ABSTRACT

Title: **AN ANALYSIS OF SUCCESS AND FAILURE FACTORS FOR ERP SYSTEMS IN ENGINEERING AND CONSTRUCTION FIRMS**

BooYoung Chung, Ph.D., 2007

Directed By: **Professor Miroslaw J. Skibniewski,**
Department of Civil & Environmental Engineering

Even though the use of ERP systems is growing and becoming more popular, these systems are still somewhat unfamiliar in the construction industry. Many engineering and construction firms know how beneficial ERP systems are, but they still hesitate to adopt these systems due to their high cost and risk. Without a doubt, a successful ERP implementation is an essential for the benefits from such systems, so this issue is always considered top priority in the ERP related research area. It is obvious that several important factors must be considered for successful implementation, but most engineering and construction firms have no idea what factors should be considered most heavily. Therefore, the main goal of this research is to help these firms better understand the critical factors that need to be considered to ensure the success of ERP systems.

This research formulated the conceptual ERP success model based on strong background theories and knowledge gained from several industry practitioners. The survey instrument was designed based on the conceptual ERP success model, and was tested before

conducting the main survey. The ERP success model and its variables were finally fixed after completing a series of data analyses with the main survey.

Since there have been few studies attempting to validate empirically the factors affecting both ERP implementation and user adoption, this research focused on identifying the factors for the ERP success from both implementation project and user adoption perspectives. Then, identified factors were examined to verify their relationships with success indicators associated with the redefined ERP success. Furthermore, the research suggested recommendations for the ERP success showing how to approach ERP implementation to avoid failure and what we should do considering the significance of each factor to a given dependent variable based on the findings of the study. These recommendations can provide helpful information to engineering and construction firms when they consider implementing or upgrading their ERP systems. This information should help companies reduce tremendous ERP implementation risks so that companies can have more chances to improve their business value with the success of EPR systems.

AN ANALYSIS OF SUCCESS AND FAILURE FACTORS FOR ERP SYSTEMS IN ENGINEERING AND CONSTRUCTION FIRMS

By

BooYoung Chung

Dissertation Submitted to the Faculty of the Graduate School of the

University of Maryland, College Park, in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

2007

Advisory committee:

Professor Miroslaw J. Skibniewski, Chair

Professor Henry C. Lucas, Jr.

Professor Gregory B. Baecher

Professor Young Hoon Kwak

Professor Boong-Yeol Ryoo

PREFACE

Even though the use of ERP systems is growing and becoming more popular, these systems are still somewhat unfamiliar in the construction industry. Many engineering and construction firms know how beneficial ERP systems are, but they still hesitate to adopt these systems due to their high cost and risk. Without a doubt, a successful ERP implementation is an essential for the benefits from such systems, so this issue is always considered top priority in the ERP related research area. It is obvious that several important factors must be considered for successful implementation, but most engineering and construction firms have no idea what factors should be considered most heavily. Therefore, the main goal of this research is to help these firms better understand the critical factors that need to be considered to ensure the success of ERP systems.

This research formulated the conceptual ERP success model based on theories and knowledge gained from several industry practitioners. The conceptual model adapted the Technology Acceptance Model (TAM) as the starting point for the structure of relationships between factors and indicators. DeLone and McLean's IS success model was used for identifying success indicators. Finally, the fundamentals of project management were incorporated into the model for analyzing the success of ERP implementation. Therefore, this model is theoretically sound and can be helpful in providing better understanding about the success of ERP systems.

The survey instrument was designed based on the conceptual ERP success model, and most items in the survey were primarily adapted from the relevant previous research in the IS contexts. It was tested before conducting the main survey to examine whether or not the proposed model was well developed to analyze ERP success. The proposed model and contents of the survey were modified based on the results of the pretest.

The main survey was conducted through a web survey, and a total of 281 responses were received. These consist of 141 responses from the U.S. (50%), 131 responses from Korea (47%), and 9 responses from other different countries (3%). Among the valid responses, 22% of respondents use SAP, 44% of respondents use Oracle, and 34% of respondents use different software other than SAP or Oracle. The average years of experience of respondents was 13.9 years, and about 80% of respondents have at least 6 years of experience in the construction industry. In addition, the average of respondent's use hours of the ERP system was 13.4 hours per week, and 68% of respondents used their ERP system at least 6 hours per week. With extensive data analysis, the proposed model was revised, and factors were fixed by reflecting a series of factor analyses before the main analysis was started.

The first main analysis done in this research was a comparison of samples using t tests or analysis of variance (ANOVA). The results of the analysis are summarized as follows:

- There are significant differences between responses from the U.S. and Korea, especially in user related variables. Most means of responses from the U.S. were higher than those of Korea indicating that the U.S. respondents were satisfied with their ERP systems more than Korean respondents.

- There is little difference in responses with respect to software used.
- There are significant differences between the more experienced group and less experienced group, especially in project related variables. Respondents in the more experienced group tended to give higher scores in variables related to the ERP project since they were possibly responsible for their ERP implementation.
- There are significant differences between the normal use group and heavy use group, especially in variables related to "Use".

The regression analysis was conducted to examine the relationships between factors and indicators. Five different regression models were presented to identify relationships between factors and each dependent variable attributed to ERP success. The main findings are summarized as follows:

- The main structure of the relationships is identified as follows: Success Factors – Perceived Usefulness – Intention to Use / Use – ERP Benefits; Function – Quality – ERP Benefits; Internal Support – Progress.
- "Function" is the most important factor to increase perceived usefulness. "Output Quality", "Result Demonstrability", "Subjective Norm", and "Perceived Ease of Use" also impact on "Perceived Usefulness" significantly.
- "Perceived Usefulness" is the main determinant of "Intention to Use / Use". "Subjective Norm" and "Perceived Ease of Use" also have a significant impact on "Intention to Use / Use".

- Both “Use” and “Quality” impact on the final dependent variable “ERP Benefits” significantly, but “Progress” does not. It indicates that although an ERP implementation project was not completed on time and within budget, a company still has a chance to get the full benefits from the ERP system if its quality and scope are satisfactory.
- Both “Internal Support” and “Consultant Support” can affect the progress (on time & on budget) of ERP implementation significantly, but “Function” does not.
- “Function” is the most important factor for “Quality” of the ERP system. “Consultant Support” can also impact on “Quality”, but there is no impact expected from “Internal Support”.

The research also found that there are significant differences in the regression analysis between the U.S. and Korean samples. The findings are described as follows:

- The main difference with respect to the regression on “Perceived Usefulness” is that “Function” and “Result Demonstrability” are the main determinants of “Perceived Usefulness” in the Korean sample, but “Subjective Norm” and “Job Relevance” are the main determinants in the U.S. sample. Another main difference between the two groups is that “Perceived Ease of Use” is significant in the U.S. sample, but not in the Korean sample. An interesting finding is that “Output” is not significant in either sample, but it becomes significant in regard to all responses.
- Regarding the regression on “Intention to Use / Use”, “Perceived Usefulness” is the most important factor in both samples. The difference between the two groups

is that “Subjective Norm” and “Perceived Ease of Use” impact on “Use” significantly in the U.S. sample, but not in the Korean sample.

- There is little difference between the U.S. and Korean samples with respect to the regression on “ERP Benefits”.
- According to the regression analysis about project success, just a marginal difference exists in “Progress” and “Quality”. “Internal Support” is the most important factor for “Progress” in both samples, but more significant in the U.S. sample. “Function” is the most important factor for “Quality” of ERP system in both samples, and its significance for each sample does not differ. The other difference found is that “Consultant Support” impact on both “Progress” and “Quality” in the U.S. sample even though the effects are marginal, but there is little impact of “Consultant Support” in the Korean sample.

This research conducted Structural Equation Modeling (SEM) to examine the validity of the proposed research model as a complementary analysis. The results using SEM were compared with those of regression analysis to see if there are any differences or additional findings with respect to the research model. The detailed results using SEM show that there is little difference between the results of SEM and regression analysis. The goodness of fit indices of the original ERP success model indicates that the model does not fit well, so “Best Fit Model” was proposed, in which all the indices of the revised model are within the desired range. The final revised model has a more parsimonious structure than the original model.

The research finally suggested several recommendations for the success of ERP systems based on the results of identifying the relationships between factors and indicators, which are described in detail in Chapter 6. These recommendations should allow engineering and construction firms to have a better understanding of ERP success and help them to avoid failure considering critical factors attributed to successful ERP implementation.

