERP user's knowledge and learning of the ERP system impact ERP user value ($\beta_{69} \neq 0$).

*Hypothesis 7 (H7):*

*$H_0$7:* ERP user's self-efficacy does not impact ERP user value ($\beta_{79} = 0$).

*$H_a$7:* ERP user's self-efficacy impacts ERP user value ($\beta_{79} \neq 0$).

*Hypothesis 8 (H8):*

*$H_0$8:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers does not impact ERP user value ($\beta_{89} = 0$).

*$H_a$8:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers impacts ERP user value ($\beta_{89} \neq 0$).

$\beta_{ij}$ is the path coefficient linking the $i^{th}$ latent variable to the $j^{th}$ endogenous variable in the structural model.

This chapter starts with a presentation of the data collection procedures used in this study. In addition, the chapter presents the PLS-SEM analysis results. The chapter provides the reliability and validity results, including indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Finally, the chapter ends with a presentation of the statistical analysis findings regarding the research questions and the tests of hypotheses.

## Data Collection

Multiple private sector firms, government entities (public sector), higher education institutions, and local ERP and supply-chain management user groups in the Denver, CO metropolitan area participated in the study. After securing Walden's IRB approval, I e-mailed an invitation letter to four firms and two ERP users groups in the Denver metropolitan area requesting them to forward the invitation to their members. In the invitation-to-participate letter, I explained the purpose of the study, outlined participants' rights, and included a direct hyperlink to the informed consent page. In addition, the invitation letter informed the participants that they had 4 weeks to complete the survey.

As the initial response rate was very low—only 35 anonymous responses in the first 2 weeks—I emailed the six entities asking them to send a reminder to their membership alerting them to the invitation to participate. By the end of Week 3, the response rate increased to 50 anonymous responses. The initial plan was to keep the online survey open for 4 weeks to allow time to capture the needed 325 responses; however, due to the low response rate after the first 3 weeks, it became evident that there was a need to extend the survey closure date and solicit the participation of additional organizations.

Five new firms and two higher education institutions in the Denver metropolitan area received an invitation to their membership to participate in the study. The closure date was extended by 2 additional weeks. By the end of Week 4, the first set of six entities received an email alerting them about the extension of the closure date by 2 additional weeks and requesting them to encourage their membership to participate. Due to these efforts, the number of anonymous responses reached 95 by the end of Week 5. I contacted three new firms, sent reminders to the other entities, and extended the due date by 3 additional weeks.

By the end of Week 8, the total number of anonymous responses reached 153. Following another set of reminders and the extension of the due date by another week, the number of responses reached 159 anonymous responses at the end of Week 9. In the 10th and last week, only four responses were entered, making the total anonymous responses reach 163 cases. By the end of Week 10, it was clear that it would be hard to reach 325 responses, so I closed the survey and sent a last e-mail to all the entities thanking them and alerting them that the online survey was no longer available.

Despite there being only 163 actual cases, this sample size exceeded the minimum sample size of 53 cases suggested by MacCallum et al. (1996) as well as the minimum sample size of 65 cases suggested by MacCallum et al. (2006) and Kim (2005). In addition, the 163 cases exceeded the minimum sample size of 84 cases recommended by Marcoulides and Saunders (2006) and Wong (2013). Furthermore, the 163 cases exceeded the 100-case minimum sample size recommended by Fabrigar et al. (2010) and the 110-case minimum sample size suggested by Barclay et al. (1995). Following Cohen's (1992) suggested usage of power analysis to compute the adequate sample size for multiple regression, for a 0.15 medium effect size, 0.80 statistical power, 0.05 significance, and an eight independent variables model, the minimum sample size needed was 107 cases. Using Faul et al. (2009) G*Power statistical software to compute the adequate sample size, for a fixed model using linear multiple regression with $R^2$ deviated from zero, for a 0.15 medium effect size, 0.80 statistical power, 0.05 significance, and four indicators per independent variable, the minimum sample size needed was 107 cases. For a 0.15 medium effect size, 0.95 statistical power, 0.05 significance, and four indicators per independent variable, the minimum sample size needed computed by G*Power was 129 cases. Thus, from all the above, the collected 163 cases were an adequate sample size, assuming a 0.15 medium effect size, 0.80 statistical power, and 0.05 significance level.

The total members of the entities that participated were about 3500 top managers, middle managers, supervisors, and staff yielding a response rate of 0.047%. After importing the data into IBM SPSS for analysis, 9 cases did not meet the inclusion criteria of ERP usage for at least 4 years and working for the organization for at least 4 years, thus reducing the sample size $N$ to 154 cases. As displayed in Table 10 below, 55.2% of the respondents were workers, 33.1% mangers, and 11.7% other positions. The other positions included senior ERP systems analyst, ERP database administrator, ERP/SIS technical support, and IT staff and managers.

Table 10

*Demographics Summary*

| Characteristic | *n* | % |
|---|---|---|
| Gender | | |
| Female | 83 | 53.89 |
| Male | 71 | 46.10 |
| Position | | |
| Manager | 51 | 33.12 |
| Worker | 85 | 55.19 |
| Other | 18 | 11.69 |
| Years with the organization | | |
| 4-10 years | 74 | 48.05 |
| More than 10 years | 80 | 51.95 |
| Years using the organization's ERP system | | |
| 4-10 years | 74 | 48.05 |
| More than 10 years | 80 | 51.95 |

*Note*. $N = 154$.

The IBM SPSS analysis showed that there were 16 incomplete cases out of the 154 cases including 98 missing values. Further analysis of the data using the multiple imputation analyze patterns functionality in IBM SPSS showed that despite the missing 16 cases represented 10.39%, the complete data values were 99.02 % (9,912 complete values out of 10,010). Performing a missing value analysis in IBM SPSS provided Little's missing completely at random (MCAR) test. The results of Little's MCAR test were $\chi 2 = 585.895$, $df = 881$, and $p = 1.0$, because $p > 0.05$, I rejected the null hypothesis that the missing data was not completely at random and accepted the alternate hypothesis that the missing data was completely at random.

# Study Results

## Descriptive Statistics

Table 11 presents the descriptive statistics of the data set. The skewness coefficients showed that most of the indicators skewed to the left meaning that the left tails was longer relative to the right tails. The kurtosis coefficients varied showing some indicators were close to the mean, others were flat relative to the mean, but many indicators had sharp peaks.

Table 11

*Descriptive Statistics*

| | | INFQ1 | INFQ2 | INFQ3 | INFQ4 | INFQ5 | SYSQ1 | SYSQ2 | SYSQ3 | SYSQ4 | SYSQ5 | SYSQ6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *N* | Valid | 153 | 151 | 153 | 153 | 153 | 154 | 153 | 153 | 153 | 153 | 153 |
| | Missing | 1 | 3 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| Mean | | 5.752 | 6.305 | 5.915 | 5.908 | 4.908 | 4.727 | 5.366 | 4.353 | 4.706 | 5.327 | 4.353 |
| Std. Error of Mean | | 0.096 | 0.098 | 0.108 | 0.118 | 0.130 | 0.127 | 0.114 | 0.138 | 0.135 | 0.134 | 0.159 |
| Median | | 6 | 7 | 6 | 6 | 5 | 5 | 6 | 4 | 5 | 6 | 5 |
| Mode | | 6 | 7 | 7 | 7 | 5 | 5 | 6 | 4 | 5 | 5[a] | 4 |
| Std. Deviation | | 1.194 | 1.200 | 1.337 | 1.462 | 1.607 | 1.577 | 1.413 | 1.703 | 1.670 | 1.654 | 1.972 |
| Variance | | 1.425 | 1.440 | 1.789 | 2.136 | 2.584 | 2.487 | 1.997 | 2.901 | 2.788 | 2.735 | 3.888 |
| Skewness | | -1.695 | -2.673 | -1.481 | -1.671 | -0.533 | -0.543 | -1.084 | -0.218 | -0.477 | -1.216 | -0.451 |
| Std. Error of Skewness | | .196 | .197 | .196 | .196 | .196 | .195 | .196 | .196 | .196 | .196 | .196 |
| Kurtosis | | 4.114 | 8.122 | 1.783 | 2.427 | -.476 | -.420 | 1.089 | -.692 | -.584 | 1.009 | -.937 |
| Std. Error of Kurtosis | | .390 | .392 | .390 | .390 | .390 | .389 | .390 | .390 | .390 | .390 | .390 |
| Range | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Minimum | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Maximum | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Percentiles | 25 | 5 | 6 | 6 | 6 | 4 | 3 | 5 | 3 | 4 | 5 | 3 |
| | 50 | 6 | 7 | 6 | 6 | 5 | 5 | 6 | 4 | 5 | 6 | 5 |
| | 75 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 7 | 6 |

*Note*. [a] Multiple modes exist. The smallest value is shown.

| | | SRVQ1 | SRVQ2 | SRVQ3 | SRVQ4 | SRVQ5 | SRVQ6 | LRN1 | LRN2 | LRN3 | LRN4 | LRN5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *N* | Valid | 153 | 153 | 151 | 151 | 152 | 151 | 153 | 152 | 152 | 153 | 153 |
| | Missing | 1 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | 1 |
| Mean | | 5.366 | 4.595 | 4.305 | 4.795 | 4.829 | 3.934 | 5.373 | 5.026 | 6.342 | 6.333 | 6.183 |
| Std. Error of Mean | | 0.113 | 0.133 | 0.130 | 0.123 | 0.124 | 0.139 | 0.107 | 0.127 | 0.092 | 0.091 | 0.092 |
| Median | | 6 | 5 | 4 | 5 | 5 | 4 | 6 | 5 | 7 | 7 | 6 |
| Mode | | 6 | 5 | 4 | 5 | 6 | 4 | 6 | 6 | 7 | 7 | 7 |
| Std. Deviation | | 1.394 | 1.644 | 1.596 | 1.511 | 1.530 | 1.711 | 1.327 | 1.561 | 1.134 | 1.130 | 1.132 |
| Variance | | 1.944 | 2.703 | 2.547 | 2.284 | 2.341 | 2.929 | 1.762 | 2.436 | 1.286 | 1.276 | 1.282 |
| Skewness | | -0.974 | -0.246 | -0.202 | -0.467 | -0.685 | 0.120 | -1.073 | -0.679 | -2.776 | -2.768 | -2.461 |
| Std. Error of Skewness | | .196 | .196 | .197 | .197 | .197 | .197 | .196 | .197 | .197 | .196 | .196 |
| Kurtosis | | .952 | -.901 | -.641 | -.420 | -.032 | -.987 | .988 | -.303 | 9.433 | 9.451 | 8.136 |
| Std. Error of Kurtosis | | .390 | .390 | .392 | .392 | .391 | .392 | .390 | .391 | .391 | .390 | .390 |
| Range | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Minimum | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Maximum | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Percentiles | 25 | 5 | 3 | 3 | 4 | 4 | 2 | 5 | 4 | 6 | 6 | 6 |
| | 50 | 6 | 5 | 4 | 5 | 5 | 4 | 6 | 5 | 7 | 7 | 6 |
| | 75 | 6 | 6 | 5 | 6 | 6 | 5 | 6 | 6 | 7 | 7 | 7 |

| | | LRN6 | LRN7 | SE1 | SE2 | SE3 | SE4 | SE5 | BLF1 | BLF2 | BLF3 | BLF4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *N* | Valid | 152 | 153 | 154 | 153 | 154 | 154 | 154 | 154 | 153 | 154 | 152 |
| | Missing | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 2 |
| Mean | | 5.789 | 5.431 | 4.877 | 4.288 | 4.701 | 5.545 | 5.039 | 5.714 | 5.078 | 4.948 | 4.836 |
| Std. Error of Mean | | 0.103 | 0.124 | 0.150 | 0.143 | 0.136 | 0.110 | 0.118 | 0.128 | 0.131 | 0.139 | 0.123 |
| Median | | 6 | 6 | 5 | 4 | 5 | 6 | 5 | 6 | 6 | 5 | 5 |
| Mode | | 7 | 7 | 7 | 4 | 6 | 6 | 6 | 7 | 6 | 6 | 6 |
| Std. Deviation | | 1.274 | 1.529 | 1.859 | 1.768 | 1.692 | 1.368 | 1.459 | 1.591 | 1.616 | 1.722 | 1.516 |
| Variance | | 1.624 | 2.339 | 3.455 | 3.127 | 2.864 | 1.870 | 2.129 | 2.532 | 2.612 | 2.965 | 2.297 |
| Skewness | | -1.425 | -0.891 | -0.548 | -0.315 | -0.373 | -1.261 | -0.733 | -1.483 | -0.773 | -0.697 | -0.515 |
| Std. Error of Skewness | | .197 | .196 | .195 | .196 | .195 | .195 | .195 | .195 | .196 | .195 | .197 |
| Kurtosis | | 2.603 | .141 | -.912 | -.860 | -.745 | 1.639 | .348 | 1.653 | -.091 | -.369 | -.195 |
| Std. Error of Kurtosis | | .391 | .390 | .389 | .390 | .389 | .389 | .389 | .389 | .390 | .389 | .391 |
| Range | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Minimum | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Maximum | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Percentiles | 25 | 5 | 4 | 3 | 3 | 3 | 5 | 4 | 5 | 4 | 4 | 4 |
| | 50 | 6 | 6 | 5 | 4 | 5 | 6 | 5 | 6 | 6 | 5 | 5 |
| | 75 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 7 | 6 | 6 | 6 |

| | | CRD1 | CRD2 | CRD3 | CRD4 | JREL1 | JREL2 | JREL3 | JREL4 | PRD1 | PRD2 | PRD3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *N* | Valid | 153 | 152 | 154 | 154 | 153 | 152 | 151 | 153 | 152 | 152 | 152 |
| | Missing | 1 | 2 | 0 | 0 | 1 | 2 | 3 | 1 | 2 | 2 | 2 |
| Mean | | 4.438 | 4.553 | 4.747 | 4.610 | 6.497 | 5.500 | 6.132 | 6.379 | 5.618 | 5.618 | 5.586 |
| Std. Error of Mean | | 0.128 | 0.140 | 0.133 | 0.137 | 0.091 | 0.121 | 0.107 | 0.090 | 0.128 | 0.125 | 0.130 |
| Median | | 4 | 5 | 5 | 5 | 7 | 6 | 6 | 7 | 6 | 6 | 6 |
| Mode | | 6 | 4[a] | 6 | 6 | 7 | 6 | 7 | 7 | 6 | 7 | 6 |
| Std. Deviation | | 1.580 | 1.729 | 1.647 | 1.697 | 1.125 | 1.492 | 1.320 | 1.112 | 1.578 | 1.544 | 1.601 |
| Variance | | 2.498 | 2.991 | 2.713 | 2.880 | 1.265 | 2.225 | 1.742 | 1.237 | 2.489 | 2.383 | 2.562 |
| Skewness | | -0.183 | -0.296 | -0.520 | -0.298 | -3.211 | -1.292 | -2.398 | -3.296 | -1.523 | -1.550 | -1.566 |
| Std. Error of Skewness | | .196 | .197 | .195 | .195 | .196 | .197 | .197 | .196 | .197 | .197 | .197 |
| Kurtosis | | -.914 | -.875 | -.673 | -.814 | 11.630 | 1.363 | 6.038 | 12.918 | 1.933 | 2.258 | 2.099 |
| Std. Error of Kurtosis | | .390 | .391 | .389 | .389 | .390 | .391 | .392 | .390 | .391 | .391 | .391 |
| Range | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Minimum | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Maximum | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Percentiles | 25 | 3 | 3 | 4 | 3 | 6 | 5 | 6 | 6 | 5 | 5 | 5 |
| | 50 | 4 | 5 | 5 | 5 | 7 | 6 | 6 | 7 | 6 | 6 | 6 |
| | 75 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |

*Note*. [a] Multiple modes exist. The smallest value is shown.

| | | EFC1 | EFC2 | EFC3 | WEF1 | WEF2 | WEF3 | ICO1 | ICO2 | ICO3 | ICO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *N* | Valid | 154 | 151 | 153 | 154 | 152 | 154 | 148 | 153 | 148 | 148 |
| | Missing | 0 | 3 | 1 | 0 | 2 | 0 | 6 | 1 | 6 | 6 |
| Mean | | 4.675 | 4.391 | 4.562 | 5.084 | 4.632 | 4.617 | 4.615 | 4.902 | 4.419 | 4.378 |
| Std. Error of Mean | | 0.133 | 0.130 | 0.132 | 0.120 | 0.129 | 0.139 | 0.121 | 0.130 | 0.117 | 0.112 |
| Median | | 5 | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 4 |
| Mode | | 5 | 4 | 4 | 5 | 5 | 6 | 4 | 5 | 4 | 4 |
| Std. Deviation | | 1.648 | 1.596 | 1.630 | 1.495 | 1.593 | 1.720 | 1.478 | 1.613 | 1.419 | 1.362 |
| Variance | | 2.717 | 2.546 | 2.656 | 2.235 | 2.539 | 2.957 | 2.184 | 2.602 | 2.014 | 1.856 |
| Skewness | | -0.452 | -0.262 | -0.366 | -0.776 | -0.383 | -0.357 | -0.183 | -0.715 | -0.094 | 0.023 |
| Std. Error of Skewness | | .195 | .197 | .196 | .195 | .197 | .195 | .199 | .196 | .199 | .199 |
| Kurtosis | | -.631 | -.379 | -.368 | .491 | -.237 | -.792 | -.005 | .123 | .396 | .559 |
| Std. Error of Kurtosis | | .389 | .392 | .390 | .389 | .391 | .389 | .396 | .390 | .396 | .396 |
| Range | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Minimum | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Maximum | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Percentiles | 25 | 3 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 4 | 4 |
| | 50 | 5 | 4 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 4 |
| | 75 | 6 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 |

**Factor Analysis**

Before executing the PLS-SEM, I performed a factor analysis to identify which observed variables (indicators) explained most of the observed variance in each latent variable in the model. After performing an initial factor solution using a principal component analysis extraction method, the reported Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.88. A KMO value of 0.88 meant that the degree of common variance among the indicators was meritorious. The KMO results indicated that the extracted indicators accounted for a substantial amount of the variance. The reported Bartlett's test of sphericity results were $\chi 2 = 11636.961$, $df = 2080$, and $p = 0.000$. A $p < 0.001$ value indicated that the intercorrelation matrix for the sample did not come from a noncollinear population meaning that the intercorrelation matrix for the population was not an identity matrix. Performing a Varimax rotation with Kaiser Normalization with an extraction based on Eigenvalues greater than 1.0 resulted in retaining the indicators shown in Table 12 below in the final model.