ACKNOWLEDGEMENTS

My deepest sense of gratitude goes to my advisor, Prof. Miroslaw Skibniewski, for his faith in this research, and his constant encouragement over the years. Working under his supervision has been a stimulating and rewarding experience. I feel very fortunate to have been his student. I would like to thank Prof. Henry Lucas Jr. for his insightful comments and suggestions. Without his help, this dissertation would have never been reality. I have greatly benefited from his advice and guidance in all aspects of my life.

I am also grateful to my committee members, Prof. Gregory Baecher, Prof. Young Hoon Kwak, and Prof. Boong-Yeol Ryoo, for their reviews, critiques, questions, and valuable guidance throughout my research. Their comments and suggestions greatly helped shape this dissertation.

I would also like to thank all organizations and personnel who assisted me in distributing the survey. Without their help and support, this research could never be possibly done. I also appreciate the support and sincere friendship of my fellow graduate students in e-Construction Group.

Finally, but most importantly, this research would not have been possible without all the love and steadfast support of my parents and parents in law. This dissertation is dedicated to my wife, Helen, and to my dearest daughters, Eugene and Sera with all my heart.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Background

Enterprise Systems (ES), also called Enterprise Resource Planning (ERP) systems, are among the most important business information technologies to emerge in the last decade. While no two industries' Enterprise Systems are the same, the basic concept of Enterprise Systems is focused mainly on standardization, synchronization and improved efficiency. ERP is basically the successor to material resource planning (MRP) and integrated accounting systems such as payroll, general ledger, and billing. The benefits of Enterprise Systems are very significant: coordinating processes and information, reducing carrying costs, decreasing cycle time and improving responsiveness to customer needs (Davenport 2000; Elarbi 2001).

Traditionally, the construction industry has been faced with the problem of getting and keeping projects on schedule, under budget, and safe with the quality specified by the owner and/or architect/engineer (A/E). Although the construction industry is one of the largest contributors to the economy, it is considered to be one of the most highly fragmented, inefficient, and geographically dispersed industries in the world. To overcome this inefficiency, a number of solutions have long been offered.

Recently, a significant number of major construction companies embarked on the implementation of integrated IT solutions such as Enterprise Systems to better integrate their various business functions, particularly those related to accounting procedures and practices. However, these integrated systems in construction present a set of unique challenges, different from those in the manufacturing or other service sector industries. Each construction project is characterized by a unique set of site conditions, a unique performance team, and the temporary nature of the relationships between project participants. This means a construction business organization needs extensive customization of pre-integrated business applications from ERP vendors. Unfortunately, such an extensive customization can lead a construction firm to ERP implementation failure. Based on a number of consultants' comments, the best way to achieve the full benefits from ERP systems is to make minimal changes to the software. For these reasons, finding the best implementation strategy of integrated Enterprise Systems is mandatory to maximize the benefits from such integrated IT solutions in construction companies.

1.2 Problem Statement

Usually, ERP vendors show off their successful implementation stories on their websites. However, there are also many failures behind their implementation experiences. ERP projects are notorious for requiring a long time and a lot of money. Jennifer Chew, an analyst at Forrester Research, found that 54 percent of respondents to her survey said that their ERP implementation project lasted more than two years. She pointed out that K-mart attempted to install an ERP system in the 1990s, but had to write off the entire $130 million project that was never launched (Worthen 2002).

Although an ERP application was developed to be an off-the-shelf package, companies often found this software too complex to install and run. One of the reasons is that ERP systems can change how people work and how businesses are run. For example, Dell computer attempted to implement the SAP R/3 system to support its manufacturing operations in 1994. However, Dell experienced significant difficulty in implementing the SAP system, and finally abandoned this implementation project two years later, in 1996. Terry Kelley, Chief Information Officer at Dell at that time, said (Stein 1998),

"SAP was too monolithic to be altered for changing business needs. . . . Over the two years we were working with SAP, our business model changed from a worldwide focus to a segmented regional focus."

Large IT projects such as ERP implementations have more chance to be failures than most people expect. In the last decades, many studies have identified that the success rate is approximately 25%, the failure rate is also about 25%, and partial successes and failures exist around 50% (Kozak-Holland 2007). Many failure cases about ERP implementation projects have been reported including the U.S. federal government cases such as the U.S. Internal Revenue Service (IRS) and Federal Bureau of Investigation (FBI) cases. The IRS launched new Customer Account Data Engine (CADE) in 1999 to upgrade its IT infrastructure and more than 100 business applications. However, most of its major projects ran into serious delays and cost overruns. The project costs have increased by more than $200 million according to the U.S. General Accounting Office (Varon 2004). Furthermore, the loss of approximately $320 million, which the IRS mistakenly paid in bad tax refunds in 2006, was caused by this delayed IT project (Keizer

2006). FBI also launched a new IT project to switch its old case management system to the new software, known as Virtual Case File (VCF) in 2000. In 2005, however, the U.S. Justice Department Inspector General Report stated that $170 million VCF project was failure and might never materialize (Knorr 2005). The main reason of IRS and FBI failures lies largely with their bureaucracy. These agencies did not follow the required procedures for developing the new systems and failed to give consistent direction to their contractors. Even the FBI gave its contractor nearly 400 requirements changes (Kozak-Holland 2007).

In most cases, the cost of a full-scale ERP implementation in a large organization can easily exceed $100 million, and the implementation usually takes at least 2 years to complete. Not only do ERP systems need plenty of time and money to implement, even successful implementations can disrupt a company’s culture, create extensive training requirements, and lead to productivity losses. Furthermore, many experts say that over 50 percent of U.S. firms experience some degree of failure when implementing advanced manufacturing or information technology. Unfortunately, many companies have already experienced significant troubles trying to implement ERP systems, and these poorly executed implementations have had serious consequences. One recent survey revealed that 65 percent of executives believe ERP implementation has at least a moderate chance of damaging their business. Obviously, it is very important to identify and understand the factors that impact heavily on the success or failure of ERP implementation (Umble and Umble 2002).

1.3 Research Objectives

The main objective of the completed research is to present guidelines for ensuring successful ERP implementation, providing factors associated with the success of ERP systems in engineering and construction firms. To do so, the research identifies the factors affecting the success or failure of ERP implementation, and analyzes these factors according to the level of significance in affecting the success of ERP systems. To achieve the goal of the study, the following research questions are addressed as primary research objectives:

1) What are the factors affecting the success or failure of ERP implementation?
   - What factors can lead users to use or intend to use ERP systems?
   - What factors can make ERP implementation projects successful?
   - What are the relationships between factors?
2) How can we define the success of ERP implementation?
   - What are the indicators to evaluate ERP implementation success?
   - What are the relationships between success indicators?
3) How do we approach implementation to avoid failure?
   - What are the relationships between factors and success indicators?
   - What factors should be considered most seriously to avoid failure?
   - What should companies do to make ERP implementation projects successful?

This research attempts to provide answers to the three major questions above to achieve the following research objectives:

1) Propose an ERP success model

- Identify factors leading users to use or intend to use ERP systems
- Identify factors affecting successful ERP implementation projects
- Present success indicators from which ERP success can be determined

2) Validate the model using extensive data analysis

- Conduct a survey based on the proposed model
- Analyze the relationships between success factors and indicators

3) Present a strategy to avoid ERP system failure

- Provide research findings based on empirical analysis of ERP success
- Suggest recommendations to achieve ERP success

1.4 Importance of Research

It is widely accepted from empirical evidence to date that the benefits from ERP systems are very significant (Gefen and Ragowsky 2005; Murphy and Simon 2002; Shang and Seddon 2000; Stensrud and Myrtveit 2003). These benefits mostly come from the integration of all the necessary business functions across the organization, with which the organization can make its business processes more efficient and effective. However, the complex nature of ERP systems has required many organizations to commit significant organizational and financial resources to their ERP initiatives, which in turn have encountered unexpected challenges associated with system implementation. For this reason, ERP implementation is generally considered a high cost and high risk activity that consumes a significant portion of a company's capital budget and is filled with a high level of risk and uncertainty. There have been many failure cases reported in the literature, which shows mostly abandoned implementation projects with significant financial damage. Many companies have suffered from partial failures which resulted in tenuous adjustment processes for their business functions and created some disruption in their regular operations (Gargeya and Brady 2005). To overcome these problems, more extensive studies with respect to the factors affecting ERP success or failure are required to minimize ERP implementation risks.

The vast literature related to ERP systems in IS research has focused on the success or failure of ERP implementation. There are many case studies of both success and failure of ERP implementation, but few studies attempt to validate empirically the factors that drive successful ERP implementation. The identification of these factors has been mostly based on the experiences of IT professionals or senior managers who have been involved in ERP implementation in their organizations. However, it may happen that end users do not care to use the ERP system in spite of a successful ERP implementation. In this case, the implementation cannot be regarded as successful. For these reasons, this study focuses on analyzing the ERP success from the combined point of view of implementation project and user adoption. Based on this concept, new success factors will be postulated with the redefined ERP success, and then will be validated empirically through data analysis.

The results of this research can provide helpful information to engineering and construction firms when they consider implementing or upgrading their Enterprise Systems. Clearly, it is critical to identify and understand the factors that largely determine the success or failure of ERP implementation. This study will identify the causes of failure and analyze them according to their significance. If these causes are addressed properly, the contribution to the knowledge about ERP success will be huge. This is one of the key issues related to Enterprise Systems in the business domain, and can reduce tremendous ERP implementation risks. Furthermore, the research provides holistic understanding about the concept of integrated Enterprise Systems, including structure and representative modules for engineering and construction firms. This approach should allow construction firms considering the implementation of integrated Enterprise Systems to make informed decisions in the early stages of strategic planning in regard to the existing alternatives.

1.5 Organization of the Research

This research consists of seven chapters. Chapter 1 introduces background information and motivation for the research in the area of ERP systems planning. Chapter 2 reviews the previous efforts and findings in related areas. It presents an overview of Enterprise Systems and application modules for engineering and construction firms by providing the general concept of such systems. Chapter 3 has two main sections. In the first section, previous research on user acceptance models in information systems and fundamentals of project management in ERP implementation are presented to form the theoretical background of the research model. The second section provides the research model, describing factors and components along with their definitions and causal relationships. Chapter 4 presents the research design, showing survey instruments and their descriptions. The results of the pilot survey examine whether or not the survey instrument is developed properly. Chapters 5 and 6 contain the analysis of the survey results and main research findings. Chapter 7 summarizes the study and concludes by examining the contributions of the completed research and presents recommendations for future continuation of this work. Figure 1.1 shows the organization of this research.

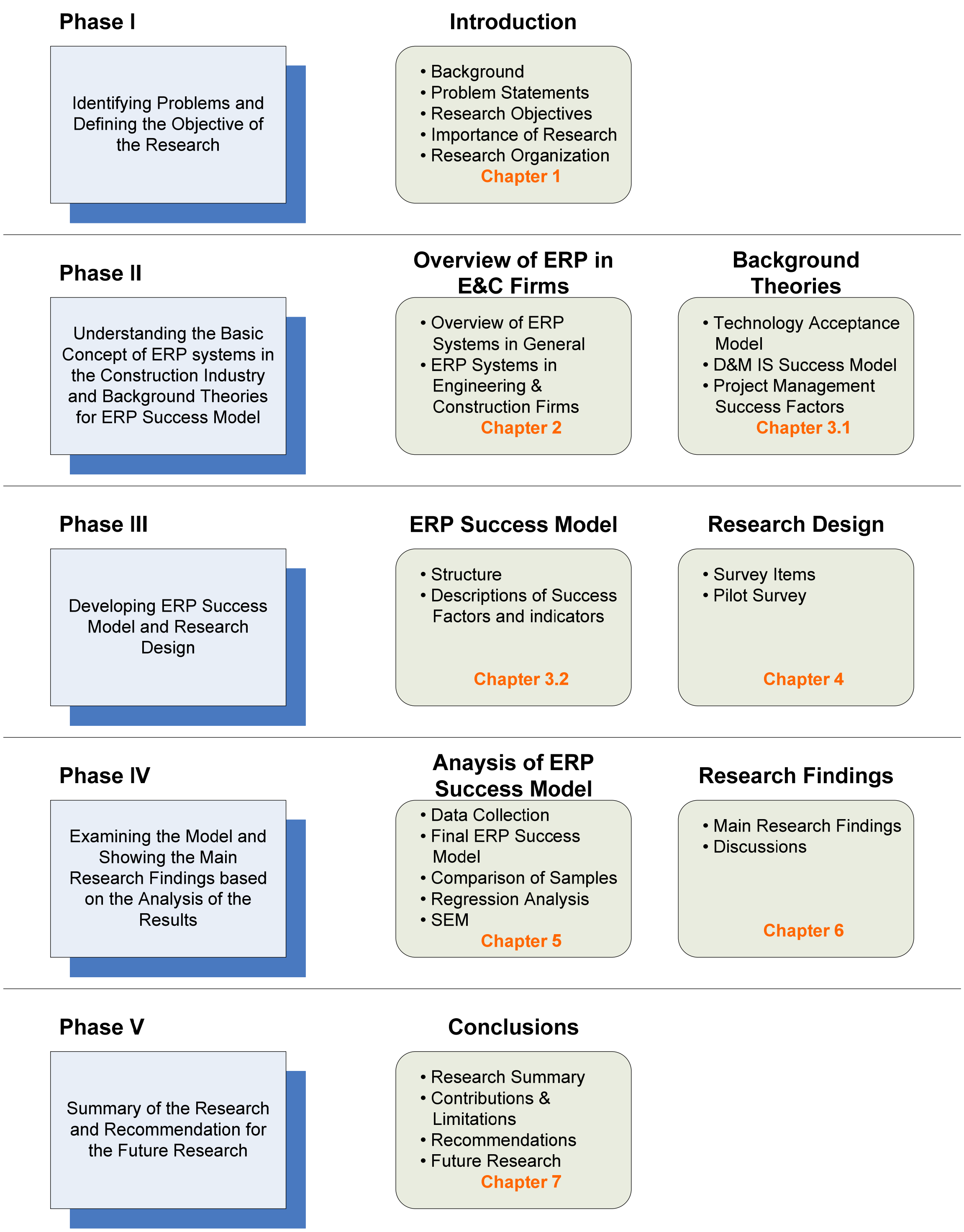


Figure 1.1 Organization of the Research

2 OVERVIEW OF ERP SYSTEMS IN ENGINEERING & CONSRUCTION FIRMS

2.1 Overview of ERP Systems in General

2.1.1 Background

Modern Enterprise Resource Planning (ERP) systems have their roots in Materials Requirement Planning (MRP I) systems, which were introduced in the 1960s. MRP I systems are computer-based systems for inventory control and managing production schedules. As data from the factory floor, warehouse, or distribution center began to affect more areas of the company, the need to distribute these data across the entire enterprise demanded that other business area databases interrelate with the MRP I system. However, MRP I systems had limitations on this functionality leading to the development of Manufacturing Resource Planning (MRP II) systems, which have now given way to ERP. MRP II systems can evaluate the entire production environment and create or adjust master schedules based on feedback from current production and purchase conditions. Finally, companies such as SAP, Oracle, and others are reaping the rewards of dramatic growth as companies move away from legacy MRP II systems and begin the process of ERP implementation. Their solutions are more robust than any host-based MRP system to date (Bedworth and Bailey 1987; Intermec 1999; Januschkowetz 2001).

O'Leary (2000) defined ERP systems as "computer-based systems designed to process an organization's transactions and facilitate integrated and real-time planning, production, and customer response" (O'Leary 2000). The process of ERP systems includes data registration, evaluation, and reporting. Data registration is entering data into a database, data evaluation is reviewing data quality and consistency, and data reporting is the process of data output sorted by certain criteria (Januschkowetz 2001). The role of enterprise resource planning (ERP) does not match its name. It is no longer related to planning and resources, but is rather related to the enterprise aspect of the name. ERP attempts to unify all systems of departments together into a single, integrated software program based on a single database so that various departments can more easily share information and communicate with each other. This integrated approach can have a remarkable payback if companies install the software properly. An increasing number of companies want to obtain all relevant information about their business processes to control and guide them in a profitable direction (Koch 2002).

Most ERP vendors have suggested that the best way to obtain the full benefits of their software was to implement their software packages with minimal changes. However, currently, instead of implementing an entire ERP package, many companies have adopted a best-of-breed approach in which separate software packages are selected for each process or function. For this reason, regardless of the agreed upon implementation approach, any integrated corporate system in which all the necessary business functions are pieced together for the company is considered the ERP system in this study.