Table 12

*Results of the Varimax Rotation with Kaiser Normalization*

| Latent variable | Retained indicators |
|---|---|
| ERP Information Quality | INFQ2, INFQ3, and INFQ4 |
| ERP System Quality | SYSQ3, SYSQ4, and SYSQ6 |
| ERP Service Quality | SRVQ1, SRVQ2, and SRVQ3 |
| Knowledge and Learning | LRN3, LRN4, and LRN5 |
| Shared Beliefs | BLF2, BLF3, and BLF4 |
| User Self-Efficacy | SE1, SE2, and SE3 |
| Job Relevance | JREL1, JREL3, and JREL4 |
| Coordination | CRD2, CRD3, and CRD4 |
| Impact on Business | EFT2, EFT3, EFT4, FLX2, PRD1, PRD2, and PRD3 |
| Impact on Efficiency | EFC1, EFC3, WEF2, and WEF3 |
| Impact on Coordination | ICO1, ICO3, and ICO4 |

**Partial Least Squares Structure Equation Modeling (PLS-SEM) Results**

Performing the PLS path-modeling estimation in SmartPLS 3.2 with the following settings:

1. Weighting Scheme: Path weighting scheme
2. Maximum Iterations: 300
3. Stop Criterion: 1.0E-7
4. Missing Values: Case wise deletion (list wise deletion)
5. Initial outer weights: 1.0

converged after 9 iterations. Figure 9 provides the obtained path coefficients from executing the PLS path-modeling estimation in SmartPLS 3.2. None of the inner path coefficients was lower than 0.1. In addition, all the outer loadings were above 0.7.

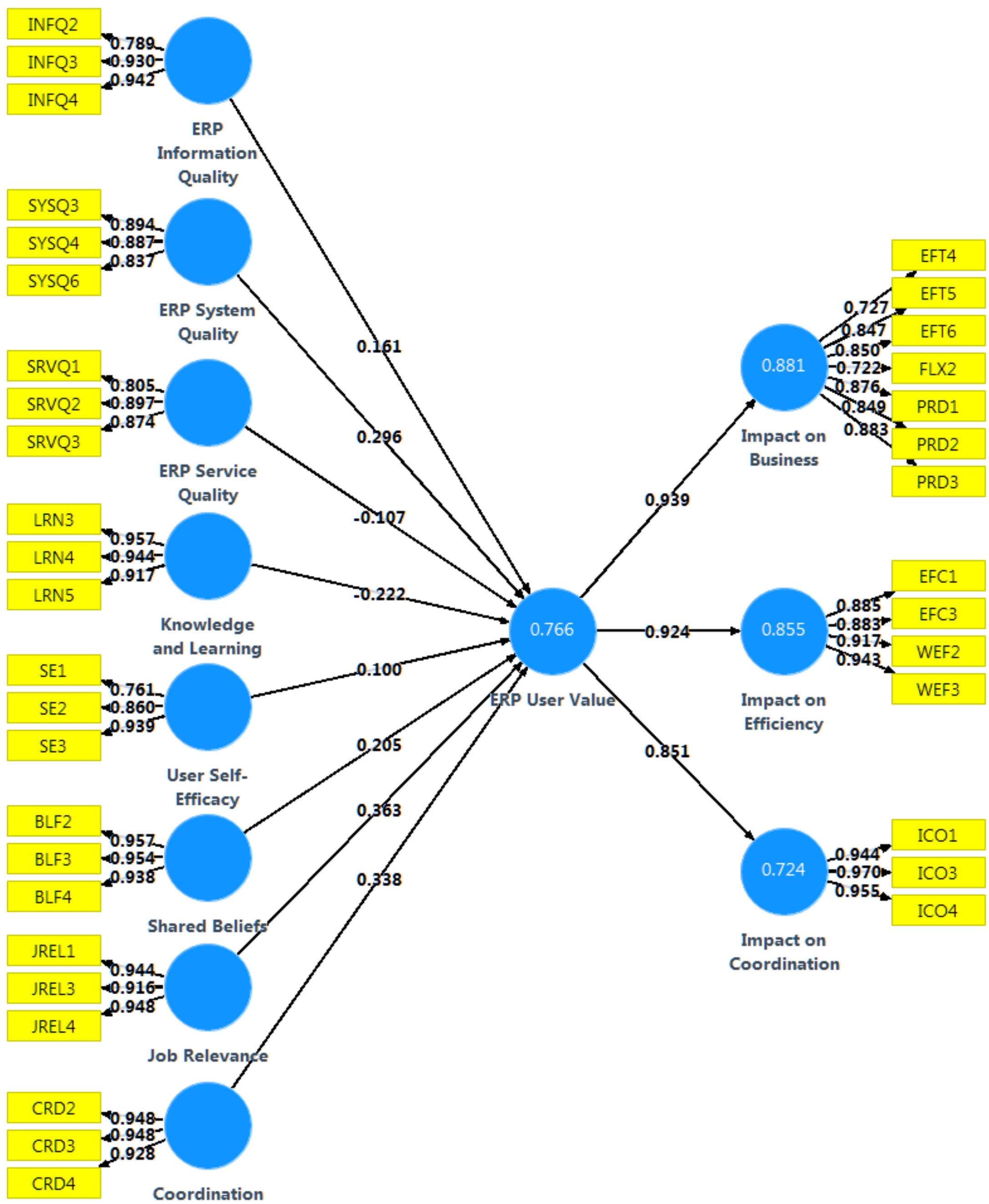


*Figure 9.* Obtained path coefficients.

Analysis of the structural model (inner model) included inspecting the coefficients of determination ($R^2$) which is a measure of the model's predictive accuracy. The PLS path-modeling estimation in SmartPLS 3.2 provided the coefficients of determination ($R^2$) for the inner model. Table 13 shows the obtained $R^2$ values. The $R^2$ values ranged from 0.72 to 0.88. Since all computed $R^2$ values were above 0.72, these $R^2$ values indicated the predictive accuracy of the research model. In addition, the computed $R^2$ for ERP user value was 0.766, which indicated that the exogenous latent variables had a substantial combined effect on the endogenous latent variable ERP user value.

Table 13

*Obtained Coefficients of Determination ($R^2$) for the Inner Model*

| | $R^2$ | $R^2$ adjusted |
|---|---|---|
| ERP User Value | 0.766 | 0.751 |
| Impact on Business | 0.881 | 0.880 |
| Impact on Coordination | 0.724 | 0.722 |
| Impact on Efficiency | 0.855 | 0.854 |

Analysis of the structural model (inner model) included inspecting the computed cross-validated redundancy measures, Stone-Geisser’s $Q^2$, computed by the blindfolding procedure in SmartPLS 3.2 with an omission distance of 10. Table 14 provides the obtained computed cross-validated redundancy measures $Q^2$. The $Q^2$ values ranged from 0.48 to 0.71. Since all computed $Q^2$ values were above 0.0, these $Q^2$ values showed that the exogenous constructs in the model had moderately predictive relevance to the endogenous construct ERP user value.

Table 14

*Obtained Cross-Validated Redundancy Measures, Stone-Geisser's $Q^2$*

| | SSO | SSE | $Q^2$ (1-SSE/SSO) |
|---|---|---|---|
| ERP User Value | 2,156.000 | 1,120.467 | 0.480 |
| Impact on Business | 1,078.000 | 451.055 | 0.582 |
| Impact on Coordination | 462.000 | 168.382 | 0.636 |
| Impact on Efficiency | 616.000 | 178.092 | 0.711 |

*Note*. SSE is the sum of the squares of the errors, and SSO is the sum of the squares of the observed values.

Table 15 provides the computed values for Cohen's effect size $f^2$ and the effect size for the predictive relevance $q^2$ using equations 3 and 4. From table 16, the latent variables ERP information quality, ERP service quality, ERP knowledge and learning, shared beliefs, and user self-efficacy had a small effect on the model—$f^2$ values ranged from 0.022 to 0.088. The $f^2$ values for the latent variables ERP system quality, job relevance, and coordination ranged from 0.17 to 0.19, which showed that these latent variables had a medium effect on the model. In addition, the relative predictive relevance $q^2$ values for ERP system quality, shared beliefs, job relevance, and coordination ranged from 0.022 to 0.049 indicating that these latent variables had a small effect in producing relative predictive relevance on user value. ERP information quality, ERP service quality, ERP knowledge and learning, and user self-efficacy $q^2$ values were less than 0.02, which showed they had no effect in producing relative predictive relevance on user value.

Table 15

*Cohen's $f^2$ Effect Size and the Relative Predictive Relevance $q^2$*

| | ERP user value | |
|---|---|---|
| | $f^2$ effect size | $q^2$ predictive relevance |
| ERP Information Quality | 0.037 | 0.011 |
| ERP System Quality | 0.170 | 0.049 |
| ERP Service Quality | 0.022 | 0.005 |
| Knowledge and Learning | 0.064 | 0.016 |
| Shared Beliefs | 0.088 | 0.022 |
| User Self-Efficacy | 0.027 | 0.007 |
| Job Relevance | 0.179 | 0.042 |
| Coordination | 0.190 | 0.049 |

**Reliability and Validity Results**

To check for reliability and validity, I investigated the indicator reliability, internal consistency reliability, convergent validity, and discriminant validity measures, which are measures of the psychometric properties of the model. Squaring the indicator loadings (outer loadings numbers) provided the indicator reliability values in Table 16 below. Although an indicator reliability value of 0.7 or higher was preferred, for exploratory research values higher than 0.4 were acceptable (Wong, 2013). The smallest indicator reliability value was 0.521, which is greater than the suggested 0.4 value for exploratory studies. The majority of the indicator reliability values in Table 16 were close to or greater than 0.7. The PLS path-modeling estimation in SmartPLS 3.2 provided the composite reliability, Cronbach's alpha, and the average variance extracted (AVE). The composite reliability values ranged from 0.891 to 0.97 and the Cronbach's alpha values ranged from 0.822 to 0.953. Since the composite reliability and Cronbach's alpha values were larger than the suggested value of 0.7, thus the indicators measuring a latent variable were similar in their scores demonstrating internal consistency reliability. The computed AVE values ranged from 0.68 to 0.914. As the computed AVE values were all greater than 0.5, thus confirming the convergent validity of the measurement model (measurement scales).

Table 16

*Results Summary of the Outer Model*

| Latent variable | Indicators | Loadings | Indicator reliability | Composite reliability | Cronbach's alpha | Average variance extracted (AVE) |
|---|---|---|---|---|---|---|
| ERP Information Quality | INFQ2 | 0.789 | 0.623 | 0.919 | 0.866 | 0.792 |
| | INFQ3 | 0.930 | 0.865 | | | |
| | INFQ4 | 0.942 | 0.887 | | | |
| ERP System Quality | SYSQ3 | 0.883 | 0.779 | 0.906 | 0.843 | 0.762 |
| | SYSQ4 | 0.843 | 0.710 | | | |
| | SYSQ6 | 0.800 | 0.640 | | | |
| ERP Service Quality | SRVQ1 | 0.805 | 0.648 | 0.894 | 0.822 | 0.739 |
| | SRVQ2 | 0.897 | 0.805 | | | |
| | SRVQ3 | 0.874 | 0.763 | | | |
| Knowledge and Learning | LRN3 | 0.957 | 0.916 | 0.958 | 0.934 | 0.883 |
| | LRN4 | 0.944 | 0.891 | | | |
| | LRN5 | 0.917 | 0.841 | | | |
| Shared Beliefs | BLF2 | 0.957 | 0.916 | 0.965 | 0.946 | 0.903 |
| | BLF3 | 0.954 | 0.911 | | | |
| | BLF4 | 0.938 | 0.881 | | | |
| User Self-Efficacy | SE1 | 0.761 | 0.579 | 0.891 | 0.826 | 0.734 |
| | SE2 | 0.860 | 0.740 | | | |
| | SE3 | 0.939 | 0.881 | | | |
| Job Relevance | JREL1 | 0.944 | 0.892 | 0.955 | 0.930 | 0.877 |
| | JREL3 | 0.916 | 0.839 | | | |
| | JREL4 | 0.948 | 0.900 | | | |

| Latent variable | Indicators | Loadings | Indicator reliability | Composite reliability | Cronbach's alpha | Average variance extracted (AVE) |
|---|---|---|---|---|---|---|
| Coordination | CRD2 | 0.948 | 0.898 | 0.959 | 0.936 | 0.886 |
| | CRD3 | 0.948 | 0.899 | | | |
| | CRD4 | 0.928 | 0.861 | | | |
| Impact on Business | EFT4 | 0.727 | 0.529 | 0.937 | 0.920 | 0.680 |
| | EFT5 | 0.847 | 0.717 | | | |
| | EFT6 | 0.850 | 0.723 | | | |
| | FLX2 | 0.722 | 0.521 | | | |
| | PRD1 | 0.876 | 0.768 | | | |
| | PRD2 | 0.849 | 0.720 | | | |
| | PRD3 | 0.883 | 0.780 | | | |
| Impact on Internal Efficiency | EFC1 | 0.885 | 0.783 | 0.949 | 0.928 | 0.824 |
| | EFC3 | 0.883 | 0.781 | | | |
| | WEF2 | 0.917 | 0.841 | | | |
| | WEF3 | 0.943 | 0.890 | | | |
| Impact on Coordination | ICO1 | 0.944 | 0.891 | 0.970 | 0.953 | 0.914 |
| | ICO3 | 0.970 | 0.940 | | | |
| | ICO4 | 0.955 | 0.912 | | | |

To measure discriminant validity I investigated the indicators cross loadings, the Fornell-Larcker criterion, and the computed heterotrait-monotriat ratio of correlations (HTMT). Table 17 below showed that discriminant validity existed because the square root of the AVE, value on the diagonal, for each latent variable was larger than the correlations among the latent variables. In Table 18 below, each indicator loading on the associated latent variable was greater than all other latent variables, which indicated discriminant validity between the latent variables. In addition, the computed HTMT values in Table 19 below were less than or equal to 0.85 and the HTMT confidence interval values were less than 1.0, thus confirming discriminant validity.

Table 17

*Fornell-Larcker Criterion Analysis for Checking Discriminant Validity*

| | ERP Information Quality | ERP System Quality | ERP Service Quality | Knowledge and Learning | Shared Beliefs | User Self-Efficacy | Job Relevance | Coordination | Impact on Business | Impact on Internal Efficiency | Impact on Coordination |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ERP Information Quality | **0.890** | | | | | | | | | | |
| ERP System Quality | 0.254 | **0.873** | | | | | | | | | |
| ERP Service Quality | 0.570 | 0.479 | **0.860** | | | | | | | | |
| Knowledge and Learning | 0.742 | 0.239 | 0.416 | **0.940** | | | | | | | |
| Shared Beliefs | 0.466 | 0.447 | 0.526 | 0.408 | **0.950** | | | | | | |
| User Self-Efficacy | 0.355 | 0.419 | 0.460 | 0.410 | 0.182 | **0.856** | | | | | |
| Job Relevance | 0.704 | 0.309 | 0.513 | 0.778 | 0.481 | 0.443 | **0.936** | | | | |
| Coordination | 0.225 | 0.699 | 0.513 | 0.242 | 0.578 | 0.292 | 0.268 | **0.941** | | | |
| Impact on Business | 0.490 | 0.643 | 0.544 | 0.426 | 0.675 | 0.382 | 0.635 | 0.636 | **0.824** | | |
| Impact on internal Efficiency | 0.407 | 0.704 | 0.497 | 0.327 | 0.557 | 0.441 | 0.427 | 0.754 | 0.790 | **0.908** | |
| Impact on Coordination | 0.357 | 0.599 | 0.424 | 0.350 | 0.503 | 0.380 | 0.447 | 0.561 | 0.682 | 0.740 | **0.956** |

Table 18

*Indicator Cross Loadings*

| | ERP Information Quality | ERP System Quality | ERP Service Quality | Knowledge and Learning | Job Relevance | Shared Beliefs | User Self-Efficacy | Coordination | Impact on Business | Impact on Internal Efficiency | Impact on Coordination |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INFQ2 | **0.789** | 0.219 | 0.435 | 0.777 | 0.717 | 0.359 | 0.324 | 0.173 | 0.383 | 0.258 | 0.320 |
| INFQ3 | **0.930** | 0.272 | 0.573 | 0.612 | 0.586 | 0.436 | 0.359 | 0.246 | 0.483 | 0.450 | 0.334 |
| INFQ4 | **0.942** | 0.180 | 0.500 | 0.623 | 0.604 | 0.444 | 0.264 | 0.172 | 0.433 | 0.357 | 0.299 |
| SYSQ3 | 0.196 | **0.894** | 0.528 | 0.192 | 0.283 | 0.364 | 0.427 | 0.560 | 0.601 | 0.594 | 0.492 |
| SYSQ4 | 0.298 | **0.887** | 0.375 | 0.287 | 0.331 | 0.388 | 0.362 | 0.540 | 0.529 | 0.608 | 0.544 |
| SYSQ6 | 0.173 | **0.837** | 0.349 | 0.150 | 0.197 | 0.417 | 0.309 | 0.728 | 0.552 | 0.640 | 0.533 |
| SRVQ1 | 0.590 | 0.374 | **0.805** | 0.533 | 0.571 | 0.486 | 0.381 | 0.453 | 0.483 | 0.423 | 0.350 |
| SRVQ2 | 0.477 | 0.431 | **0.897** | 0.267 | 0.398 | 0.504 | 0.429 | 0.430 | 0.514 | 0.444 | 0.390 |
| SRVQ3 | 0.393 | 0.430 | **0.874** | 0.269 | 0.347 | 0.350 | 0.371 | 0.439 | 0.392 | 0.411 | 0.350 |
| LRN3 | 0.707 | 0.212 | 0.365 | **0.957** | 0.761 | 0.414 | 0.316 | 0.196 | 0.411 | 0.281 | 0.333 |
| LRN4 | 0.700 | 0.166 | 0.380 | **0.944** | 0.733 | 0.364 | 0.326 | 0.181 | 0.367 | 0.229 | 0.306 |
| LRN5 | 0.684 | 0.282 | 0.422 | **0.917** | 0.699 | 0.369 | 0.493 | 0.290 | 0.415 | 0.391 | 0.343 |
| JREL1 | 0.640 | 0.301 | 0.477 | 0.762 | **0.944** | 0.399 | 0.474 | 0.251 | 0.586 | 0.386 | 0.455 |
| JREL3 | 0.658 | 0.320 | 0.518 | 0.659 | **0.916** | 0.543 | 0.377 | 0.291 | 0.646 | 0.469 | 0.413 |
| JREL4 | 0.681 | 0.237 | 0.437 | 0.773 | **0.948** | 0.394 | 0.394 | 0.201 | 0.540 | 0.330 | 0.383 |
| BLF2 | 0.478 | 0.471 | 0.532 | 0.433 | 0.511 | **0.957** | 0.191 | 0.570 | 0.665 | 0.561 | 0.488 |
| BLF3 | 0.415 | 0.326 | 0.483 | 0.373 | 0.441 | **0.954** | 0.129 | 0.521 | 0.581 | 0.482 | 0.477 |
| BLF4 | 0.432 | 0.466 | 0.481 | 0.354 | 0.418 | **0.938** | 0.192 | 0.552 | 0.671 | 0.539 | 0.468 |
| SE1 | 0.249 | 0.348 | 0.311 | 0.358 | 0.316 | 0.120 | **0.761** | 0.229 | 0.198 | 0.283 | 0.182 |
| SE2 | 0.291 | 0.326 | 0.351 | 0.329 | 0.356 | 0.039 | **0.860** | 0.159 | 0.249 | 0.292 | 0.219 |
| SE3 | 0.352 | 0.400 | 0.476 | 0.376 | 0.441 | 0.243 | **0.939** | 0.322 | 0.446 | 0.487 | 0.468 |
| CRD2 | 0.195 | 0.689 | 0.536 | 0.198 | 0.234 | 0.555 | 0.309 | **0.948** | 0.614 | 0.726 | 0.542 |
| CRD3 | 0.239 | 0.633 | 0.463 | 0.303 | 0.308 | 0.556 | 0.317 | **0.948** | 0.598 | 0.724 | 0.540 |
| CRD4 | 0.200 | 0.653 | 0.446 | 0.180 | 0.214 | 0.519 | 0.195 | **0.928** | 0.584 | 0.678 | 0.500 |
| EFT4 | 0.307 | 0.629 | 0.314 | 0.267 | 0.339 | 0.488 | 0.236 | 0.565 | **0.727** | 0.624 | 0.668 |

| | ERP Information Quality | ERP System Quality | ERP Service Quality | Knowledge and Learning | Job Relevance | Shared Beliefs | User Self-Efficacy | Coordination | Impact on Business | Impact on Internal Efficiency | Impact on Coordination |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EFT5 | 0.464 | 0.549 | 0.499 | 0.358 | 0.531 | 0.558 | 0.477 | 0.461 | **0.847** | 0.646 | 0.587 |
| EFT6 | 0.474 | 0.587 | 0.491 | 0.449 | 0.523 | 0.623 | 0.365 | 0.593 | **0.850** | 0.726 | 0.589 |
| FLX2 | 0.230 | 0.765 | 0.342 | 0.172 | 0.285 | 0.551 | 0.275 | 0.646 | **0.722** | 0.760 | 0.656 |
| PRD1 | 0.470 | 0.399 | 0.510 | 0.410 | 0.681 | 0.555 | 0.304 | 0.475 | **0.876** | 0.604 | 0.497 |
| PRD2 | 0.432 | 0.365 | 0.479 | 0.414 | 0.669 | 0.553 | 0.279 | 0.454 | **0.849** | 0.577 | 0.449 |
| PRD3 | 0.441 | 0.385 | 0.489 | 0.379 | 0.640 | 0.551 | 0.247 | 0.456 | **0.883** | 0.596 | 0.466 |
| EFC1 | 0.278 | 0.657 | 0.431 | 0.241 | 0.320 | 0.558 | 0.374 | 0.690 | 0.734 | **0.885** | 0.657 |
| EFC3 | 0.326 | 0.613 | 0.379 | 0.253 | 0.348 | 0.389 | 0.378 | 0.583 | 0.625 | **0.883** | 0.624 |
| WEF2 | 0.442 | 0.637 | 0.535 | 0.375 | 0.453 | 0.548 | 0.445 | 0.752 | 0.743 | **0.917** | 0.683 |
| WEF3 | 0.425 | 0.647 | 0.453 | 0.313 | 0.423 | 0.517 | 0.403 | 0.704 | 0.758 | **0.943** | 0.716 |
| ICO1 | 0.382 | 0.611 | 0.444 | 0.373 | 0.463 | 0.487 | 0.397 | 0.557 | 0.671 | 0.758 | **0.944** |
| ICO3 | 0.335 | 0.574 | 0.404 | 0.312 | 0.414 | 0.478 | 0.376 | 0.530 | 0.670 | 0.687 | **0.970** |
| ICO4 | 0.303 | 0.531 | 0.365 | 0.318 | 0.403 | 0.477 | 0.315 | 0.520 | 0.612 | 0.673 | **0.955** |

Table 19

*Heterotrait-Monotrait Ratio (HTMT) [and 95% Confidence Intervals]*

| | ERP Information Quality | ERP System Quality | ERP Service Quality | Knowledge and Learning | Shared Beliefs | User Self-Efficacy | Job Relevance | Coordination | Impact on Business | Impact on Internal Efficiency |
|---|---|---|---|---|---|---|---|---|---|---|
| ERP System Quality | 0.296 [.083, .480] | | | | | | | | | |
| ERP Service Quality | 0.667 [.503, .785] | 0.575 [.358, .755] | | | | | | | | |
| Knowledge and Learning | 0.839 [.70, .918] | 0.265 [.036, .439] | 0.471 [.242, .633] | | | | | | | |
| Shared Beliefs | 0.512 [.297, .667] | 0.496 [.306, .664] | 0.589 [.375, .755] | 0.432 [.168, .616] | | | | | | |
| User Self-Efficacy | 0.409 [.176, .584] | 0.498 [.307, .672] | 0.534 [.337, .706] | 0.459 [.264, .604] | 0.175 [-.051, .372] | | | | | |
| Job Relevance | 0.797 [.58, .915] | 0.346 [.149, .498] | 0.580 [.409, .70] | 0.838 [.585, .942] | 0.506 [.271, .664] | 0.491 [.31, .628] | | | | |
| Coordination | 0.246 [.026, .432] | 0.786 [.665, .887] | 0.584 [.397, .752] | 0.253 [.034, .417] | 0.612 [.457, .743] | 0.311 [.11, .49] | 0.283 [.066, .445] | | | |
| Impact on Business | 0.546 [.293, .716] | 0.725 [.599, .823] | 0.62 [.397, .78] | 0.456 [.12, .665] | 0.72 [.558, .834] | 0.394 [.184, .573] | 0.684 [.504, .798] | 0.683 [.543, .803] | | |
| Impact on Internal Efficiency | 0.444 [.248, .601] | 0.795 [.687, .879] | 0.566 [.353, .733] | 0.342 [.123, .507] | 0.589 [.423, .728] | 0.47 [.273, .636] | 0.452 [.283, .581] | 0.806 [.711, .881] | 0.85 [.755, .928] | |
| Impact on Coordination | 0.393 [.172, .574] | 0.667 [.524, .789] | 0.477 [.282, .645] | 0.369 [.126, .547] | 0.53 [.358, .672] | 0.378 [.154, .561] | 0.472 [.264, .622] | 0.593 [.418, .743] | 0.725 [.616, .807] | 0.784 [.682, .867] |

**Multicollinearity Results**

The PLS-SEM path modeling estimation in SmartPLS 3.2 computed the variance inflation factor (VIF) values and the tolerance levels as presented in Table 20 below. The VIF values ranged from 1.586 to 3.316. All VIF values were less than 5.0, which indicated that there were no critical levels of collinearity in the model. The tolerance level values ranged from 0.302 to 0.63. All the tolerance levels were greater than 0.2, which implied low levels of multicollinearity.

Table 20

*Variance Inflation Factor (VIF) and Tolerance Level*

| Latent variable | VIF | Tolerance level |
|---|---|---|
| Coordination | 2.573 | 0.389 |
| ERP Information Quality | 2.991 | 0.334 |
| ERP Service Quality | 2.225 | 0.449 |
| ERP System Quality | 2.211 | 0.452 |
| Job Relevance | 3.141 | 0.318 |
| Knowledge and Learning | 3.316 | 0.302 |
| Shared Beliefs | 2.025 | 0.494 |
| User Self-Efficacy | 1.586 | 0.630 |

**Research Questions and Hypotheses Testing Results**

**Research Question 1.** From an ERP user's point of view, what were the sustainability factors that maximized the value of an ERP system for the user in the onward-and-upward phase? To address research question 1, I performed the PLS path-modeling analysis on the research model. The PLS path-modeling estimation results showed that none of the obtained path coefficients was lower than 0.1. If an inner path coefficient is greater than or equal to 0.1, then the path is significant (Wong, 2013). A significant path in the outer model indicated that this latent variable had an effect on ERP user value. The structural model results (see Figure 9) showed that the path coefficient of job relevance ($\beta_{59}$ = 0.363) had the strongest effect on ERP user value followed by coordination ($\beta_{89}$ = 0.338). Although ERP system quality ($\beta_{29}$ = 0.296), ERP knowledge and learning ($\beta_{69}$ = -0.222), shared beliefs ($\beta_{49}$ = 0.205), and ERP information quality ($\beta_{19}$ = 0.161) had a moderate effect, ERP service quality ($\beta_{39}$ = -0.107) and user self-efficacy ($\beta_{79}$ = 0.10) had weak effect on ERP user value.

Inspecting the coefficient of determination ($R^2$), which is a measure of the model's predictive accuracy, the computed $R^2$ for ERP user value was 0.766 (76.6%). The computed $R^2$ for ERP user value (0.766) indicated that the exogenous latent variables had a substantial combined effect on the endogenous latent variable ERP user value. The exogenous latent variables explained 76.6% of the variance in the endogenous latent variable ERP user value. The computed cross-validated redundancy measure, Stone-Geisser's $Q^2$, computed by the blindfolding procedure in SmartPLS 3.2 with an omission distance of 10, was 0.48. Since the computed $Q^2$ for ERP user value 0.48 is greater than 0.0, the exogenous constructs had moderately predictive relevance to the endogenous construct ERP user value. Accordingly, the identified factors of ERP information quality, ERP system quality, ERP service quality,  ERP knowledge and learning, shared beliefs, job relevance, user self-efficacy, and coordination were the sustainability factors that maximized ERP user value from the ERP user's point of view.

**Research Question 2.** Which postimplementation sustainability factors in the onward-and-upward phase maximized the value of an ERP system from the user's point of view, and how significant were those factors? Performing the bootstrapping procedure in SmartPLS 3.2 generated the *t*-values for the inner and outer models. The settings for the complete bootstrapping procedure included 5000 subsamples, no sign changes, and a two-tailed test with $\alpha = 0.05$ significance level. Table 21 below provides the obtained path coefficients, standard error, confidence interval lower and upper limits, *t*-values, and *p* values for the inner model. Figure 10 below provides the obtained *t*-values that measured the significance of the path coefficients of the inner and outer models.

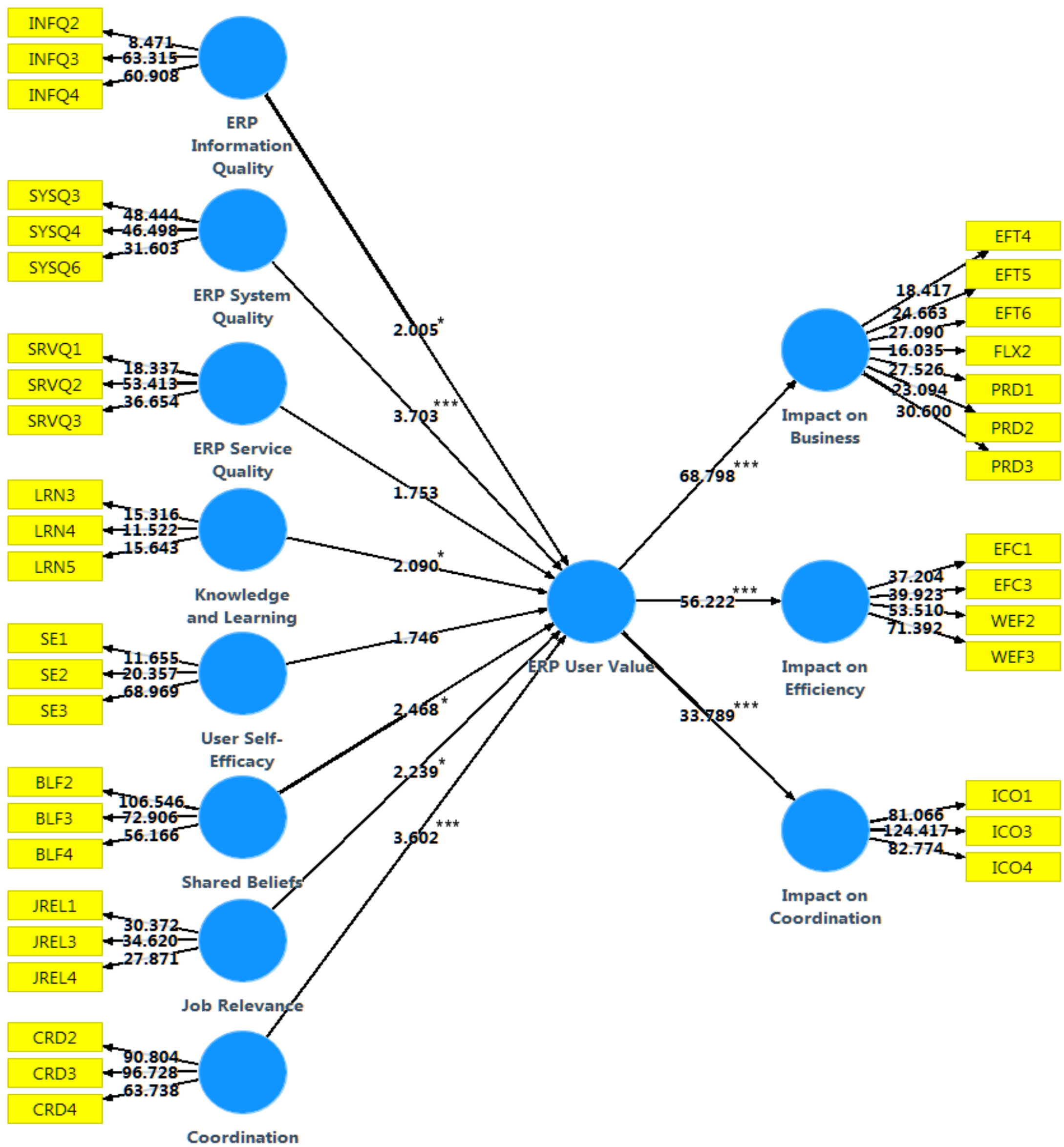


*Figure 10.* Obtained *t*-values for path coefficients.