2.1.2 Advantages and Disadvantages

ERP systems can support a company's work in many ways. Since ERP systems integrate all parts of a company seamlessly, more proper control is possible. ERP systems are able to minimize redundant data registration, control data produced by different departments, and reduce registration errors. The interconnectivity among all the modules of ERP systems reduces the time to perform the different operational tasks, so the company's efficiency can be increased. ERP systems enable users to access timely information and accurate reports can be produced at any time. The main reasons that companies undertake ERP systems are summarized as follows (Koch 2002):

① Integrate financial information

Finance has its own set of revenues, sales, costs, and other information. Different business units may have their own versions of how much they contribute to revenues. ERP systems create a single version of the information that cannot be questioned because all members of a company are using the same system.

② Integrate customer order information

ERP systems can become the platform for where the customer order stays from the time a customer service representative receives it until the merchandise is shipped and an invoice sent. By having this information in one integrated system rather than scattered among many different systems that cannot communicate with one another, companies are able to keep track of orders more easily and coordinate other related departments with them across many different locations at the same time.

③ Standardize and speed up manufacturing processes

Many companies often find that multiple business units across the company, e.g., following a merger or acquisition, make the same product part using different methods and computer systems. ERP systems use standard methods for automating some of the manufacturing process steps. Standardizing these processes and using a single, integrated system can save time, increase productivity, and reduce product cycle time.

④ Reduce inventory

ERP systems can make the manufacturing process flow more efficiently, and it improves observation ability of the order processing inside the company. This can lead to reduced inventories of the parts used to make products, and can help users make better planned deliveries to customers, reducing the finished product inventory at the warehouses and shipping docks.

⑤ Standardize HR information

ERP can fix the HR problem of a company that may not have a unified, simple method for tracking employees' time and communicating with them about benefits and services, especially in the case of companies with multiple business units.

While there can be many advantages of ERP systems, as described above, there are also several disadvantages. The implementation costs of ERP systems are so high that this prohibits small and medium businesses from acquiring such systems. In addition, ERP systems require considerable time to implement in a company, and they may slow down the routine operations within a company during the implementation period. Since this integrated system has to be well-defined in the beginning of implementation, it will be difficult to change it afterwards. The criticisms of ERP systems are summarized as follows (Davenport 2000):

① Inflexibility

Once an ERP is installed in a company, it is too difficult to change how the company works and is organized. ERP systems are like cement, which is highly flexible in the beginning, but rigid afterward.

② Long implementation periods

It takes too long to implement ERP systems. A three to five year implementation period of ERP systems is fairly common in a large company. In the current rapidly changing business world, five and even ten year projects are not supportable.

③ Overly hierarchical organizations

ERP systems presume that information will be centrally monitored and that organizations have a well-defined hierarchical structure. Therefore, these systems will not match with organizations of empowerment or with employees as free agents.

ERP systems for the construction industry have similar advantages and disadvantages according to the literature (O'connor and Dodd 2000; Shi and Halpin 2003). In particular, construction firms can achieve benefits associated with materials management by using such systems. Lee et al (2002) stated in their study that an ERP system can shorten the procurement cycle up to approximately 80%, by automating the repeating transactions, and reducing manpower to perform the task (Lee et al. 2004).

2.1.3 Major Vendors

1) SAP

The first company which introduced a functional enterprise system was SAP AG, headquartered in Walldorf, Germany. Five software engineers at IBM in Germany had the idea for a cross-functional information system. However, the idea was rejected by IBM, so the engineers founded their own company in 1972. R/2, SAP's earliest integrated system, ran on mainframes. R/3, the next version of the system, was a client/server system introduced in 1992. mySAP ERP, the successor to SAP R/3, is the first service-oriented business application on the market based on SAP NetWeaver, an open integration platform that allows new applications to be developed. In 2005, SAP had about 26,150 customers, 12 million users, 88,700 installations, more than 1,500 partners and a share of over 30 percent of the ERP market. SAP is the world's largest inter-enterprise software company and the world's third largest independent software supplier (Davenport 2000; SAP 2005).

SAP's strength is the breadth and extensive capability of its software's functionality, even though it leads to complexity in the system and its implementation. SAP spends much more on R&D than any other competitor and is most likely to introduce new functionality as a result (Davenport 2000). In 2003, SAP NetWeaver became the first platform to allow seamless integration among various SAP and non-SAP solutions, reducing customization and solving the integration issue at the business level. The solution of SAP regarding the integration issue is the use of open standards that allow software applications to be accessed as web services. With SAP NetWeaver, customers could pick and choose the specific SAP web services modules that met their own needs. It delivers much more valuable business functions, such as order management, with the flexibility of web services (SAP 2005).

2) Oracle

Oracle Corporation was first founded by Larry Ellison in 1977 as a database company. Oracle technology can be found in nearly every industry around the world; its database offering is the most popular repository of ERP data. Oracle began to develop its own business applications in the late 1980s, the early version of the applications coming from co-development projects with customer companies. Its ERP package, named Oracle E-Business Suite, has almost 50 different modules in seven categories: Finance, Human Resources, Projects, Corporate Performance, Customer Relationship, Supply Chain, and Procurement. It also offers industry-specific solutions, most of which were acquired from companies that had developed them to a certain degree. Currently, Oracle has developed 100 percent internet-enabled enterprise systems across its entire product line: databases, business applications, and application development and decision support tools. Oracle is the world's leading supplier of software for information management, and the world's second largest independent software company overall (Davenport 2000; www.oracle.com 2005).

In 2005, Oracle closed the gap with SAP in the ERP market by buying PeopleSoft Inc. for $10.3 billion. Previously, PeopleSoft Inc. merged with J.D. Edwards, so Oracle now has three different product lines in enterprise solutions: Oracle's "E-Business Suite," PeopleSoft's "Enterprise," and J.D. Edwards's "EnterpriseOne" and "World." The new combined company plan is to incorporate the best features and usability characteristics from Oracle, PeopleSoft, and J.D. Edwards products in the new standards-based product set. The successor product, named Oracle Fusion, is expected to evolve over time and incorporate a modern architecture, including the use of web services in a service-oriented architecture. The outcome will be the best in exceptionally deep and flexible process automation, as well as high quality, real-time information (www.oracle.com 2007).

Among the Oracle product lines, PeopleSoft Enterprise enables organizations to reduce costs and increase productivity by Pure Internet Architecture, directly connecting customers, suppliers, partners, and employees to business processes on-line, in real time. PeopleSoft's integrated applications include Customer Relationship Management, Supply Chain Management, Human Capital Management, Financial Management and Application Integration. J.D. Edwards EnterpriseOne, suitable for large organizations, is the complete solution for modular, pre-integrated industry-specific business applications designed for rapid deployment and easy administration on pure internet architecture. J.D. Edwards World is ideally suited for small businesses because of its reliable, functionality-rich, web-enabled environment for managing plants, inventories, equipment, finances, and people. It is a synchronized, integrated, and pre-bundled enterprise software on a single database, which reduces implementation cost and complexity (www.oracle.com 2007).

2.1.4 Main Functions and Characteristics

1) Structure

An ERP system has the following technological characteristics (Keller 1994):

- Use or integration of a relational database
- Several interfaces, including a graphical user interface (GUI)
- Openness to different hardware platforms
- Client-server architecture
- Consideration of supply chain
- Openness to internet and intranet

Since ERP systems fulfill the managerial functions and the information needs of the organization, the structure of ERP systems is typically divided into three data layers as follows:

- Operational system (Registration layer)
- Tactical system (Controlling layer)
- Strategic system (Executive Information Systems (EIS) layer)

The structure of an ERP system is shown in Figure 2.1.

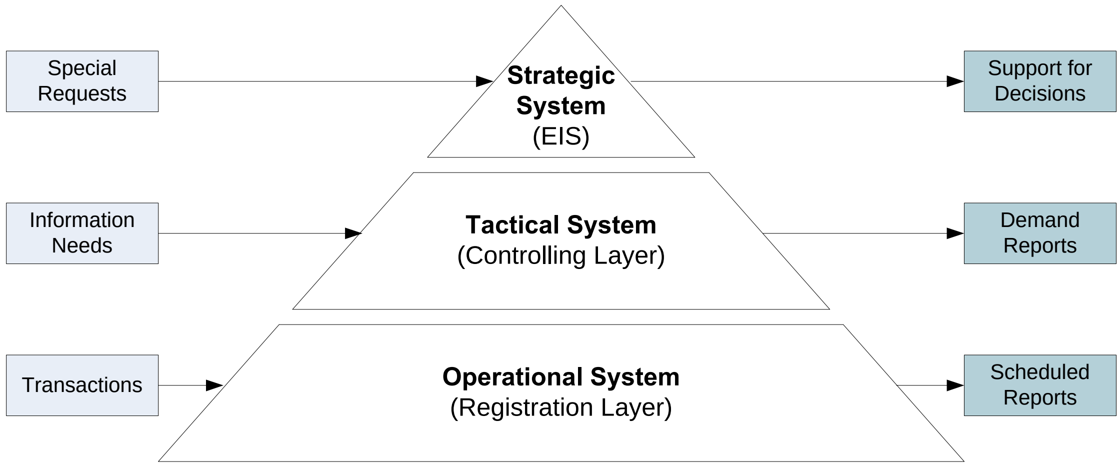


Figure 2.1 Structure of an ERP System (Januschkowetz 2001; Schultheis et al. 1992)

Most ERP systems now run on a client/server computing architecture. This means that some parts are processed on a server and some by the client, such as on a desktop computer. Those systems are large and complex applications needing powerful servers and PCs. Early versions of ERP systems ran on centralized mainframes. A few firms still use these mainframe versions, but most companies are moving toward the installation of the client/server version (Davenport 2000).

Some brands of ERP (e.g., SAP) currently use the three-tier model of a client/server version, which has a clear division between the three different system layers. The basic layer is the database server, which manages the working data of an organization, including master data, transaction data, and meta-data in a relational database. The second layer is the application server where the complete system applications are processed. The application servers use the data of the database server and write data back to that server. The top layer is the presentation server, the graphical user interface (GUI). Currently, additional layers can be used for web applications, CAD systems, or simulation tools. Figure 2.2 shows an example (SAP R/3) of the client/server system architecture (SAP 1999).

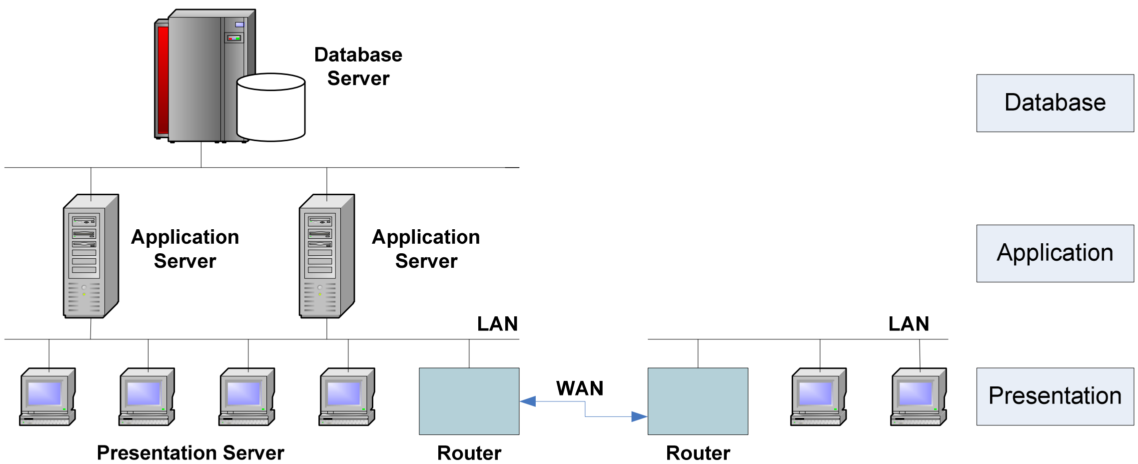


Figure 2.2 Client/Server System Architecture (SAP 1999)

2) Functions

Most major operational processes can be supported by ERP systems. Although there is some variation across vendor packages, ERP systems can support all financial processes, supply chain processes, manufacturing processes, customer service process, and human resource management. The main functions and their interrelation within ERP systems are shown in Figure 2.3. Detailed descriptions of each follow (Januschkowetz 2001):

① Production Planning and Controlling:

Material, bill of material (BOM), quantities, production times, goods on order, routings, work order, machinery, sales planning, primary and secondary demand, jobs

② Procurement:

BOM, material, prices, conditions, source of supply, quantities, order requests, orders, offers of suppliers, procurement information, inventories, handling of stock

③ Plant Management:

Facilities, investment, service plans, maintenance plans, maintenance orders

④ Sales and Distribution:

Information about partners, customers, BOM, sales prices, quantity, sale conditions, revenue, mailing conditions, transportation, contracts, offers, inquires, service contracts

⑤ Financials and Accounting:

Accounts of debtors, creditors, receipts, liquidity calculations

⑥ Controlling:

Type of costs, type of outputs, receipts, cost units, cost calculations, cost centers, profit centers

⑦ Personnel:

Number of co-workers, qualifications, departments, type of wages, travel information, time management, application information

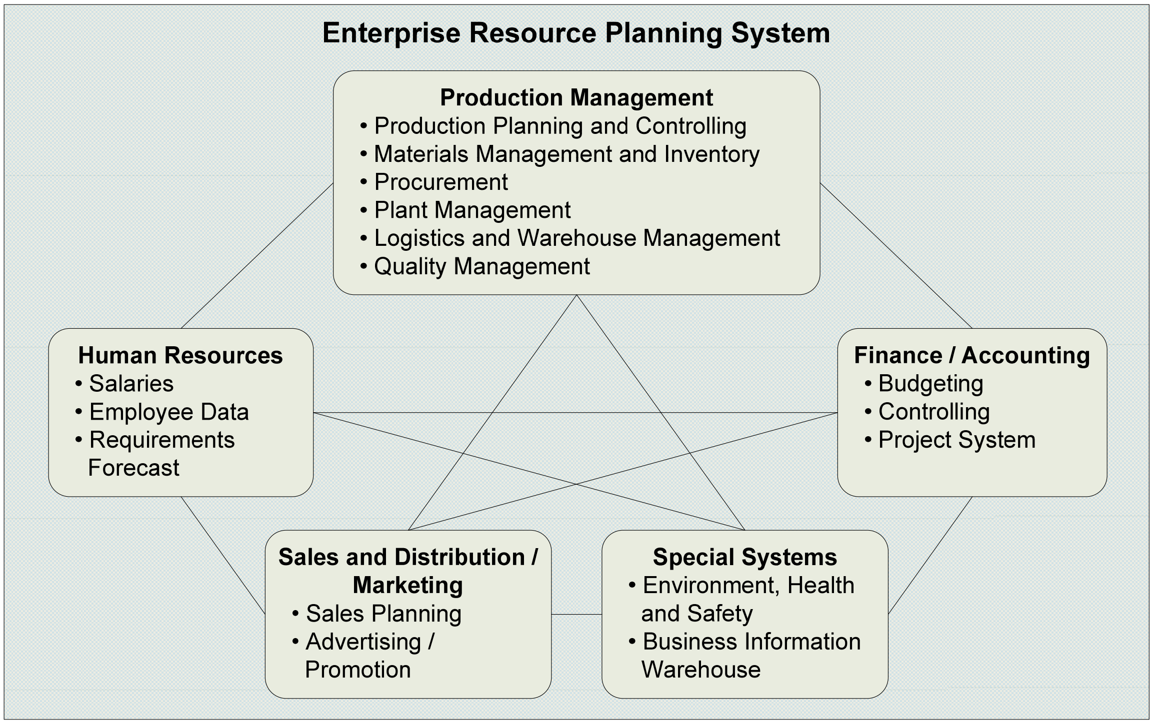


Figure 2.3 Business Functions within ERP Systems (O'Brien 2004)

3) Modules

ERP systems are groups of application modules. SAP, the most comprehensive ERP package, has 12 modules, as shown in Figure 2.4. The modules can interact with each other either directly or by updating a central database. All modules can be implemented as single modules and only those needed are installed. Companies can expand or replace functionality offered by an ERP vendor with software from a third party provider. The goal in such cases is that the third parity software acts as another module, so some customized interfaces must be developed in order for the third party software to connect with the ERP system (Davenport 2000). The functional modules integrated in SAP R/3 are listed in Appendix A-1.