Table 21

*T-Statistics of Path Coefficients for the Inner Model*

| | PC(β) | *SE* | 95% CI | | *t* | *p* |
|---|---|---|---|---|---|---|
| | | | LL | UL | | (two-tailed) |
| ERP Information Quality -> ERP User Value | 0.161 | 0.080 | 0.008 | 0.323 | 2.005 | .045* |
| ERP System Quality -> ERP User Value | 0.296 | 0.080 | 0.146 | 0.456 | 3.703 | .000*** |
| ERP Service Quality -> ERP User Value | -0.107 | 0.061 | -0.222 | 0.016 | 1.753 | .08 |
| Knowledge and Learning -> ERP User Value | -0.222 | 0.106 | -0.401 | 0.012 | 2.090 | .037* |
| Shared Beliefs -> ERP User Value | 0.205 | 0.083 | 0.042 | 0.362 | 2.468 | .014* |
| User Self-Efficacy -> ERP User Value | 0.100 | 0.057 | -0.013 | 0.216 | 1.746 | .081 |
| Coordination -> ERP User Value | 0.338 | 0.094 | 0.158 | 0.531 | 3.602 | .000*** |
| Job Relevance -> ERP User Value | 0.363 | 0.162 | 0.027 | 0.617 | 2.239 | .025* |
| ERP User Value -> Impact on Business | 0.939 | 0.014 | 0.907 | 0.961 | 68.798 | .000*** |
| ERP User Value -> Impact on Coordination | 0.851 | 0.025 | 0.795 | 0.894 | 33.789 | .000*** |
| ERP User Value -> Impact on Efficiency | 0.924 | 0.016 | 0.889 | 0.954 | 56.222 | .000*** |

*Note.* PC = path coefficient; *SE* = standard error; CI = confidence interval; LL = lower limit, UL = upper limit.

$*p < .05$. $**p < .01$. $***p < .001$.

**Hypothesis 1 (H1).** The null hypothesis was *$H_0 1$:* The ERP information quality does not impact ERP user value ($\beta_{19} = 0$). The alternate hypothesis was *$H_a 1$:* The ERP information quality impacts ERP user value ($\beta_{19} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{19} = 0.161$, $t = 2.005$, and $p = .045$. Since $p < 0.05$, the null hypothesis was rejected and the alternate hypothesis was retained. Accordingly, ERP information quality positively impacted ERP user value.

**Hypothesis 2 (H2).** The null hypothesis was *$H_0 2$:* The ERP system quality does not impact ERP user value ($\beta_{29} = 0$). The alternate hypothesis was *$H_a 2$:* The ERP system quality impacts ERP user value ($\beta_{29} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{29} = 0.296$, $t = 3.703$, and $p = .000$. Since $p < 0.001$, the null hypothesis was rejected and the alternate hypothesis was retained. Accordingly, ERP system quality positively impacted ERP user value.

**Hypothesis 3 (H3).** The null hypothesis was *$H_0 3$:* The ERP service quality does not impact ERP user value ($\beta_{39} = 0$). The alternate hypothesis was *$H_a 3$:* The ERP service quality impacts ERP user value ($\beta_{39} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{39} = -0.107$, $t = 1.753$, and $p = .08$. Since $p > 0.05$, the null hypothesis was retained. ERP service quality did not impact ERP user value.

**Hypothesis 4 (H4).** The null hypothesis was *$H_0 4$:* ERP workers and peers' shared belief in the benefits of the ERP system does not impact ERP user value ($\beta_{49} = 0$). The alternate hypothesis was *$H_a 4$:* ERP workers and peers' shared belief in the benefits of the ERP system impacts ERP user value ($\beta_{49} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{49} = 0.205$, $t = 2.468$, and $p = .014$. Since $p < 0.05$, the null hypothesis was rejected and the alternate hypothesis was retained. Accordingly, ERP workers and peers' shared belief in the benefits of the ERP system impacted ERP user value.

**Hypothesis 5 (H5).** The null hypothesis was *$H_0$5:* The extent to which employees felt the ERP system is relevant for their jobs does not impact ERP user value ($\beta_{59} = 0$). The alternate hypothesis was *$H_a$5:* The extent to which employees felt the ERP system is relevant for their jobs impacts ERP user value ($\beta_{59} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{59} = 0.363$, $t = 2.239$, and $p = .025$. Since $p < 0.05$, the null hypothesis was rejected and the alternate hypothesis was retained. Accordingly, the extent to which employees felt the ERP system is relevant for their jobs impacted ERP user value.

**Hypothesis 6 (H6).** The null hypothesis was *$H_0$6:* ERP user's knowledge and learning of the ERP system do not impact ERP user value ($\beta_{69} = 0$). The alternate hypothesis was *$H_a$6:* ERP user's knowledge and learning of the ERP system impact ERP user value ($\beta_{69} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{69} = -0.222$, $t = 2.09$, and $p = .037$. Since $p < 0.05$, the null hypothesis was rejected and the alternate hypothesis was retained. Accordingly, ERP user's knowledge and learning of the ERP system impacted ERP user value.

**Hypothesis 7 (H7).** The null hypothesis was *$H_0$7:* ERP user's self-efficacy does not impact ERP user value ($\beta_{79} = 0$). The alternate hypothesis was *$H_a$7:* ERP user's self-efficacy impacts ERP user value ($\beta_{79} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{79} = -0.10$, $t = 1.746$, and $p = .081$. Since $p > 0.05$, the null hypothesis was retained. ERP user's self-efficacy does not impact ERP user value.

**Hypothesis 8 (H8).** The null hypothesis was *$H_0 8$:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers does not impact ERP user value ($\beta_{89} = 0$). The alternate hypothesis was *$H_a 8$:* The extent of the ERP system's ability to enable coordination and synchronization among the different units, departments, partners, and suppliers impacts ERP user value ($\beta_{89} \neq 0$). The bootstrapping procedure results were as follows: path coefficient $\beta_{89} = 0.338$, $t = 3.602$, and $p = .000$. Since $p < 0.001$, the null hypothesis was rejected and the alternate hypothesis was retained. Accordingly, the extent of the ERP system ability to enable coordination and synchronization among the different units, departments, partners, and suppliers impacted ERP user value ERP.

Hypotheses testing indicated that ERP information quality, ERP system quality, ERP knowledge and learning, shared beliefs, job relevance, and coordination significantly impacted ERP user value. Further, ERP service quality and user self-efficacy did not significantly impact ERP user value. From the PLS-SEM path results, ERP user value explained 88.1% ($R^2$ 0.881) of the variance regarding the impact on business, 85.5% ($R^2$ 0.855) of the variance regarding the impact on internal efficiency, and 72.4% ($R^2$ 0.742) of the variance regarding the impact on coordination, which were the measures of business value. The impact of ERP user value was significant, $\beta = 0.939$, $t = 68.798$, $p < 0.001$, on the users' operational effectiveness, operational flexibility, and productivity. In addition, the impact of ERP user value was significant, $\beta = 0.924$, $t =$

56.222, and $p < 0.001$, on the operational efficiency and work efficiency, as well as coordination and cooperation, $\beta = 0.851$, $t = 33.789$, and $p < 0.001$. As a result, ERP information quality, ERP system quality, ERP knowledge and learning, shared beliefs, job relevance, and coordination significantly impacted ERP user value in the onward and outward phase.

## Summary

The purpose of this quantitative study was to identify the factors that provided ERP user value in the onward-and-upward phase from the ERP user's point of view. In addition, this research investigated the relationships between the sustainability factors that positively affected productivity, effectiveness, internal efficiency, and coordination, thus leading to the maximization of the value of the ERP system from the ERP user's point of view. The PLS-SEM results identified the sustainability factors of ERP information quality, ERP system quality, ERP knowledge and learning, shared beliefs, job relevance, and coordination maximized ERP user value in the onward-and-upward phase. Hypotheses testing indicated that independent variables ERP information quality, ERP system quality, ERP knowledge and learning, shared beliefs, job relevance, and coordination significantly impacted the dependent ERP user value. Further, ERP service quality and user self-efficacy did not significantly impact ERP user value.

Chapter 5, which is the concluding chapter of this research, contains a summary of this study findings as well as an interpretation of the findings. The chapter provides a discussion about the limitations of the study and recommendations for future research.

The chapter concludes with an analysis of the social change ramifications of this study as well as recommendations for the information management practice.

# Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this quantitative study was to identify the different postimplementation sustainability factors, factors that provided sustained competitive advantage, in the onward-and-upward phase from the ERP user's point of view. In addition, I investigated the relationships between the sustainability factors that positively affected productivity, effectiveness, internal efficiency, and coordination, thus leading to the maximization of the value of the ERP system from the ERP user's point of view. The problem that was the focus of this study was that many organizations have not realized the benefits to justify the costs in implementing an ERP system as well as the resources necessary to sustain the system in a rapidly changing business environment.

Although there is research about the use of ERP from a management perspective, the research is not clear as to whether the ERP benefits justify the costs, not only in dollars, but also in effort, from the end user's perspective. There is a need for research that identifies the user's perspective regarding the benefits of an ERP system and how the users of the ERP system view the benefits of an ERP system. As ERP users in the state of Colorado had mixed feelings about the value of implemented ERP systems, it was important to conduct a quantitative study in the state of Colorado to determine the sustainability factors that maximized the value of the implemented ERP system in the onward-and-upward phase postimplementation from the user's point of view.

The structural model in this study incorporated the TOE framework to predict the postimplementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. The PLS-SEM approach provided the needed explanatory analysis to test the structural model. In addition, the PLS-SEM methodology allowed for testing the hypotheses statistically. The PLS-SEM results identified the sustainability factors of ERP information quality, ERP system quality, ERP service quality, ERP knowledge and learning, shared beliefs, job relevance, user self-efficacy, and coordination as the set of factors that maximized ERP user value in the onward-and-upward phase. Hypotheses testing indicated that independent variables ERP information quality, ERP system quality, ERP knowledge and learning, shared beliefs, job relevance, and coordination significantly impacted the dependent variable ERP user value. Further, ERP service quality and user self-efficacy did not significantly impact ERP user value.

## Interpretation of Findings

The outcomes of this study filled a gap in ERP research because it investigated the relationship between ERP technology capabilities, organizational support systems and processes already in place, and organizational shared beliefs, and how these factors impact ERP user value. The results of this study provide much-needed insights into the relationship among the organizational management support systems already in place—mainly, organizational shared beliefs, employee ERP knowledge and learning, and job relevance—and how these support systems influence ERP user value. In this research, I went beyond merely identifying how ERP systems can benefit an organization by carrying out a postimplementation study to ascertain the real efficiencies from the ERP user's point of view that can sustain the ERP competitive advantage.

The study findings revealed that the technological factors of ERP information quality and ERP system quality had a moderate effect and a significant impact on ERP user value (H1 and H2). These findings are consistent with results from previous studies (Althonayan &Papazafeiropoulou, 2013; J. S. Chou & Hong, 2013; Dezdar & Ainin, 2010; Ifinedo, 2011d; Ifinedo et al., 2010; Lin, 2010; Madapusi & D'Souza, 2012; Tsai et al., 2011, 2012). Although other studies found that ERP service quality had a positive impact on ERP usage, ERP perceived usefulness, and ERP success (Althonayan & Papazafeiropoulou, 2013; J. S. Chou & Hong, 2013; Ifinedo et al., 2010), this study found that the ERP service quality had a weak effect and did not significantly impact ERP user value (H3). This result supported previous findings obtained by Chang, Yen, Ho, and Chiang (2011) indicating that ERP service quality had mixed effects on ERP user satisfaction and ERP success. A possible explanation for the insignificance of ERP service quality in ERP user value in this study might be the lack of direct contacts between the ERP end users and the ERP system provider.

The obtained results showed that while the organizational factors of ERP knowledge, ERP learning, and shared beliefs had a moderate effect on ERP user value, job relevance had the strongest effect. All of the previous three organizational factors significantly impacted ERP user value (H4, H5, and H6). The significant influence of ERP knowledge and learning on ERP user value supported previous findings that training, education, and organizational learning capacity facilitated ERP usage and user performance (H. H. Chang et al., 2011; H. W. Chou, Chang, et al., 2014; Jeng & Dunk, 2013; Lee et al., 2010; Nwankpa & Roumani, 2014; Ram et al., 2013; Ruivo, Johansson, et al., 2012; Ruivo, Oliveira, et al., 2014). Furthermore, the significance of shared beliefs on ERP user values confirmed Amoako-Gyampah and Salam's (2004) study, which showed that ERP users' shared beliefs in the benefits of the ERP system had a positive effect on the ERP system's ease of use and perceived usefulness.

The job relevance significance on ERP user value in this study contradicted the findings of Chung, Skibniewski, Lucas, et al. (2008) that job relevance was insignificant on perceived ERP usefulness. The strong effect of job relevance on ERP user value demonstrated that ERP users found the ERP system relevant, important, and pertinent to various job-related tasks, and that it met their task requirements when it was routinely used postimplementation. During the implementation of the ERP system, users have mixed feelings regarding the new ERP system and its relevance to their job and tasks, which explains the insignificance of the job relevance factor in the Chung, Skibniewski, Lucas, et al. (2008) study.

The study finding that user self-efficacy was insignificant and had a weak effect on ERP user value postimplementation (H7) supported many previous studies. Shih and Huang (2009) found that self-efficacy affected perceived ease of ERP system use but did not affect ERP perceived usefulness. Hung et al. (2011) indicated that computer self-efficacy was insignificant and did not have a positive effect on ERP outcome expectations and ERP user satisfaction. The results of Sternad et al. (2011) showed that computer self-efficacy was an unimportant factor of the personal characteristics of information literacy, which they found insignificant, and did not influence ERP ease of use. Fillion et al. (2012) found that the mediating effect of ERP system self-efficacy was insignificant and did not influence the intention to use the ERP system. In contrast to the findings of this study, H. W. Chou, Chang, et al. (2014) showed that ERP postimplementation training self-efficacy had a significant influence on learning willingness and capability, which in turn affected ERP postimplementation learning. In addition, Kwahk and Ahn (2010) showed that computer self-efficacy impacted ERP perceived usefulness and influenced the intention to use the ERP system. Many factors contribute to the mixed results regarding user self-efficacy, including the complexity of the ERP system, the different ERP packages used, and the routine use of the ERP system.

The obtained results showed that the coordination environmental factor, which measured the ability of the ERP system to enable coordination and synchronization among the different units, departments, partners, and suppliers of the firm, had a strong effect and significantly impacted ERP user value (H8). This result supported Rich and Dibbern's (2013) study, which showed that cross-functional collaboration influenced ERP benefits postimplementation. In addition, this finding confirmed Ha and Ahn's (2013) results that interdepartmental collaboration and communication positively influenced ERP performance postimplementation. Furthermore, the obtained results validated the Ruivo, Oliveira, et al. (2014) study, which indicated that collaboration affected ERP value.

The study results indicated that the set of sustainability factors explained 76.6% of the variance in ERP user value, which demonstrated the predictive power of the research structural model. In addition, the study results showed that ERP user value explained 88.1% of the variance regarding the impact on business, 85.5% of the variance regarding the impact on internal efficiency, and 72.4% of the variance regarding the impact on coordination, which were the measures of business value. The obtained results confirmed the assertions of Ruivo, Johansson, et al. (2012) that the ERP system should deliver value to the user through the user's experience with the ERP system and the benefits derived from using it. The study findings supported Hsu's (2013a, 2013b) argument that the ERP value to the user should depend not only on the ERP system's functionality, but also on the tangible and intangible benefits of the user's experience using the system.

## Limitations of the Study

Due to the use of self-reported rating to measure all the constructs, method variance might exist and might have contributed to part of the correlation between the constructs. In addition, performing the study in the Denver, CO metropolitan area represented a potential limitation, thus limiting generalizations beyond the identified geographic region. As the sampling procedure used in this study was convenience sampling instead of random sampling, the sampling procedure prevented the generalization of the study findings to all ERP users. Even though the obtained 163 cases met many sample size recommendations by other researchers and exceeded the G*Power statistical software computed minimum sample size of 129, as discussed in Chapter 4, the study sample size represented a potential limitation that might limit the ability to replicate the study by other researchers.

The study participants' length of experience using the ERP technology could have affected individual responses. In addition, factors such as ethnicity, nationality, religion, the composition of ERP users and teams, and the business type or business relationships that serve the organization and its supply chain were not part of the analysis. Although the findings of this study might contribute to a better understanding of the sustainability factors of implemented ERP systems, due to the heterogeneous nature of the ERP systems, the study did not control for the different types of ERP packages used by the participants, which might be problematic.

## Recommendations

The goal of this quantitative study was to identify the different postimplementation sustainability factors, factors that provided sustained competitive advantage, in the onward-and-upward phase from the ERP user's point of view as well as ascertain which postimplementation sustainability factors in the onward-and-upward phase significantly maximized ERP user value. There was a need for this research because it addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value affects firm-achieved ERP benefits. The structural model in this study incorporated the TOE framework to predict the postimplementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. The PLS-SEM approach provided the needed explanatory analysis to test the predictive power of the structural model.

Further research could shed more light on the role of the technological factors, organizational factors, and environmental factors on ERP user value and identify which TOE factors contribute the most to the variance in ERP user value. Future research could identify the set of postimplementation sustainability factors by business type or sector. To enable the generalization of the study findings, researchers need to replicate this study in different geographic areas and regions. Since this study was quantitative in nature, future research could use other research methodologies to enhance the understating of ERP user value. A qualitative study might provide needed insights into how users view ERP user value. Case study research could enable comparing and contrasting the postimplementation sustainability factors between multiple organizations.

Even though the Denver, CO metropolitan area includes many businesses and organizations that use ERP systems, it is unclear why the participation response rate for the study was low. Given that the target population was made of individuals with very involved jobs, it would be reasonable to speculate that they were either too busy or survey fatigued. Despite the online survey statements were of a conceptual nature and only focused on participants' experiences using ERP systems and their working environment, potential participants might have declined to participate because they did not know the researcher and might have not totally understood the objectives and importance of the study. Future empirical studies should try to offer some kind of incentive to participate, which might increase the participation response rate.