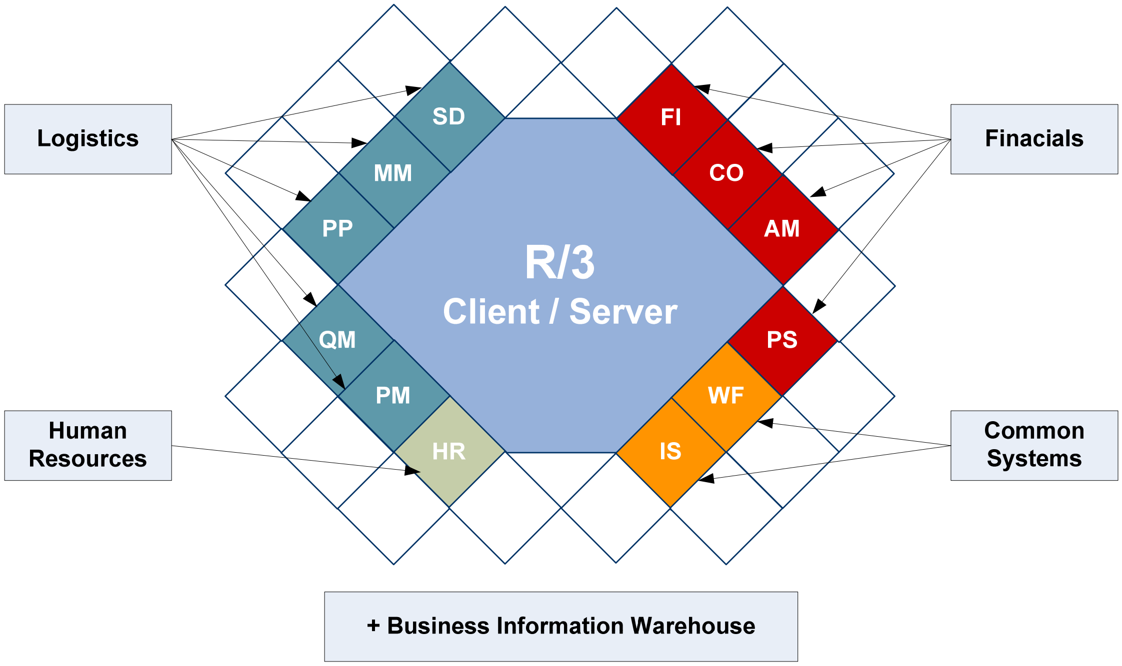


Figure 2.4 Modules in SAP R/3 (SAP 1996)

Oracle has similar application modules which provide business information for effective decision-making, enable an adaptive enterprise for optimal responsiveness, and offer a superior total ownership experience that drives profitability. Its functional modules are classified into seven categories and described in Appendix A-2 (www.oracle.com 2007).

2.2 ERP Systems in Engineering & Construction (E&C) Firms

Major ERP solution vendors such as SAP and Oracle now provide specific solutions for the construction industry. Figures 2.5 and 2.6 show each company's solution maps for the construction industry. As shown in these figures, their solutions handle the full range of business processes that a construction company needs. Even though these solutions have a broad scope, some construction companies may not choose all the solutions provided. Enterprise Portals by Oracle can give employees and partners access to the full range of information, applications, and services they need to work and collaborate online. With this solution, construction companies can manage integrated information from across the organization and the supply chain as well as improve communication with different parties.

This section will show information regarding IT solutions for the construction industry. Because of the project-based nature of the construction industry, project management modules are generally considered top priority, so these modules from ERP vendors will be explained more in detail. After that, the general concept of ERP Systems including major functions and the structure of such systems in the construction industry will be provided.

Enterprise Mgmt.	Strategic Enterprise Mgmt.	Mgmt. Accounting	Financial Accounting	Corporate Governance	Financial Supply Chain Mgmt.	Business Analytics
Project Mgmt.	Planning & Scheduling		Contract Mgmt.		Controlling	
Business Development & Acquisition	Portfolio Planning		Project Development		Opportunity Mgmt.	
Design & Engineering	Basic Design and Engineering		Detail Engineering		Collaboration	
Procurement & Material Mgmt.	Request for Quotation & Awarding		Subcontracting & Purchase Orders		Expediting & Tracking / Quality Inspection	
Fabrication & Assembly	Planning		Execution		Quality Assurance	
Construction Mgmt.	Site Planning & Scheduling	Site Mgmt. & Execution	Fleet Equipment & Tools Mgmt.	Punch List & Warranty	Commissioning / Startup / Handover	
Facility & Plant Operations	Space Mgmt.	Facility Lease Out / In	Maintenance & Operation of Assets	Service, Sales, & Marketing	Service Operations	
Business Support	Compliance Mgmt.	Custom Mgmt.	Fixed Asset Mgmt.	Employee Transaction Mgmt.	Workforce Deployment	

Figure 2.5 SAP Engineering, Construction & Operation (EC&O) Solution Map (SAP 2004)

Streamline Opportunity Management	Drive Bid and Proposal Efficiently	Optimize Delivery of Pre-Construction Tasks	Control Project Changes and Enhance Execution	Manage Close-Out and Ongoing Operations
Sales - Sales - Project Costing **Customer Data Mgmt.** - Customer Data Hub - Customer Data Spoke - Cust. Data Librarian	**Proposal Management** - Proposals - Project Management - Project Collaboration - Project Costing - Project Contracts - CADView-3D - Adv. Project Catalog - Sourcing	**Project Planning** - Project Contracts - Project Management - Project Collaboration - Adv. Project Catalog - CADView-3D **Resource Management** - Project Resource Mgmt. - iProcurement - Purchasing - Service Procurement - iSupplier Portal	**Project Planning** - Project Management - Project Collaboration **Cost Management** - Project Costing - Time & Labor - Payroll - Advanced Benefits - Financials - Project Billing	**Accounting** - Financials - iReceivables - Project Costing - Project Billing **HR Management** - Human Resources - Self-Service HR **Facilities Maintenance** - Enterprise Asset Mgmt. - Self-Service Work Reqs. - Network Logistics

Performance Management	E-Business Intelligence, Balanced Scorecard, Enterprise Planning & Budgeting
Corporate Governance	Internal Controls Manager, Financials, Tutor, Learning Management
IT Infrastructure	Database Server, Applications Server, Systems Management, Development Tools, Collaboration Suite
Services	Consulting, On Demand, Education, Support

Figure 2.6 Oracle Solution Map for Engineering and Construction (www.oracle.com 2006)

2.2.1 Application Modules for E&C Firms

The main application area for the construction industry is project management. Major ERP vendors such as SAP and Oracle provide robust project management solutions for the construction industry. In their project management modules, they cover all the necessary functions in construction project administration, including project cost management, contract management, resource management, collaboration with other parties, and project data management. All the data produced in each module will be updated automatically in real time, because all the functions and modules use one central database. They provide more accurate and timely information to users, which in turn help them make better decisions. The representative project management modules are described below (www.oracle.com 2007; www.sap.com 2007):

1) Project Cost Management

Project cost management functions provided by major ERP vendors (i.e., SAP and Oracle) are powerful and seamlessly integrated to other ERP modules, such as the finance accounting module. The functions include project costing, project billing and change management:

① Project costing provides integrated cost management solutions, including cost tracking and cost trend analysis.

② Project billing can simplify client invoicing, improve cash flow, and measure the profitability of contracting with support for planning, execution, and analysis.

③ Change management can streamline the workflow required for the change order process. It can help control the change process and analyze the impact of changes. The change will be updated to project costing, which in turn will simultaneously update finance accounting.

2) Project Contract Management

Project contract functions can be divided into two categories: managing a contract with the client and subcontracting. The former function helps manage contractual obligations, contract documents and specifications, while the latter manages subcontract-related processes and payment control.

3) Resources Management

Project resources include materials, equipment, and labor. This function provides accurate information regarding project resources and is directly connected with procurement modules and finance accounting. The employees' time and expense-related information in the project is handled by different functions such as time and labor, which is directly connected to the human resources modules.

4) Project Collaboration

This module enables team members to collaborate in reviewing and completing project work. Both SAP and Oracle provide very good workflow functions that can support not only users within an organization, but also the other project participants including the owner, A/E, subcontractors and suppliers.

5) Project Data Management

This module manages all the project data including project documents, drawings, specifications, and material classifications. It also provides version control and makes the final records of projects that are directly related to knowledge management modules.

2.2.2 General Concept of ERP Systems in E&C Firms

Since implementation costs of Enterprise Systems are very high, there are few construction companies implementing fully integrated ERP systems. In addition, the benefits of ERP systems are difficult to quantify, so a very limited number of construction companies are now using or implementing them in the U.S. Even most of those companies use only finance or HR modules and they have legacy systems or use commercially available software in project management areas. However, construction companies require optimizing the utilization of their internal and external resources to maximize their business goals, and need better business decision to be made in a timely manner as their business grows. For this reason, many large construction companies have recently implemented or are considering implementing fully integrated ERP systems, so this research will help them make appropriate decisions.

The general concept of ERP system structure and major functions for engineering and construction firms is illustrated in Figure 2.7. Although the business processes of construction companies are different depending on the company's business culture and its major area of construction, there are many similarities in the business functions because of the project-based production in construction. The major application areas for engineering and construction firms are Financial Accounting and Project Management. These two core functions are tightly connected together, and all the other functions support them to streamline the whole business processes. Other functional modules which are not shown in Figure 2.7 can be included in a certain company's ERP system depending on the company needs for its own business area.

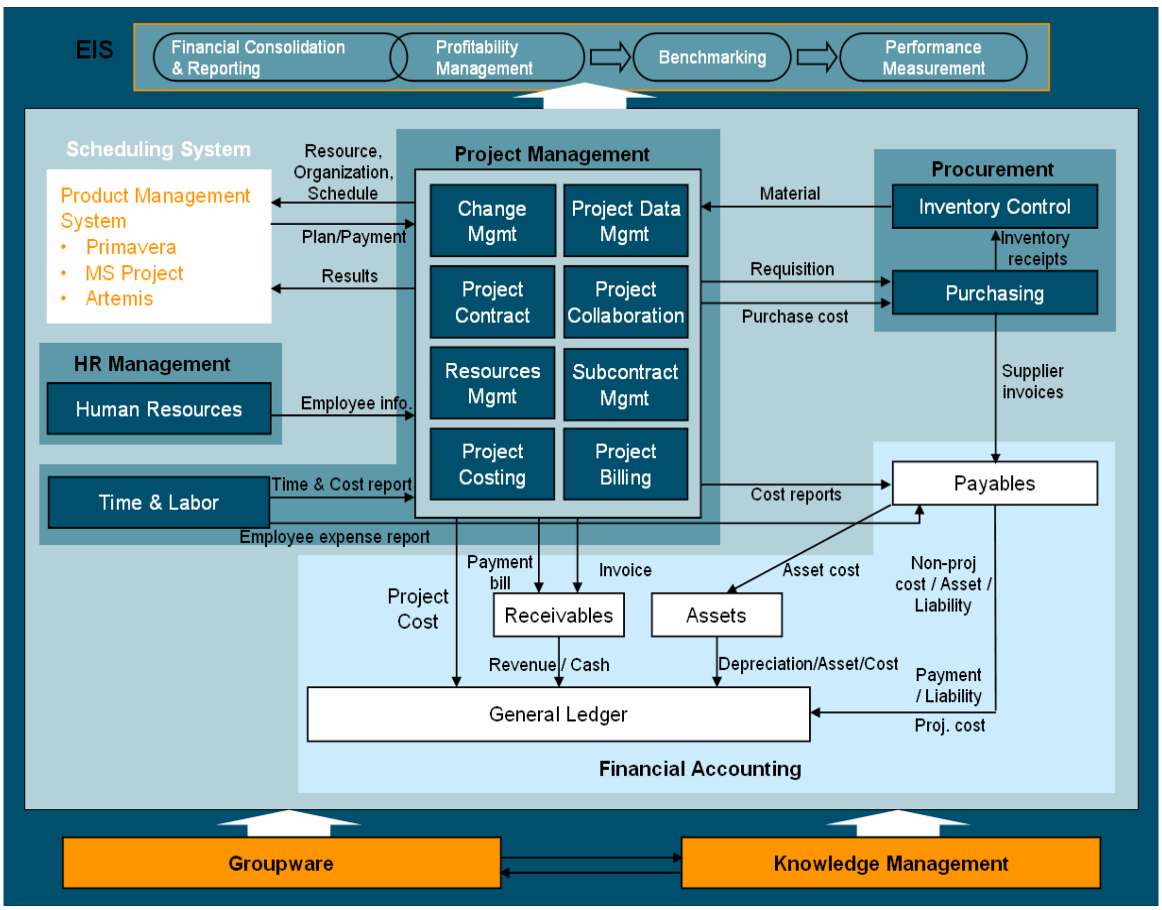


Figure 2.7 General Concept of ERP Systems in Construction

2.2.3 Problems in ERP Implementations for E&C Firms

Currently, SAP, Oracle, and other companies such as Deltek, CMiC, and Timberline provide specific solutions for the construction industry. They claim that their solutions can support all the functions a construction company needs. However, most engineering and construction firms in the U.S. have implemented their ERP systems adopting a best-of-breed approach in which separate software packages are selected for each process or function rather than using the full packages of major ERP vendors. They pick several modules, such as Financial Accounting and HR, from major ERP vendors and piece them together with their own in-house developed software or other third party products using custom-built interfaces. The main reason for using this approach is that construction processes are unique for each project: each project has a different owner, is managed by a different project team, requires different specifications, etc.

There is one case study in which initial ERP implementation was a failure. This company is one of the biggest home builders in the U.S. and has grown through mergers and acquisitions, so the company needed standard business processes and an ERP system that could integrate their old business units with the newly acquired divisions. SAP provided consulting and their software packages to implement the company's ERP system at the cost of $65 million. However, this project was eventually abandoned because of the rigid standardized processes insisted upon by SAP. Most ERP benefits are obtained by standardized processes, but the company needed mass customization because their buyers usually want to change an average of 30-40 options in home design. As a result, if a community had a large amount of customization, the data overflowed. The other reason that the project was abandoned is that the education level of users in the construction industry is relatively low, so easy interfaces are mandatory. However, SAP software is such a mature technology that users need extensive training. Due to its lack of flexibility and not being easy to use, the company users were reluctant to adopt it, which eventually resulted in failure and $65 million wasted. From this case study, we can learn that strategies from other industries, e.g., manufacturing, may not be suitable for the construction industry. The success or failure factors and their significance for ERP implementation in the construction industry may be different from those in the manufacturing industry, and the approach to successful ERP implementation should therefore also differ.

2.3 Chapter Summary

This Chapter reviews ERP systems in general including background information, advantages and disadvantages, and major vendors along with their functional modules. In background information section, the origin and definition of ERP systems are addressed as well as possible implementation approaches such as an entire ERP package implementation and a best-of-breed approach. From the literature review, it can be concluded that ERP systems have many benefits mostly from integrated functions and standardization, but also have disadvantages due to their high cost and long implementation periods. Two major vendors are introduced in this chapter, describing their history, strength and representative solutions. Furthermore, main functions and characteristics of ERP systems including structure, system architecture, and modules are described in this chapter.

The second part of Chapter 2 focuses on ERP systems in engineering and construction firms. It introduces specific solutions for the construction industry provided by SAP and Oracle, particularly describing their project management modules in detail. Based on the review of such solutions and their system architecture, the general concept of ERP system structure and major functions for engineering and construction firms are derived in this chapter. Finally, problems in ERP implementation for engineering and construction firms are addressed, showing a case study in which initial ERP implementation was a failure. With this case study, we can learn possible factors that can lead to the failure of ERP implementation in the construction industry.

3 THEORIES & RESEARCH MODEL

3.1 Theories

Since ERP systems are considered an innovative information system, previous research on user acceptance models for information systems (IS) can be helpful to understand the success of ERP system adoption. This research deals with two prevalent models related to IS acceptance, which are the Technology Acceptance Model and the DeLone & McLean (D&M) IS Success Model. In addition, the fundamentals of the project management discipline are reviewed for identifying the factors affecting ERP implementation project.