## Implications

The problem that was the focus of this study was that many organizations have not realized the benefits to justify the costs in implementing an ERP system and the resources necessary to sustain the system in a rapidly changing business environment. Although there is research about the use of ERP from a management perspective, the research is not clear as to whether the ERP benefits justify the costs, not only in dollars, but also in effort, from the end user's perspective. The goal of this study was to identify the different postimplementation sustainability factors, factors that provided sustained competitive advantage, in the onward-and-upward phase from the ERP user's point of view as well as ascertain which postimplementation sustainability factors in the onward-and-upward phase significantly maximized ERP user value.

There was a need for this research because it addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value affects firm-achieved ERP benefits. The purpose of this research was to investigate the relationships between the sustainability factors that positively affect productivity, effectiveness, internal efficiency, and coordination, thus leading to the maximization of the value of the ERP system from the ERP user's point of view, and how they correlated to ERP value postimplementation. The outcomes of this study filled a gap in ERP research because it investigated the relationship between ERP technology capabilities, user's job relevance, user's ERP knowledge and learning, organizational support systems and processes already in place, and organizational shared beliefs, and how these factors impact ERP user value. This study is important in that it went beyond merely identifying how ERP systems can benefit an organization, but also by carrying out a postimplementation study to ascertain the real efficiencies from the ERP user's point of view that can sustain the ERP competitive advantage. This research also partially filled a void in scholastic literature where research on ERP value postimplementation is at best fragmentary.

This study is significant because the obtained results may help organizations adopting ERP systems to maximize the value of their functional ERP system. In recent years, there has been an increased interest in postimplementation ERP research but the research "still lack insight into human factors that are prevalent in the system" (Singh, Singh, & Pereira, 2010). McCubbrey and Fukami's (2009) study pointed out that there is a relationship between how users react to the ERP system and ERP success. Their study of a public sector organization in the state of Colorado indicated that there were mixed points of views regarding the value of the installed ERP system between management and end users. This study attempted to answer the questions raised by McCubbrey and Fukami (2009) and measured the users' perspectives in the state of Colorado regarding the benefits of an ERP system as well as how the users of the ERP system viewed the ERP benefits.

The results of this study provide much-needed insights into the relationship among the organizational management support systems already in place—mainly, organizational shared beliefs, employee ERP knowledge and learning, and job relevance—and how these support systems influence ERP user value. Insights from this study should aid IT professionals and those in organizational management in recognizing the set of ERP sustainability factors from users' perspectives and their impact on organizational performance. In addition, this research addressed the lack of a social change context in current ERP research identified by Grabski et al. (2011). Investigating ERP users' acceptance and perspectives regarding the value of the installed ERP system as well as measuring the impact of shared beliefs and users' self-efficacy on ERP user value in this study could lead to a positive social change in ERP adopting organizations.

The positive social change implications of this study include a better understanding of ERP postimplementation sustainability factors from the users' perspectives and their impact on organizational performance, which could lead to increased employee effectiveness, productivity, efficiency, and individual satisfaction due to ERP usage. Insights from this study could aid IT professionals and organizational management in understanding the set of ERP sustainability factors from user's perspectives and their impact on organizational performance. By recognizing ERP users' acceptance and perspectives, this study addressed the lack of a social change context in current ERP research. Investigating ERP users' points of views and perspectives regarding the impact of ERP user value in this study provided information that could lead to a positive social change context in current ERP research.

## Conclusions

This study resulted in an important contribution to ERP postimplementation research. This research addressed an underresearched area—the ERP postimplementation onward-and-upward phase—and how user acceptance of ERP value affects firm-achieved ERP benefits. This study is important in that it went beyond merely identifying how ERP systems can benefit an organization, but also by carrying out a postimplementation study to ascertain the real efficiencies from the ERP user's point of view that can sustain the ERP competitive advantage. The results of this study provide much-needed insights into the relationship among the organizational management support systems already in place—mainly, organizational shared beliefs, employee ERP knowledge and learning, and job relevance—and how these support systems influence ERP user value. Insights from this study should aid IT professionals and those in organizational management in recognizing the set of ERP sustainability factors from users' perspectives and their impact on organizational performance. This study is significant because the obtained results may help organizations implement strategies and processes that could increase the ERP user value of their functional ERP system, thus enabling them to realize the business benefits to justify the costs of implementing an ERP system as well as the resources necessary to sustain the system in a rapidly changing business environment. This research also partially filled a void in scholastic literature where research on ERP value postimplementation is at best fragmentary.

The positive social change implications of this study include a better understanding of ERP postimplementation sustainability factors from the users' perspectives and their impact on organizational performance, which could lead to increased employee effectiveness, productivity, efficiency, and individual satisfaction due to ERP usage. By recognizing ERP users' acceptance and perspectives, this study addressed the lack of a social change context in current ERP research. Investigating ERP users' points of views and perspectives regarding the impact of ERP user value in this study provided information that could lead to a positive social change context in current ERP research.

References

Abugabah, A., & Sanzogni, L. (2010). Re-conceptualizing information systems models: An experience from ERP systems environment. *International Journal for Infonomics*, *3*, 414-421.

Addo-Tenkorang, R., & Helo, P. (2011). Enterprise resource planning (ERP): A review literature report. In *Proceedings of the World Congress on Engineering and Computer Science* (Vol. 2, pp. 1074-1080).

Ahmad, M. M., & Pinedo Cuenca, R. (2013). Critical success factors for ERP implementation in SMEs. *Robotics and Computer-Integrated Manufacturing*, *29*(3), 104-111. doi:10.1016/j.rcim.2012.04.019

Akter, S., D'Ambra, J., & Ray, P. (2011). An evaluation of PLS based complex models: The roles of power analysis, predictive relevance and GoF index. In *Proceedings of the Seventeenth Americas Conference on Information Systems (AMCIS2011)* (pp. 1-7).

Aloini, D., Dulmin, R., & Mininno, V. (2012). Risk assessment in ERP projects. *Information Systems*, *37*(3), 183-199. doi:10.1016/j.is.2011.10.001

Althonayan, M., & Papazafeiropoulou, A. (2013, January). Evaluating the performance on ERP systems in King Saud University (KSU): A stakeholders' perspective. In *System Sciences (HICSS), 2013 46th Hawaii International Conference* (pp. 4074-4083). doi:10.1109/HICSS.2013.210

Amid, A., Moalagh, M., & Zare Ravasan, A. (2012). Identification and classification of ERP critical failure factors in Iranian industries. *Information Systems*, *37*(3), 227-237. doi:10.1016/j.is.2011.10.010

Amoako-Gyampah, K. (2004). ERP implementation factors: A comparison of managerial and end-user perspectives. *Business Process Management Journal, 10*(2), 171-183.

Amoako-Gyampah, K., & Salam, A. F. (2004). An extension of the technology acceptance model in an ERP implementation environment. *Information & Management*, *41*(6), 731-745. doi:10.1016/j.im.2003.08.010

Azadeh, A., Afshari–Mofrad, M., & Khalojini, M. (2012). The role of organisational infrastructure in successful ERP implementation: An empirical study by hierarchical regression and PCA. *International Journal of Business Information Systems*, *10*(1), 40-67. doi:10.1504/IJBIS.2012.046680

Azevedo, P. S., Romão, M., & Rebelo, E. (2012). Advantages, limitations and solutions in the use of ERP systems (enterprise resource planning) – A case study in the hospitality industry. *Procedia Technology*, *5*, 264-272. doi:10.1016/j.protcy.2012.09.029

Bagozzi, R., & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science, 40*(1), 8-34. doi:10.1007/s11747-011-0278-x

Bagozzi, R. P., Yi, Y., & Phillips, L. W. (1991). Assessing construct validity in organizational research. *Administrative Science Quarterly, 36*(3), 421-458.

Baker, J. (2012). The technology–organization–environment framework. In *Information systems theory* (pp. 231-245). New York, NY: Springer. doi:10.1007/978-1-4419-6108-2_12

Barclay, D., Higgins, C., & Thompson, R. (1995). The partial least squares (PLS) approach to causal modeling: Personal computer adoption and use as an illustration. *Technology Studies*, *2*(2), 285-309.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120. doi:10.1177/014920639101700108

Barney, J. B. (2001). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management*, *27*(6), 643-650. doi:10.1177/014920630102700602

Basu, V., & Lederer, A. L. (2011). Agency theory and consultant management in enterprise resource planning systems implementation. *ACM SIGMIS Database*, *42*(3), 10-33. doi:10.1145/2038056.2038058

Beheshti, H. M., & Beheshti, C. M. (2010). Improving productivity and firm performance with enterprise resource planning. *Enterprise Information Systems*, *4*(4), 445-472. doi:10.1080/17517575.2010.511276

Bendoly, E., & Cotteleer, M. J. (2008). Understanding behavioral sources of process variation following enterprise system deployment. *Journal of Operations Management*, *26*(1), 23-44. doi:10.1016/j.jom.2007.03.002

Bentler, P. M., & Chou, C. P. (1987). Practical issues in structural modeling. *Sociological Methods & Research*, *16*(1), 78-117. doi:10.1177/0049124187016001004

Bernroider, E. W. (2008). IT governance for enterprise resource planning supported by the DeLone–McLean model of information systems success. *Information & Management*, *45*(5), 257-269. doi:10.1016/j.im.2007.11.004

Bernroider, E. W., & Schmöllerl, P. (2013). A technological, organisational, and environmental analysis of decision making methodologies and satisfaction in the context of IT induced business transformations. *European Journal of Operational Research*, *224*(1), 141-153. doi:10.1016/j.ejor.2012.07.025

Bernroider, E. W., Wong, C. W., & Lai, K. H. (2014). From dynamic capabilities to ERP enabled business improvements: The mediating effect of the implementation project. *International Journal of Project Management*, *32*(2), 350-362. doi:10.1016/j.ijproman.2013.05.006

Bologa, R., & Lupu, A. R. (2014). Organizational learning networks that can increase the productivity of IT consulting companies. A case study for ERP consultants. *Expert Systems with Applications*, *41*(1), 126-136. doi:10.1016/j.eswa.2013.07.016

Boztepe, S. (2007). User value: Competing theories and models. *International Journal of Design*, *1*(2), 55-63.

Bradford, M. & Florin, J. (2003). Examining the role of innovation diffusion factors on the implementation success of enterprise resource planning systems. *International Journal of Accounting Information Systems,* 4(3), 205-225. doi:10.1016/S1467-0895(03)00026-5

Byrne, B. (2005). Factor analytic models: Viewing the structure of an assessment instrument from three perspectives. *Journal of Personality Assessment, 85*(1), 17-32. doi:10.1207/s15327752jpa8501_02

Calisir, F., Gumussoy, C. A., & Bayram, A. (2009). Predicting the behavioral intention to use enterprise resource planning systems: An exploratory extension of the technology acceptance model. *Management Research News*, *32*(7), 597-613. doi:10.1108/01409170910965215

Cao, J., Nicolaou, A. I., & Bhattacharya, S. (2013). A longitudinal examination of enterprise resource planning system post-implementation enhancements. *Journal of Information Systems*, *27*(1), 13-39. doi:10.2308/isys-50398

Chang, M. K., Cheung, W., Cheng, C.H., & Yeung, J. H. Y. (2008). Understanding ERP system adoption from the user's perspective. *International Journal of Production Economics, 113*(2), 928-942. doi:10.1016/j.ijpe.2007.08.011

Chang, H.-H., Chou, H. W., Lin, C.-P.Y. and Cecilia, I. (2011). *ERP post-implementation learning, ERP usage and individual performance impact*. Paper presented at Pacific Asia Conference on Information Systems, Brisbane, Australia.

Chang, S. I., Yen, D. C., Ng, C., Chang, I.C., Yu, S.Y. (2011). An ERP system performance assessment model development based on the balanced scorecard approach. *Information Systems Frontiers, 13*(3), 429-450. doi:10.1007/s10796-009-9225-5

Chen, H. H., Chen, S. C., & Tsai, L. H. (2009). A Study of successful ERP- From the organization fit perspective. *Journal of Systemics, Cybernetics & Informatics*, *7*(4), 8-16.

Chen, G., & Wang, J. (2010, August). Analysis on performance evaluation system of ERP implementation. In *Information Science and Management Engineering (ISME), 2010 International Conference of* (Vol. 1, pp. 185-188). IEEE. doi:10.1109/ISME.2010.135

Chin, W. W. (2010). How to write up and report PLS analyses. In *Handbook of partial least squares* (pp. 655-690). Berlin, Germany: Springer.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information Systems Research*, *14*(2), 189-217.

Chong, A. Y. L., Ooi, K. B., Lin, B., & Raman, M. (2009). Factors affecting the adoption level of c-commerce: An empirical study. *Journal of Computer Information Systems*, *50*(2), 13-22.

Chou, S., & Chang, Y. (2008). The implementation factors that influence the ERP (enterprise resource planning) benefits. *Decision Support Systems, 46*(1), 149-157. doi:10.1016/j.dss.2008.06.003

Chou, H. W., Chang, H. H., Lin, Y. H., & Chou, S. B. (2014). Drivers and effects of post-implementation learning on ERP usage. *Computers in Human Behavior*, *35*, 267-277. doi:10.1016/j.chb.2014.03.012

Chou, S. W., & Chen, P. Y. (2009). The influence of individual differences on continuance intentions of enterprise resource planning (ERP). *International Journal of Human-Computer Studies*, *67*(6), 484-496.

doi:10.1016/j.ijhcs.2009.01.001

Chou, J. S., & Hong, J. H. (2013). Assessing the impact of quality determinants and user characteristics on successful enterprise resource planning project implementation. *Journal of Manufacturing Systems*, *32*(4), 792-800. doi:10.1016/j.jmsy.2013.04.014

Chou, H. W., Lin, Y. H., Lu, H. S., Chang, H. H., & Chou, S. B. (2014). Knowledge sharing and ERP system usage in post-implementation stage. *Computers in Human Behavior*, *33*, 16-22. doi:10.1016/j.chb.2013.12.023

Chung, B., Skibniewski, M. J., & Kwak, Y. (2009). Developing ERP systems success model for the construction industry. *Journal of Construction Engineering & Management, 135*(3), 207-216. doi:10.1061/(ASCE)0733-9364(2009)135:3(207)

Chung, B., Skibniewski, M. J., Lucas, H. C., & Kwak, Y. (2008). Analyzing enterprise resource planning system implementation success factors in the engineering–construction industry. *Journal of Computing in Civil Engineering, 22*(6), 373-382. doi:10.1061/(ASCE)0887-3801(2008)22:6(373)

Clark, T. D., Jones, M. C., & Zmud, R. W. (2009). Post adoptive ERP use behaviors: A dynamic conceptualization. *Proceedings of the 27th International Conference of the System Dynamics Society,* Albuquerque, NM. Retrieved from http://www.systemdynamics.org/conferences/2009/proceed/papers/P1015.pdf

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155-159. doi:10.1037/0033-2909.112.1.155

Cua, F. C. (2012). Applying "business case" construct using the "diffusion of innovations" theory framework: Empirical case study in the higher education. In *Information Systems Theory* (pp. 303-333). New York, NY: Springer. doi:10.1007/978-1-4419-6108-2_16

Dantes, G. R., & Hasibuan, Z. A. (2011). The impact of enterprise resource planning (ERP) system implementation on organization: Case study ERP implementation in Indonesia. *IBIMA Business Review*, *2011*, 1-10. doi:10.5171/2011.210664

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-339.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, *38*(3), 475-487. doi:10.1006/imms.1993.1022

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. doi:10.1287/mnsc.35.8.982

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

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9-30.

Dery, K., Grant, D., Harley, B., & Wright, C. (2006). Work, organisation and enterprise resource planning systems: An alternative research agenda. *New Technology, Work and Employment 21*(3), 199–214. doi:10.1111/j.1468-005X.2006.00175.x

Dezdar, S., &Ainin, S. (2010). ERP implementation success in Iran: Examining the role of system environment factors. *World Academy of Science, Engineering & Technology*, *66*, 449-455.

Esteves, J. (2009). A benefits realisation road-map framework for ERP usage in small and medium-sized enterprises. *Journal of Enterprise Information Management*, *22*(1/2), 25-35. doi:10.1108/17410390910922804

Fabrigar, L. R., Porter, R. D., & Norris, M. E. (2010). Some things you should know about structural equation modeling but never thought to ask. *Journal of Consumer Psychology*, *20*(2), 221-225. doi:10.1016/j.jcps.2010.03.003

Farzaneh, M., Vanani, I. R., & Sohrabi, B. (2013).A survey study of influential factors in the implementation of enterprise resource planning systems. *International Journal of Enterprise Information Systems (IJEIS)*, *9*(1), 76-96. doi:10.4018/jeis.2013010105

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*, 1149-1160. doi:10.3758/BRM.41.4.1149

Federici, T. (2009). Factors influencing ERP outcomes in SMEs: A post-introduction assessment. *Journal of Enterprise Information Management*, *22*(1/2), 81-98. doi:10.1108/17410390910922840

Fillion, G., Braham, H., & Ekionea, J. P. B. (2012). Testing UTAUT on the use of ERP systems by middle managers and end-users of medium-to large-sized Canadian enterprises. *Academy of Information & Management Sciences Journal*, *15*(2), 1-28.

Gable, G. G., Sedera, D., & Chan, T. (2003). Enterprise systems success: A measurement model. In March, Salvatore T., Massey, Anne, & DeGross, Janice I. (Eds.) *Twenty-Fourth International Conference on Information Systems*, Dec. 14-17, Seattle, WA.

Gable, G. G., Sedera, D., & Chan, T. (2008). Re-conceptualizing information system success: The IS-impact measurement model. *Journal of the Association for Information Systems*, *9*(7), 1-32.

Gajic, G., Stankovski, S., Ostojic, G., Tesic, Z., & Miladinovic, L. (2014). Method of evaluating the impact of ERP implementation critical success factors – A case study in oil and gas industries. *Enterprise Information Systems*, *8*(1), 84-106. doi:10.1080/17517575.2012.690105

Gallagher, K. P., & Gallagher, V. C. (2012). Organizing for post-implementation ERP: A contingency theory perspective. *Journal of Enterprise Information Management*, *25*(2), 170-185. doi: 10.1108/17410391211204400

Gallagher, K.P., & Gallagher, V.C. (2010, January). An exploratory study of organizing structures for post-implementation ERP.*2010 43rd Hawaii International Conference on System Sciences (HICSS)* (pp. 1-10). doi:10.1109/HICSS.2010.56

Galy, E., & Sauceda, M. J. (2014). Post-implementation practices of ERP systems and their relationship to financial performance. *Information & Management*, 51(3), 310-319. doi:10.1016/j.im.2014.02.002

Garača, Ž. (2011). Factors related to the intended use of ERP systems. *Management: Journal of Contemporary Management Issues, 16*(2), 23-42.

Gattiker, T. F., & Goodhue, D. L. (2005). What happens after ERP implementation: Understanding the impact of inter-dependence and differentiation on plant-level outcomes. *MIS Quarterly, 29*(3), 559-585.

Ghobakhloo, M., Arias-Aranda, D., & Benitez-Amado, J. (2011). Adoption of e-commerce applications in SMEs. *Industrial Management & Data Systems*, *111*(8), 1238-1269. doi:10.1108/02635571111170785

Grabski, S. V., Leech, S. A., & Schmidt, P. J. (2011). A review of ERP research: A future agenda for accounting information systems. *Journal of Information Systems, 25*(1), 37-78. doi:10.2308/jis.2011.25.1.37

Ha, Y. M., & Ahn, H. J. (2013). Factors affecting the performance of Enterprise Resource Planning (ERP) systems in the post-implementation stage. *Behaviour & Information Technology*, (ahead-of-print), 1-17. doi:10.1080/0144929X.2013.799229

Haddara, M., & Elragal, A. (2013). ERP adoption cost factors identification and classification: A study in SMEs. *International Journal of Information Systems and Project Management*, *1*(2), 5-21.

Haddara, M., & Zach, O. (2011, January). ERP systems in SMEs: A literature review. In *System Sciences (HICSS), 2011 44th Hawaii International Conference on* (pp. 1-10). IEEE. doi:10.1109/HICSS.2011.191

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM).* Thousand Oaks, CA: Sage Publications, Inc.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *The Journal of Marketing Theory and Practice*, *19*(2), 139-152. doi:10.2753/MTP1069-6679190202

Hair, J. F., Sarstedt, M., Pieper, T. M., & Ringle, C. M. (2012a). The use of partial least squares structural equation modeling in strategic management research: a review of past practices and recommendations for future applications. *Long Range Planning*, *45*(5), 320-340. doi:10.1016/j.lrp.2012.09.008

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012b). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, *40*(3), 414-433.

Häkkinen, L., & Hilmola, O. P. (2008). Life after ERP implementation: Long-term development of user perceptions of system success in an after-sales environment.

*Journal of Enterprise Information Management*, *21*(3), 285-310. doi:10.1108/17410390810866646

Hanafizadeh, P., Gholami, R., Dadbin, S., & Standage, N. (2010). The core critical success factors in implementation of enterprise resource planning systems. *International Journal of Enterprise Information Systems (IJEIS)*, *6*(2), 82-111. doi:10.4018/jeis.2010040105

Henderson, D., Sheetz, S. D., & Trinkle, B. S. (2012). The determinants of inter-organizational and internal in-house adoption of XBRL: A structural equation model. *International Journal of Accounting Information Systems*, *13*(2), 109-140. doi:10.1016/j.accinf.2012.02.001

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115-135. doi 10.1007/s11747-014-0403-8-21.

Hsu, P. F. (2013a). Commodity or competitive advantage? Analysis of the ERP value paradox. *Electronic Commerce Research and Applications*, *12*(6), 412-424. doi:10.1016/j.elerap.2013.06.004

Hsu, P. F. (2013b). Integrating ERP and e-business: Resource complementarity in business value creation. *Decision Support Systems*, *56*, 334-347. doi:10.1016/j.dss.2013.06.013

Huang, Z. (2010). A compilation research of ERP implementation critical success factors. *Issues in Information System*, *11*(1), 507-512.

Huang, S., & Wang, X. (2009, August). Influence of organizational system to end-users' acceptance of ERP system in Chinese enterprises. In *Hybrid Intelligent Systems, 2009. HIS'09. Ninth International Conference on* (Vol. 3, pp. 160-164). IEEE. doi:10.1109/HIS.2009.323

Hung, W. H., Chang, L. M., Yen, D. C., Ho, C. T., & Chiang, M. C. (2011). ERP success in the SMEs: The perspectives of service quality and social cognitive theory. *Asia Pacific Management Review*, *16*(4), 503-519.

Iacobucci, D. (2009). Everything you always wanted to know about SEM (structural equations modeling) but were afraid to ask. *Journal of Consumer Psychology*, *19*(4), 673-680. doi:10.1016/j.jcps.2009.09.002

Iacobucci, D. (2010). Structural equations modeling: Fit indices, sample size, and advanced topics. *Journal of Consumer Psychology*, *20*(1), 90-98. doi:10.1016/j.jcps.2009.09.003

Ifinedo, P. (2012). Internet/E-Business technologies acceptance in Canada’s SMEs: Focus on organizational and environmental factors. *E-Business–Applications and Global Acceptance*, 1-18.

Ifinedo, P. (2011a). Internal IT knowledge and expertise as antecedents of ERP system effectiveness: An empirical investigation. *Journal of Organizational Computing & Electronic Commerce, 21*(1), 1-23. doi:10.1080/10919392.2011.540979

Ifinedo, P. (2011b). Internet/e-business technologies acceptance in Canada's SMEs: An exploratory investigation. *Internet Research*, *21*(3), 255-281. doi:10.1108/10662241111139309

Ifinedo, P. (2011c). An empirical analysis of factors influencing Internet/e-business technologies adoption by SMEs in Canada. *International Journal of Information Technology & Decision Making, 10*(4), 731-766. doi:10.1142/S0219622011004543

Ifinedo, P. (2011d). Examining the influences of external expertise and in-house computer/IT knowledge on ERP system success. *Journal of Systems and Software*, *84*(12), 2065-2078. doi:10.1016/j.jss.2011.05.017

Ifinedo, P., & Nahar, N. (2006). Quality, impact and success of ERP systems: A study involving some firms in the Nordic-Baltic region. *Journal of Information Technology Impact*, *6*(1), 19-46.

Ifinedo, P., & Nahar, N. (2009). Interactions between contingency, organizational IT factors, and ERP success. *Industrial Management & Data Systems, 109*(1), 118-137. doi:10.1108/02635570910926627

Ifinedo, P., Rapp, B., Ifinedo, A., & Sundberg, K. (2010). Relationships among ERP post-implementation success constructs: An analysis at the organizational level. *Computers in Human Behavior, 26*(5), 1136-1148. doi:10.1016/j.chb.2010.03.020

Ince, H., Imamoglu, S. Z., Keskin, H., Akgun, A., & Efe, M. N. (2013). The impact of ERP systems and supply chain management practices on firm performance: Case of Turkish companies. *Procedia-Social and Behavioral Sciences*, *99*, 1124-1133. doI:10.1016/j.sbspro.2013.10.586

Jacobson, S., Shepherd, J., D'Aquila, M., & Carter, K. (2007). *The ERP market sizing report, 2006–2011.* Retrieved from AMR Research database.

Jan, A. U., & Contreras, V. (2011). Technology acceptance model for the use of information technology in universities. *Computers in Human Behavior*, *27*(2), 845-851. doi:10.1016/j.chb.2010.11.009

Jenatabadi, H. S., Huang, H., Ismail, N. A., Satar, N. B. M. & Radzi, C. W. (2013). Impact of supply chain management on the relationship between enterprise resource planning system and organizational performance. *International Journal of Business and Management*, *8*(19), 107-121. doi:10.5539/ijbm.v8n19p107

Jeng, J. F. D., & Dunk, N. (2013). Knowledge management enablers and knowledge creation in ERP system success. *International Journal of Electronic Business*, *11*(1), 49-59. ISSN:1728-2047

Johansson, B. (2013). Feedback in the ERP value-chain: What influence has thoughts about competitive advantage. In *Enterprise Information Systems of the Future* (pp. 134-148). Berlin, Germany: Springer. doi:10.1007/978-3-642-36611-6_10

Johansson, B., & Newman, M. (2010). Competitive advantage in the ERP system's value-chain and its influence on future development. *Enterprise Information Systems*, *4*(1), 79-93. doi:10.1080/17517570903040196

Jones, C. M., McCarthy, R. V., Halawi, L., & Mujtaba, B. (2010). Utilizing the technology acceptance model to assess the employee adoption of information systems security measures. *Journal of International Technology and Information Management*, *19*(2), 43-56.

Jones, M. C., Zmud, R. W., & Clark Jr, T. D. (2008). ERP in practice: A snapshot of post-installation perception and behaviors. *Communications of the Association for Information Systems*, *23*(1), 437-462.

Kallunki, J. P., Laitinen, E. K., & Silvola, H. (2011). Impact of enterprise resource planning systems on management control systems and firm performance. *International Journal of Accounting Information Systems*, *12*(1), 20-39. doi:10.1016/j.accinf.2010.02.001

Kamhawi, E. M. (2008). System characteristics, perceived benefits, individual differences and use intentions: A survey of decision support tools of ERP systems. *Information Resources Management Journal (IRMJ)*, *21*(4), 66-83. doi:10.4018/irmj.2008100104

Kanellou, A., & Spathis, C. (2013). Accounting benefits and satisfaction in an ERP environment. *International Journal of Accounting Information Systems*, *14*(3), 209-234. doi:10.1016/j.accinf.2012.12.002

Karimi, J., Somers, T. M., & Bhattacherjee, A. (2007a). The role of information systems resources in ERP capability building and business process outcomes. *Journal of Management Information Systems*, *24*(2), 221-260. doi:10.2753/MIS0742-1222240209

Karimi, J., Somers, T. M., & Bhattacherjee, A. (2007b). The impact of ERP implementation on business process outcomes: A factor-based study. *Journal of Management Information Systems*, *24*(1), 101-134. doi:10.2753/MIS0742-1222240103

Karimi, J., Somers, T., & Bhattacherjee, A. (2009). The role of ERP implementation in enabling digital options: A theoretical and empirical analysis. *International Journal of Electronic Commerce*, *13*(3), 7-42.

Khoo, H. M., Robey, D., & Rao, S. V. (2011). An exploratory study of the impacts of upgrading packaged software: A stakeholder perspective. *Journal of Information Technology, 26*(3), 153-169. doi:10.1057/jit.2011.1

Kim, K. H. (2005). The relation among fit indexes, power, and sample size in structural equation modeling. *Structural Equation Modeling*, *12*(3), 368-390. doi:10.1207/s15328007sem1203_2

Kim, Y. J., Chun, J. U., & Song, J. (2009). Investigating the role of attitude in technology acceptance from an attitude strength perspective. *International Journal of Information Management*, *29*(1), 67-77. doi:10.1016/j.ijinfomgt.2008.01.011

Kini, R. B., & Basaviah, S. (2013). Critical success factors in the implementation of enterprise resource planning systems in small and midsize businesses: Microsoft Navision implementation. *International Journal of Enterprise Information Systems*, *9*(1), 97-117. doi:10.4018/jeis.2013010106

Koch, C. (2011, May). Closing the Blackbox? A Status on Enterprise Resource Planning (ERP) Studies in Information Systems Research. In *Computer and Information Science (ICIS), 2011 IEEE/ACIS 10th International Conference* (pp. 409-414). IEEE. doi:10.1109/ICIS.2011.70

Koh, S. L., Gunasekaran, A., & Goodman, T. (2011). Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis.

*The Journal of Strategic Information Systems*, *20*(4), 385-402. doi:10.1016/j.jsis.2011.07.001

Kraaijenbrink, J., Spender, J. C., & Groen, A. J. (2010). The resource-based view: A review and assessment of its critiques. *Journal of Management*, *36*(1), 349-372. doi:10.1177/0149206309350775

Kronbichler, S. A., Ostermann, H., Rol, R., & Staudinger, S. (2009). A review of critical success factors for ERP-projects. *Open Information Systems Journal*, *3*, 14-25.

Kronbichler, S. A., Ostermann, H., & Staudinger, R. (2010). A comparison of ERP-success measurement approaches. *JISTEM - Journal of Information Systems and Technology Management, 7*(2), 281-310. doi:10.4301/S1807-7752010000200003

Kwak, Y. H., Park, J., Chung, B. Y., & Ghosh, S. (2012). Understanding end-users' acceptance of enterprise resource planning (ERP) system in project-based sectors. *Engineering Management, IEEE Transactions on*, *59*(2), 266-277. doi:10.1109/TEM.2011.2111456

Kwahk, K.Y., & Ahn, H. (2010). Moderating effects of localization differences on ERP use: A socio-technical systems perspective, *Computers in Human Behavior, 26*(2), 186-198. doi:10.1016/j.chb.2009.10.006

Larsen, T. J. (2009). A multilevel explanation of end-user computing satisfaction with an enterprise resource planning system within an international manufacturing organization. *Computers in Industry*, *60*(9), 657-668. doi:10.1016/j.compind.2009.05.004

Law, C. C., Chen, C. C., & Wu, B. J. (2010). Managing the full ERP life-cycle:

Considerations of maintenance and support requirements and IT governance practice as integral elements of the formula for successful ERP adoption. *Computers in Industry*, *61*(3), 297-308. doi:10.1016/j.compind.2009.10.004

Lee, D.H., Lee, S.M., Olson, D. L., & Chung, S.H. (2010). The effect of organizational support on ERP implementation*. Industrial Management & Data Systems, 110*(2), 269-283. doi:10.1108/02635571011020340

Lee, O. K., Wang, M., Lim, K. H., & Peng, Z. (2009). Knowledge management systems diffusion in Chinese enterprises: A multistage approach using the technology-organization-environment framework. *Journal of Global Information Management (JGIM)*, *17*(1), 70-84. doi:10.4018/jgim.2009010104

Li, L. (2012). Effects of enterprise technology on supply chain collaboration: Analysis of China-linked supply chain. *Enterprise Information Systems*, *6*(1), 55-77. doi:10.1080/17517575.2011.639904

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

Lin, H.F., (2010). An investigation into the effects of IS quality and top management support on ERP system usage. *Total Quality Management & Business Excellence, 21*(3), 335-349. doi:10.1080/14783360903561761

Lip-Sam, T., & Hock-Eam, L. (2011).Estimating the determinants of B2B E-commerce adoption among small & medium enterprises. *International Journal of Business &*

*Society*, *12*(1), 15-30.

Liu, P. L. (2011). Empirical study on influence of critical success factors on ERP knowledge management on management performance in high-tech industries in Taiwan. *Expert Systems with Applications*, *38*(8), 10696-10704. doi:10.1016/j.eswa.2011.02.045

Liu, H., & Wang, X. (2010, November). Strategy research of enterprise information planning based on TOE-TAM model: Case study for ERP implementation of a discrete manufacturing. In *Database Technology and Applications (DBTA), 2010 2nd International Workshop* (pp. 1-5). IEEE. doi:10.1109/DBTA.2010.5658969

López, C., & Salmeron, J. L. (2014a). Dynamic risks modelling in ERP maintenance projects with FCM. *Information Sciences*, *256*, 25-45. doi:10.1016/j.ins.2012.05.026

López, C., & Salmeron, J. L. (2014b). Modeling maintenance projects risk effects on ERP performance. *Computer Standards & Interfaces*, *36*(3), 545-553. doi:10.1016/j.csi.2013.11.002

MacCallum, R. C., Browne, M. W., & Cai, L. (2006). Testing differences between nested covariance structure models: Power analysis and null hypotheses. *Psychological Methods*, *11*(1), 19-35. doi:1 0.1037/1082-989X.11.1.19

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*(2), 130-149. doi:10.1037/1082-989X.1.2.130

MacKenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Construct measurement and validation procedures in MIS and behavioral research: Integrating new and existing techniques. *MIS Quarterly*, *35*(2), 293-334.

Madapusi, A., & D'Souza, D. (2012). The influence of ERP system implementation on the operational performance of an organization. *International Journal of Information Management*, *32*(1), 24-34. doi:10.1016/j.ijinfomgt.2011.06.004

Magal, S. R., & Word, J. (2012). *Integrated business processes with ERP systems*. Hoboken, NJ: John Wiley & Sons.

Maldonado, M., & Sierra, V. (2013). User satisfaction as the foundation of the success following an ERP adoption: An empirical study from Latin America. *International Journal of Enterprise Information Systems (IJEIS)*, *9*(3), 77-99. doi:10.4018/jeis.2013070104

Marcoulides, G. A., & Saunders, C. (2006). PLS: A silver bullet?. *Management Information Systems Quarterly*, *30*(2), iii-ix.

Martins, M., & Oliveira, T. (2009). Determinants of e-commerce adoption by small firms in Portugal. In *Proceedings of the 3rd European Conference on Information Management and Evaluation* (pp. 328-338).

Marques, A., Oliveira, T., Dias, S. S., & Martins, M. F. O. (2011). Medical records system adoption in European hospitals. *Electronic Journal of Information Systems Evaluation*, *14*(1), 89-99.

Mathrani, S., & Mathrani, A. (2013). Utilizing enterprise systems for managing enterprise risks. *Computers in Industry*, *64*(4), 476-483. Doi:10.1016/j.compind.2013.02.002

May, J., Dhillon, G., & Caldeira, M. (2013). Defining value-based objectives for ERP systems planning. *Decision Support Systems*, *55*(1), 98-109. doi:10.1016/j.dss.2012.12.036

McCubbrey, D. J., & Fukami, C. V. (2009). ERP at the Colorado department of transportation: The whistle blower's dilemma. *Communications of the Association for Information Systems*, *24*(1), 105-112.

Moon, Y. B. (2007). Enterprise resource planning (ERP): A review of the literature. *International Journal of Management and Enterprise Development*, *4*(3), 235-264.

Morris, M., & Venkatesh, V. (2010). Job characteristics and job satisfaction: Understanding the role of enterprise resource planning system implementation. *Management Information Systems Quarterly, 34*(1), 143-161.

Nah, F. F. H., Islam, Z., & Tan, M. (2007). Empirical assessment of factors influencing success of enterprise resource planning implementations. *Journal of Database Management (JDM)*, *18*(4), 26-50. doi:10.4018/jdm.2007100102

Neufeld, D. J., Dong, L., & Higgins, C. (2007). Charismatic leadership and user acceptance of information technology. *European Journal of Information Systems*, *16*(4), 494-510. doi:10.1057/palgrave.ejis.3000682

Nicolaou, A. & Bhattacharya, S. (2008). Sustainability of ERPS performance outcomes:

The role of post-implementation review quality. *International Journal of Accounting Information Systems, 9*(1), 43-60. doi:10.1016/j.accinf.2007.07.003

Nikookar, G., Yahya Safavi, S., Hakim, A., & Homayoun, A. (2010). Competitive advantage of enterprise resource planning vendors in Iran. *Information Systems*, *35*(3), 271-277. doi:10.1016/j.is.2009.09.002

Nwankpa, J., & Roumani, Y. (2014). Understanding the link between organizational learning capability and ERP system usage: An empirical examination. *Computers in Human Behavior*, *33*, 224-234. doi:10.1016/j.chb.2014.01.030

O'Leary-Kelly, S. W., & J Vokurka, R. (1998). The empirical assessment of construct validity. *Journal of Operations Management*, *16*(4), 387-405. doi:10.1016/S0272-6963(98)00020-5

Oliveira, T., & Martins, M. F. (2009). Firms' patterns of e-Business adoption: Evidence for the European Union-27. In *The Proceedings of the 3rd European Conference on Information Management and Evaluation: University of Gothenburg, Sweden, 17-18 September 2009* (p. 371-379). Academic Conferences Limited.

Oliveira, T. & Martins, M.F. (2010a). Firms patterns of e-business adoption: Evidence for the European Union-27. *The Electronic Journal Information Systems Evaluation*, *13*(1), 47-56.

Oliveira, T., & Martins, M. F. (2010b).Understanding e-business adoption across industries in European countries. *Industrial Management & Data Systems*, *110*(9), 1337-1354. doi:10.1108/02635571011087428

Oliveira, T., &Martins, M. (2011). Literature review of information technology adoption models at firm level. *Electronic Journal of Information Systems Evaluation, 14*(1), 110-121.

Pan, M. J., & Jang, W. Y. (2008). Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan's communications industry. *Journal of Computer Information Systems*, *48*(3), 94-102.

Pan, K., Nunes, M. B., & Peng, G. C. (2011). Risks affecting ERP post-implementation: Insights from a large Chinese manufacturing group. *Journal of Manufacturing Technology Management*, *22*(1), 107-130. doi:10.1108/17410381111099833

Pang, C., Dharmasthira, Y., Eschinger, C., Motoyoshi, K. & Brant, K. F. (2013, May 7*).* *Market share analysis: ERP software, worldwide, 2012* (ID: G00249091). Retrieved from Gartner database.

Pasaoglu, D. (2011). Analysis of ERP usage with technology acceptance model. *Global Business and Management Research: An International Journal*, *3*(2), 157-166.

Peng, G. C., & Nunes, M. B. (2009). Identification and assessment of risks associated with ERP post-implementation in China. *Journal of Enterprise Information Management*, *22*(5), 587-614. doi:10.1108/17410390910993554

Peng, G. C., & Nunes, M. B. (2010, January). Interrelated barriers and risks affecting ERP post-implementation in China. In *System Sciences (HICSS), 2010 43rd Hawaii International Conference* (pp. 1-10). IEEE. doi:10.1109/HICSS.2010.240

Peslak, A. R., & Boyle, T. A. (2010). An exploratory study of the key skills for entry-level ERP employees. *International Journal of Enterprise Information Systems (IJEIS)*, *6*(2), 1-14. doi:10.3200/JOEB.82.5.267-275

Petter, S., DeLone, W., & McLean, E. (2008). Measuring information systems success: Models, dimensions, measures, and interrelationships. *European Journal of Information Systems, 17*(3), 236-263. doi:10.1057/ejis.2008.15

Petter, S., & McLean, E. R. (2009). A meta-analytic assessment of the DeLone and McLean IS success model: An examination of IS success at the individual level. *Information & Management, 46*(3), 159-166. doi:10.1016/j.im.2008.12.006

Rahrovani, Y., & Pinsonneault, A. (2012). On the business value of information technology: A theory of slack resources. In *Information Systems Theory* (pp. 165-198). New York, NY: Springer. doi: 10.1007/978-1-4419-6108-2_9

Ram, J., & Corkindale, D. (2014). How “critical” are the critical success factors (CSFs)?: Examining the role of CSFs for ERP. *Business Process Management Journal*, *20*(1), 151-174. doi:10.1108/BPMJ-11-2012-0127

Ram, J., Corkindale, D., & Wu, M. L. (2013). Implementation critical success factors (CSFs) for ERP: Do they contribute to implementation success and post-implementation performance?. *International Journal of Production Economics*, *144*(1), 157-174. doi:10.1016/j.ijpe.2013.01.032

Ramdani, B. (2012). Information technology and organisational performance: Reviewing the business value of IT literature. In *Information Systems Theory* (pp. 283-301). New York, NY: Springer. doi:10.1007/978-1-4419-6108-2_15

Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, *22*(1/2), 10-24. doi:10.1108/17410390910922796

Rich, D., & Dibbern, J. (2013). A team-oriented investigation of ERP post-implementation integration projects: how cross-functional collaboration influences ERP benefits. In *Innovation and Future of Enterprise Information Systems* (pp. 115-127). Berlin, Germany: Springer.

Rigdon, E. E. (1994). Calculating degrees of freedom for a structural equation model. *Structural Equation Modeling: A Multidisciplinary Journal*, *1*(3), 274-278. doi:10.1080/10705519409539979

Ringle, C. M., Sarstedt, M., & Straub, D. W. (2012). Editor's comments: a critical look at the use of PLS-SEM in MIS quarterly. *MIS quarterly*, *36*(1), iii-xiv.

Ringle, C. M., Wende, S., & Will, A. (2005). SmartPLS–Version 2.0. *Universität Hamburg.* Hamburg: Germany.

Rogers, E. M. (1962). *Diffusion of innovations*. New York, NY: Free Press.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Rotchanakitumnuai, S. (2010). Success factors of large scale ERP implementation in Thailand. *World Academy of Science, Engineering and Technology*, *40*, 605-608.

Ruivo, P., Johansson, B., Oliveira, T., & Neto, M. (2012). Determinants that influence ERP use and value: Cross-country evidence on Scandinavian and Iberian SMEs. *Procedia Technology*, *5*, 354-362. doi:10.1016/j.protcy.2012.09.039

Ruivo, P., Oliveira, T., & Neto, M. (2014). Examine ERP post-implementation stages of use and value: Empirical evidence from Portuguese SMEs. *International Journal of Accounting Information Systems*, *15*(2), 166-184. doi:10.1016/j.accinf.2014.01.002

Saeed, K. A., Abdinnour, S., Lengnick-Hall, M. L., & Lengnick-Hall, C. A. (2010). Examining the impact of pre-implementation expectations on post-implementation use of enterprise systems: A longitudinal study. *Decision Sciences, 41*(4), 659-688. doi:10.1111/j.1540-5915.2010.00285.x

Sayer, A. (2000). *Methods in Social Science, A realist approach* (2nd ed.). New York, NY: Routledge.

Schlichter, B. R., & Kraemmergaard, P. (2010). A comprehensive literature review of the ERP research field over a decade. *Journal of Enterprise Information Management*, *23*(4), 486-520. doi:10.1108/17410391011061780

Seddon, P. B. (1997). A respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research, 8*(3), 240-253. doi:10.1287/isre.8.3.240

Seddon, P. B., Calvert, C., & Yang, S. (2010). A multi-project model of key factors affecting organizational benefits from enterprise systems. *MIS Quarterly*, *34*(2), 305-328.

Seethamraju, R., & Krishna Sundar, D. (2013). Influence of ERP systems on business process agility. *IIMB Management Review*, *25*(3), 137-149. doi:10.1016/j.iimb.2013.05.001

Seymour, L., Makanya, W., & Berrangé, S. (2007, April). End-users' acceptance of enterprise resource planning systems: An investigation of antecedents. In *Proceedings of the 6th Annual ISOnEworld Conference* (pp. 26-1-26-22).

Shahawai, S. S., & Idrus, R. (2011, May).Malaysian SMEs perspective on factors affecting ERP system adoption. In *Modelling Symposium (AMS), 2011 Fifth Asia* (pp. 109-113). IEEE. doi:10.1109/AMS.2011.30

Shao, Z., Feng, Y., & Liu, L. (2012). The mediating effect of organizational culture and knowledge sharing on transformational leadership and Enterprise Resource Planning systems success: An empirical study in China. *Computers in Human Behavior*, *28*(6), 2400-2413. doi:10.1016/j.chb.2012.07.011

Shih, Y. Y., & Huang, S. S. (2009). The actual usage of ERP systems: An extended technology acceptance perspective. *Journal of Research & Practice in Information Technology*, *41*(3), 263-276.

Singh, L. P., Singh, S., & Pereira, N. M. (2010, July). Human risk factors in post-implementation phase of ERP in SMEs in India. In *Technology Management for Global Economic Growth (PICMET), 2010 Proceedings of PICMET'10:* (pp. 1-11). IEEE.

Singleton, R., & Straits, B. (2010). *Approaches to social research* (5th ed.). New York, NY: Oxford University Press.

Snider, B., da Silveira, G. J., & Balakrishnan, J. (2009). ERP implementation at SMEs: Analysis of five Canadian cases. *International Journal of Operations & Production Management*, *29*(1), 4-29. doi:10.1108/01443570910925343

Srivastava, S. C., &Teo, T. S. (2010). E-government, E-business, and national economic performance. *Communications of the Association for Information Systems*, *26*, 267-286.

Stephenson, S. V., & Sage, A. P. (2007). Architecting for enterprise resource planning. *Information, Knowledge, Systems Management*, *6*(1), 81-121.

Sternad, S., & Bobek, S. (2013). Impacts of TAM-based external factors on ERP acceptance. *Procedia Technology*, *9*, 33-42. doi:10.1016/j.protcy.2013.12.004

Sternad, S., Gradisar, M., & Bobek, S. (2011). The influence of external factors on routine ERP usage. *Industrial Management & Data Systems*, *111*(9), 1511-1530. doi:10.1108/02635571111182818

Su, Y. F., & Yang, C. (2010a). Why are enterprise resource planning systems indispensable to supply chain management?. *European Journal of Operational Research*, *203*(1), 81-94. doi:10.1016/j.ejor.2009.07.003

Su, Y. F., & Yang, C. (2010b). A structural equation model for analyzing the impact of ERP on SCM. *Expert Systems with Applications*, *37*(1), 456-469. doi:10.1016/j.eswa.2009.05.061

Sun, Y., Bhattacherjee, A., & Ma, Q. (2009). Extending technology usage to work settings: The role of perceived work compatibility in ERP implementation. *Information & Management*, *46*(6), 351-356. doi:10.1016/j.im.2009.06.003

Supramaniam, M., & Kuppusamy, M. (2010). ERP system adoption in Malaysia: A comparative analysis between SMEs and MNCs. *Proceedings of The European Conference on Information Management & Evaluation*, 372-380.

Supramaniam, M., & Kuppusamy, M. (2011). Analysis of critical success factors in implementing enterprise resource planning systems in Malaysian business firms. *The Electronic Journal of Information Systems in Developing Countries*, *46*(5), 1-19.

Sykes, T. A., Venkatesh, V., & Johnson, J. L. (2014). Enterprise system implementation and employee job performance: Understanding the role of advice networks. *MIS Quarterly*, *38*(1), 51-72.

Taher, M. (2012). Resource-based view theory. In *Information Systems Theory* (pp. 151-163). New York, NY: Springer. doi:10.1007/978-1-4419-6108-2_8

Tornatzky, L.G., and Fleischer, M. (1990). *The processes of technological innovation*. Lexington, MA: Lexington Books.

Trochim, W., & Donnelly, J. (2007). *The research methods knowledge base* (3rd ed.). Mason, OH: Thomson Custom Publishing.

Tsai, W. H., Chen, S. P., Hwang, E. T., & Hsu, J. L. (2010). A study of the impact of business process on the ERP system effectiveness. *International Journal of Business and Management*, *5*(9), 26-37.

Tsai, W. H., Lee, K. C., Liu, J. Y., Lin, S. J., & Chou, Y. W. (2012). The influence of enterprise resource planning (ERP) systems' performance on earnings management. *Enterprise Information Systems*, *6*(4), 491-517. doi:10.1080/17517575.2011.622414

Tsai, W. H., Lee, P. L., Shen, Y. S., & Yang, C. C. (2009, December).The relationship between ERP software selection criteria and ERP success. In *Industrial*

*Engineering and Engineering Management, 2009. IEEM 2009. IEEE International Conference* (pp. 2222-2226). IEEE. doi:10.1109/IEEM.2009.5373085

Tsai, W. H., Shaw, M. J., Fan, Y. W., Liu, J. Y., Lee, K. C., & Chen, H. C. (2011). An empirical investigation of the impacts of internal/external facilitators on the project success of ERP: A structural equation model. *Decision Support Systems*, *50*(2), 480-490. doi:10.1016/j.dss.2010.11.005

Urbach, N., & Müller, B. (2012). The updated DeLone and McLean model of information systems success. In *Information Systems Theory* (pp. 1-18). New York, NY: Springer.

Uwizeyemungu, S., & Raymond, L. (2012). Impact of an ERP system’s capabilities upon the realisation of its business value: A resource-based perspective. *Information Technology and Management*, *13*(2), 69-90. doi:10.1007/s10799-012-0118-9

Vathanophas, V., & Stuart, L. (2009). Enterprise resource planning: Technology acceptance in Thai universities. *Enterprise Information Systems*, *3*(2), 133-158. doi:10.1080/17517570802653800

Velcu, O. (2010). Strategic alignment of ERP implementation stages: An empirical investigation. *Information & Management*, *47*(3), 158-166. doi:10.1016/j.im.2010.01.005

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, *39*(2), 273-315. doi:10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204. doi:10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*, *36*(1), 157-178.

Wang, Y. M., Wang, Y. S., & Yang, Y. F. (2010).Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting and Social Change*, *77*(5), 803-815. doi:10.1016/j.techfore.2010.03.006

Wen, K.W., & Chen, Y. (2010). E-business value creation in small and medium enterprises: A US study using the TOE framework. *International Journal of Electronic Business, 8*(1), 80-100.

Westland, J.C. (2010). Lower bounds on sample size in structural equation modeling. *Electronic Commerce Research and Applications*, *9*(6), 476-487. doi:10.1016/j.elerap.2010.07.003

Weston, R., & Gore, P. A. (2006). A brief guide to structural equation modeling. *The Counseling Psychologist*, *34*(5), 719-751. doi:10.1177/0011000006286345

Williams, M. D., Rana, N. P., & Dwivedi, Y. K. (2012). A bibliometric analysis of articles citing the unified theory of acceptance and use of technology. In *Information Systems Theory* (pp. 37-62). New York, NY: Springer.

Wolfe, R. A. (1994). Organizational innovation: Review, critique and suggested research directions*. *Journal of Management Studies*, *31*(3), 405-431. doi:10.1111/j.1467-6486.1994.tb00624.x

Wong, K. K. K. (2013). Partial Least Squares Structural Equation Modeling (PLS-SEM) Techniques Using SmartPLS. *Marketing Bulletin*, *24*, 1-32.

Wu, W. W. (2011). Segmenting and mining the ERP users' perceived benefits using the rough set approach. *Expert Systems with Applications*, *38*(6), 6940-6948. doi:10.1016/j.eswa.2010.12.030

Wu, M. Y., Wu, M. H., & Shih, Y. Y. (2010). A study of factors affecting behavioral intention to use ERP systems in high-tech industry using TAM and TTF. *Journal of Statistics and Management Systems*, *13*(5), 877-898. doi:10.1080/09720510.2010.10701509

Wurster, L. f., Dharmasthira, Y., Eschinger, C., Granetto, B. F., Correia, J. M., De Silva, F., … Coyle, D. M. (2013, June 13*). Forecast: Enterprise software markets, worldwide, 2012-2017, 2Q13 update (*ID: G00249486). Retrieved from Gartner database.

Yang, C., & Su, Y. F. (2009). The relationship between benefits of ERP systems implementation and its impacts on firm performance of SCM. *Journal of Enterprise Information Management*, *22*(6), 722-752. Doi:10.1108/17410390910999602

Yeh, C. H., & Xu, Y. (2013). Managing critical success strategies for an enterprise resource planning project. *European Journal of Operational Research*, *230*(3), 604-614. doi:10.1016/j.ejor.2013.04.032

Yoon, C. (2009). The effects of organizational citizenship behaviors on ERP system success. *Computers in Human Behavior*, *25*(2), 421-428. doi:10.1016/j.chb.2008.10.004

Youngberg, E., Olsen, D., & Hauser, K. (2009). Determinants of professionally autonomous end user acceptance in an enterprise resource planning system environment. *International Journal of Information Management*, *29*(2), 138-144. doi:10.1016/j.ijinfomgt.2008.06.001

Zhu, K., Dong, S., Xu, S. X., & Kraemer, K. L. (2006). Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies. *European Journal of Information Systems*, *15*(6), 601-616. doi:10.1057/palgrave.ejis.3000650

Zhu, Y., Li, Y., Wang, W., & Chen, J. (2010). What leads to post-implementation success of ERP? An empirical study of the Chinese retail industry. *International Journal of Information Management*, *30*(3), 265-276. doi:10.1016/j.ijinfomgt.2009.09.007

Appendix A: Research Questionnaire

**Research Questionnaire**

**Directions:**

This questionnaire deals with your opinion about your organization's ERP system (Banner, Colleague, Datatel, JD Edwards, Microsoft Dynamics NAV, Oracle Fusion, PeopleSoft, SAGE X3, SAP, or any other ERP system). Your input is of tremendous importance for this study.

Based on your experiences as a user of your organization's ERP system, please show the extent to which you think about each statement. If you strongly agree, click the radio button under 7. If you strongly disagree, click the radio button under 1. If your feeling is less strong, click the radio
button under the number that closely matches your opinion.

There is no right or wrong answers – the interest is in the number that truly reflects your expectations and experiences with your organization's ERP system.

**1. ERP Information Quality**: Characteristics of the ERP system output.

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| The ERP system of our company provides timely information | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The ERP system of our company provides us important information. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The information and related reports that the ERP system provides are useful to me in my work | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The information and related reports that the ERP system provides are relevant for me in my work. | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| The information and related reports on our ERP system are available to me when and where I need them | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**2. ERP System Quality:** Performance characteristics of the ERP system.

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Our ERP system is easy to use. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system functions reliably. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system is flexible. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system allows for customization. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system combines data from different areas of the organization. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system allows for integration with other IT systems (e.g. CRM, E-commerce, KM, etc.). | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**3. ERP Service Quality:** Characteristics of the support provided by the ERP provider.

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Our ERP system provides prompt information to users. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has an easy to use interface. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has visually appealing features. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system provides the right solution to my requests. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Our ERP service provider is dependable. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP service provider provides quality training and services. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**4. ERP Learning:**

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| I can always gain ERP experience and knowledge from my colleagues. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| My colleagues always try to share their expertise about the ERP system with me. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am willing to exchange my ERP experience or know-how with my colleagues. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am willing to share my ERP expertise with my colleagues. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am able to recognize the value of ERP knowledge I learned. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am able to assimilate the ERP knowledge I learned and turn it into my own knowledge base. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| I am able to learn the needed ERP know-how. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**5. Self-efficacy:**

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| **I could complete my job using our ERP system:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| If there was no one around to tell me what to do. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| If I had only the software manuals for reference. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| If I had just the built-in help functionality for assistance. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| If I could call someone for help if I got stuck. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| If I had a lot of time to complete the job. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**6. Shared Beliefs:**

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| I believe in the benefits of our ERP system. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| My peers believe in the benefits of our ERP system. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| My management team believes in our ERP system benefits. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| The different departments, units, partners, and suppliers believe in the ERP system benefits. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**7. Coordination:**

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Our ERP system helps us to adjust to changing conditions among the different departments, units, partners, and suppliers. | | | | | | | |
| Our ERP system has improved the coordination among the different departments, units, partners, and suppliers. | | | | | | | |
| Our ERP system facilitates the integration of important information among the different departments, units, partners, and suppliers. | | | | | | | |
| Our ERP system helps to synchronize activities among the different departments, units, partners, and suppliers. | | | | | | | |

**8. ERP Relevance:**

Please indicate the extent to which you agree with the following statements by selecting the appropriate scale.

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| In my job, usage of the ERP system is important. | | | | | | | |
| The ERP system meets my task requirements. | | | | | | | |
| The use of the ERP system is pertinent to my various job-related tasks. | | | | | | | |
| In my job, usage of the ERP system is relevant. | | | | | | | |
| Using our ERP system improved my performance. | | | | | | | |
| Using our ERP system improved my effectiveness. | | | | | | | |
| Using our ERP system improved my productivity. | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Overall, using the ERP system is very useful in my job | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| The data provided by our ERP system add value to our operations. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| The ERP system has improved timely access to corporate data. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| The ERP system provides a high level of enterprise-wide data integration. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| The ERP system helps us make better sales forecasts than before. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| The functionalities of our ERP system adequately meet the requirements of our jobs. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| The ERP system has improved our quality of operations. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

(1=Strongly Disagree, 2=Disagree, 3=Somewhat Disagree, 4=Neither Agree or Disagree, 5=Somewhat Agree, 6=Agree, 7=Strongly Agree)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Our ERP system has given us more ways to customize our processes. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has made our company more agile. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has made us more adaptive to changing business environment. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has improved the flexibility of our operations. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has improved our efficiency of operations. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our ERP system has lowered our costs of operation. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Our ERP system has reduced the amount of rework needed for data entry errors. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| **Thanks to our ERP system:** | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Our business transactions are performed efficiently. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Decisions are made more quickly. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our internal processes are more efficient. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Coordination with our suppliers and partners improved. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Cooperation between our departments and units is facilitated. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our procurement costs decreased. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| Our inventory costs decreased. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Demographics**
**Your job position in your organization is:**

☐ Managerial

☐ Non Managerial

☐ Other

**How long have you been with your organization?**

☐ Less than 1 year

☐ 1 - Less than 4 years

☐ 4 - 10 years

☐ More than 10 years

**How many years have you been using your organization's ERP system?**

- Less than 1 year
- 1 - Less than 4 years
- 4 - 10 years
- More than 10 years

**Gender:**

- Female
- Male

*Thank you very much for spending your time and completing the questionnaire.*

Appendix B: Invitation to Participate and Informed Consent Form

**Invitation to Participate in a Research Study and Consent Form**

You are invited to take part in a research study investigating the post-implementation sustainability factors from the enterprise resource planning (ERP) user's point of view and their impact on the overall ERP benefits for the organization. Your point of view is important since recent research indicated that there are mixed points of views regarding the value of the installed ERP system between management and end users.

The researcher is inviting ERP users in the state of Colorado, who have at least 4-year experience working with ERPs, to be in the study. You are invited to participate in this research because of your membership in an organization (public or private) or a technology user group in the state of Colorado. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Mohamed Lotfy, who is a doctoral candidate at Walden University.

**Background Information:**

The purpose of this study is to identify the different post-implementation sustainability factors, factors that will provide sustained competitive advantage from the ERP user's point of view. This study is important in that it goes beyond merely identifying how ERP systems can benefit an organization, but also to ascertain the real efficiencies from the ERP user's point of view that can sustain the ERP competitive advantage. The results of this study will provide much-needed insights into how user acceptance of ERP value impacts the firm's achieved ERP benefits.

**Procedures:**

If you agree to be in this study:

- You will be asked to provide the extent to which you agree or disagree with the research questionnaire statements by selecting the appropriate scale.
- The research questionnaire should take about 15 - 25 minutes to complete.
- The questionnaire will be available for 2 weeks between **January 6, 2015** and **March 22, 2015**.
- Your responses are anonymous
- The questionnaire will not collect any personally identifying information like your name, ID, or place of employment.

Here are some sample questions:

1. Our ERP system is easy to use.
2. I believe in the benefits of our ERP system.

**Voluntary Nature of the Study:**

Your participation in this study is voluntary. You may refuse to participate in or discontinue the questionnaire without penalty. You may stop at any time.

**Risks and Benefits of Being in the Study:**

Being in this type of study involves some risk of the minor discomforts that can be encountered in daily life, such as anxiety created by

- Strong personal feelings about the statements
- The length of time it takes to answer the statements

Being in this study would not pose risk to your safety or wellbeing.

Benefits by participating in this study are that your responses may help to develop a better understanding of post-implementation sustainability factors from the ERP user's point of view and their impact on the overall ERP benefits for the organization. You will also have the satisfaction of knowing you contributed to a pioneer research study that helps to explore how research findings align with practice.

**Payment:**

You will not receive compensation for participating in this research.

**Privacy:**

Any information you provide is anonymous. The questionnaire will not collect any personally identifying information like your name, ID, place of employment, or information that will identify your organization. The anonymous coded data will be kept secure and stored in a password file and folder. Data will be kept for a period of at least 5 years, as required by the university.

**Contacts and Questions:**

If you have any questions, please contact the researcher Mohamed Lotfy at mohamedabdalla.lotfy@waldenu.edu or the dissertation committee chairperson Dr.

Anthony Lolas at anthony.lolas@waldenu.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 612-312-1210. Walden University's approval number for this study is **01-05-15-0118147** and it expires on **January 4, 2016.**

Please print or save this consent form for your records.

**Statement of Consent:**

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. **By clicking on the "Go to Questionnaire" button below or completing the questionnaire implies consent to participate**, I understand that I am agreeing to the terms described above.

If you are not ready to take the questionnaire at this time or not agreeing to the terms described above, click on the "No Thank You" button.

**Go to Questionnaire** **No Thank you**

# Appendix C: Copyright Permissions

**From:** Carry Koolbergen [mailto:C.Koolbergen@iospress.nl]
**Sent:** Tuesday, October 07, 2014 12:51 AM
**To:** Lotfy, Mohamed
**Subject:** RE: Permission to use a figure

Dear Mohamed Lotfy,

We hereby grant you permission to reproduce the below mentioned material in **print and electronic format** at no charge subject to the following conditions:

1. If any part of the material to be used (for example, figures) has appeared in our publication with credit or acknowledgement to another source, permission must also be sought from that source. If such permission is not obtained then that material may not be included in your publication/copies.

2. Suitable acknowledgement to the source must be made, either as a footnote or in a reference list at the end of your publication, as follows:

"Reprinted from Publication title, Vol number, Author(s), Title of article, Pages No., Copyright (Year), with permission from IOS Press".

3. This permission is granted for non-exclusive world **English** rights only. For other languages please reapply separately for each one required.

4. Reproduction of this material is confined to the purpose for which permission is hereby given.

Yours sincerely

**Carry Koolbergen (Mrs.)**

*Contracts, Rights & Permissions Coordinator*

*Not in the office on Wednesday's*

**IOS Press BV**
Nieuwe Hemweg 6B
1013 BG Amsterdam
The Netherlands
Tel.: +31 (0)20 687 0022
Fax: +31 (0)20 687 0019
Email: c.koolbergen@iospress.nl / publisher@iospress.nl
URL: www.iospress.nl

-

-

**Van:** Lotfy, Mohamed [mailto:mlotfy@regis.edu]
**Verzonden:** dinsdag 7 oktober 2014 4:35
**Aan:** Carry Koolbergen
**Onderwerp:** Permission to use a figure

Hi,

I am a Ph.D. student and want to include an adapted version of figure 3 on p. 91 form your paper "Stephenson, S. V., & Sage, A. P. (2007). Architecting for enterprise resource planning. *Information, Knowledge, Systems Management*, *6*(1), 81-121." in my dissertation. Will you permit me to use it and put the adapted diagram in my dissertation?

Thank you,

Mohamed Lotfy

**From:** Patricia Zline [mailto:pzline@rowman.com]
**Sent:** Monday, October 06, 2014 11:21 AM
**To:** Lotfy, Mohamed
**Subject:** RE: Permission to use a figure

Dear Mohamed,
Thank you for your email.

Yes, you have permission, no fee, and non-exclusive, to use the material you cite below which was originally published by Lexington Books.
**Permission is granted for your dissertation only.** It is understood that your dissertation may be included in an academic publishing archive. If it is decided to publish it independently at a later date, permission must be re-cleared.

Best
Patricia

Patricia Zline

Rights and Permissions Assistant
Rowman & Littlefield
4501 Forbes Blvd, Suite 200
Lanham, Maryland 20706 USA
pzline@rowman.com
301-459-3366 ext. 5420 301-429-5748 fax
www.rowman.com

**From:** Lotfy, Mohamed [mailto:mlotfy@regis.edu]
**Sent:** Sunday, October 05, 2014 4:08 PM
**To:** Patricia Zline
**Subject:** Permission to use a figure

Dear Patricia,
I am a Ph.D. student and want to include an adapted version of figure 7-1 form the book

"Tornatzky, L.G., and Fleischer, M. (1990). *The processes of technological innovation*. Lexington, Massachusetts: Lexington Books."

in my dissertation. Will you provide me the permission to use an adapted diagram from figure 7-1from the above-mentioned book in my dissertation?

Thank you,
Mohamed Lotfy
mlotfy@regis.edu

**From:** Kara Tucker [mailto:kara.tucker@informs.org]
**Sent:** Wednesday, October 08, 2014 10:12 AM
**To:** Lotfy, Mohamed
**Cc:** Anoweck, Kimberly
**Subject:** RE: Permission to use a figure

Dear Mohamed Lotfy,

Your permissions request has been forwarded to me for reply.

Permission is granted to use the following material in your dissertation at no charge:

Figure 2 from: DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3(1)*, 60-95.

Please use the following credit line:

“Reprinted by permission, (author), (title of article), (title of journal), volume (#), number (#), (month, year). Copyright (year), the Institute for Operations Research and the Management Sciences, 5521 Research Park Drive, Suite 200, Catonsville, Maryland 21228 USA.”

If you are using an adaptation of the figure, please use this credit line instead:

"Adapted with permission from (author), (title of article), (title of journal), volume (#), number (issue #), (month, year). Copyright (year), the Institute for Operations Research and the Management Sciences, 5521 Research Park Drive, Catonsville, Maryland 21228."

Please let me know if you have any questions.

Thank you,
Kara

---------------------------------------------------

**Kara Tucker**
Production Editor/Marketing Content Specialist

INFORMS

INFORMS CAP Tops CIO Magazine List of 11 Big Data certifications that will pay off

**From:** Anoweck, Kimberly
**Sent:** Tuesday, October 07, 2014 9:17 AM
**To:** Kara Tucker
**Subject:** FW: Permission to use a figure

**From:** General Mail
**Sent:** Tuesday, October 07, 2014 8:59 AM
**To:** Anoweck, Kimberly
**Subject:** FW: Permission to use a figure

**From:** Lotfy, Mohamed [mailto:mlotfy@regis.edu]
**Sent:** Monday, October 06, 2014 10:50 PM
**To:** General Mail
**Subject:** Permission to use a figure

Hi,

I am a Ph.D. student and want to include figure 2 on page 87 from DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the defendant variable? *Information Systems Research, 3(1)*, 60-95.

in my dissertation. Will you provide me the permission to use an adapted diagram from figure 2 from the above-mentioned paper in my dissertation?

Thank you,
Mohamed Lotfy
mlotfy@regis.edu

M.E. Sharpe INC.
PUBLISHER

80 Business Park Drive
Armonk, New York 10504
Phone: 914-273-1800
FAX: 914-273-2106
Federal ID # 13-1887165

**PERMISSION TO REPRINT**

October 8, 2014

Mohamed Lotfy
3095 S. Idalia Street
Aurora, CO 80013

Dear Mr. Lofty,

We are pleased to grant permission to you for the reprinting of: W.H. DeLone and E.R. McLean, "The DeLone and McLean model of information systems success: A ten-year update," *Journal of Management Information Systems,* 19(4) (2003), 9–30; specifically, figure 3

For use in: Mohamed Lotfy, PhD Dissertation: Sustainability of ERP benefits post-implementation: An individual user perspective (Applied Management and Decision Sciences, Information Systems Management Specialization, Walden University)

This permission is subject to the following conditions:

1. Payment on or before initial publication of the book of the following fee: US$ NO FEE.
2. Each copy containing our material that is reproduced or distributed **must bear the following copyright notice**:

From W.H. DeLone and E.R. McLean, "The DeLone and McLean model of information systems success: A ten-year update," *Journal of Management Information Systems,* 19(4) (2003), figure 3. Used by permission of M.E. Sharpe, Inc. All Rights Reserved. Not for reproduction.

3. Permission is granted for non-exclusive world rights in the **English language** only.
4. Permission is granted for print and electronic (as in the **contiguous electronic dissertation**) usage only. No permission is granted for any other uses, including but not limited to granting others the right to reproduce the Material.
5. This permission grant is for publication of one edition of the book (including non-profit editions for the visually handicapped), with a print quantity not exceeding 20,000 copies.
6. This permission does not apply to any material copyrighted by or credited in our publication to another source. It is the responsibility of the prospective publisher for determining the source of any such material.
7. This License shall automatically terminate if you fail to exercise the rights granted hereunder to make the Use specified within 36 months of the date of this letter or fail to comply with the terms herein. In addition, we reserve the right to revoke this permission at any time effective upon written notice to you in the event we conclude, in our reasonable judgment, that your use of our Material in electronic format is compromising our proprietary rights in this Material.

With best wishes,

Elizabeth Parker

Elizabeth Parker
Rights & Permissions Manager