3.1.1 Technology Acceptance Model (TAM)

Davis (1986) introduced the Technology Acceptance Model (TAM), adapting the Theory of Reasoned Action (TRA), specifically modified for modeling user acceptance of information systems. The goal of TAM is to explain the determinants of computer acceptance related to user behavior across a broad range of end-user computing technologies and user populations. In addition, TAM provides a basis for tracing the impact of external variables on internal beliefs, attitudes, and intentions. TAM was formulated in an attempt to achieve these goals by identifying a small number of primary variables suggested by previous research dealing with the cognitive and affective determinants of IS acceptance, and using TRA as a theoretical background for modeling the theoretical relationships among these variables (Davis et al. 1989).

In this model, perceived usefulness and perceived ease of use are of primary relevance for IS acceptance behavior as shown in Figure 3.1. Perceived usefulness is defined as the prospective user's subjective probability of increase in his or her job performance using a specific information system within an organization. Perceived ease of use indicates the degree to which the prospective user expects the target system to be free of effort. TAM proposes that external variables indirectly affect attitude toward using, which finally leads to actual system use by influencing perceived usefulness and perceived ease of use. As indicated by Legris et al. (2003), all the relations among the elements of TAM had been validated through many empirical studies. The tools used with TAM have proven to be of quality and to yield statistically reliable results (Legris et al. 2003).

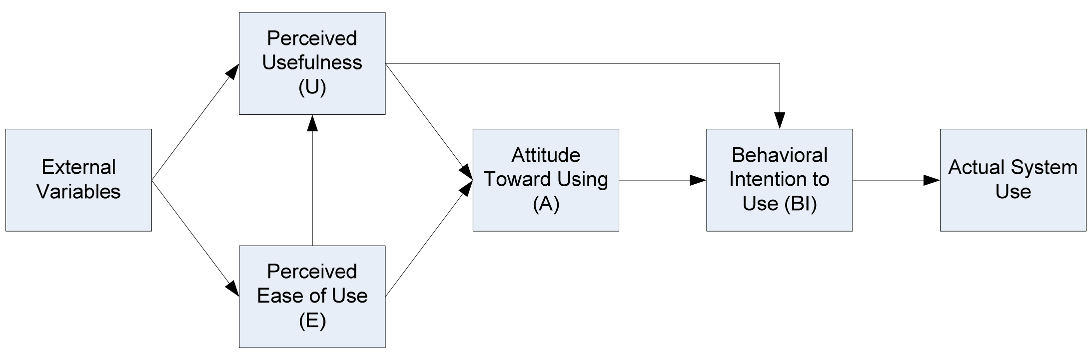


Figure 3.1 Technology Acceptance Model (Davis et al. 1989)

The main difference between TRA and TAM is the absence of subjective norm in TAM. Subjective norm is defined as “the person's perception that most people who are important to him think he should or should not perform the behavior in question” (Fishbein and Ajzen 1975). Davis did not include the variable subjective norms in TAM because of its uncertain theoretical and psychometric status, and negligible effect on perceived usefulness and ease of use. However, Hartwick and Barki (1994) identified a mixed finding about subjective norm: After separating their respondents into voluntary and mandatory use contexts, they found that subjective norm had a significant impact on intention in mandatory system use but not in voluntary settings (Hartwick and Barki 2001). For this reason, the updated TAM, also called TAM2, extended the original TAM by including subjective norm as an additional predictor of intention in the case of mandatory system use. Furthermore, TAM2 incorporated additional theoretical constructs including social influence processes and cognitive instrumental processes. The causal relationships and elements of TAM2 are described in Figure 3.2 (Venkatesh and Davis 2000).

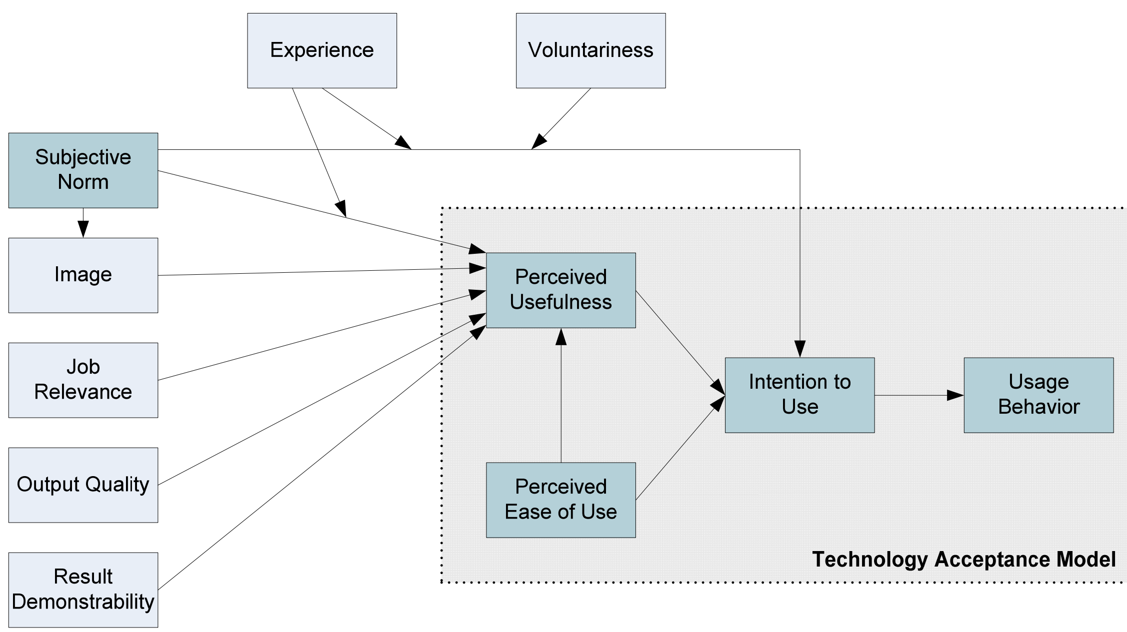


Figure 3.2 Updated Technology Acceptance Model (Venkatesh and Davis 2000)

3.1.2 DeLone & McLean IS Success Model

In recognition of the importance in defining the IS dependent variables and IS success measures, DeLone and McLean proposed a taxonomy and an interactive model as a framework for organizing the concept of IS success. They defined six major dimensions of IS success – System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organizational Impact. Then, a total of 180 articles related to IS success were reviewed using these dimensions to construct the model. DeLone & McLean's IS Success Model (D&M IS Success Model), as shown in Figure 3.3, deals with both process and causal consideration. These six dimensions in the model are proposed to be interrelated rather than independent. These dimensions are defined as follows (DeLone and McLean 1992):

1) System Quality - the measure of the information processing system,
2) Information Quality - the measure of information system output,
3) Use - the recipient consumption in the output of an information system,
4) User Satisfaction - the recipient response to the use of the output of an information system,
5) Individual Impact - the measure of the effect of information on the behavior of the recipient, and
6) Organizational Impact - the measure of the effect of information on organizational performance.

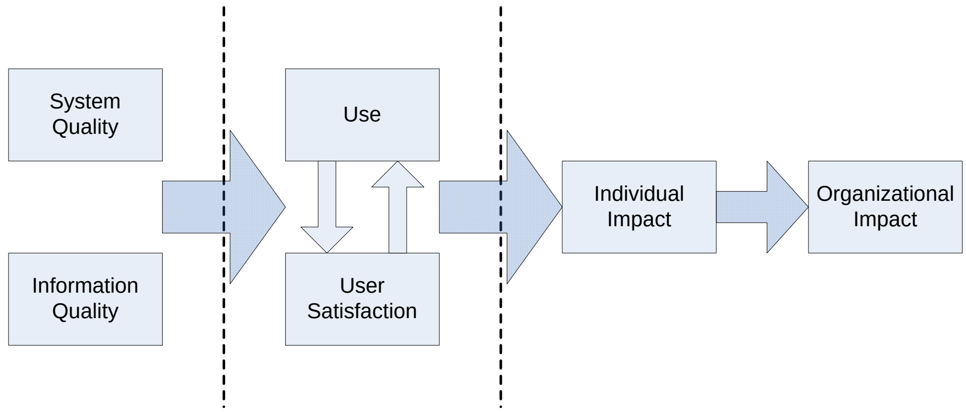


Figure 3.3 Original D&M IS Success Model (DeLone and McLean 1992)

Until 2003, the association among the measures in D&M IS Success Model had been tested by 16 different empirical studies. The results of these studies validated the causal structure of the D&M IS Success Model. Considering the reviews of their original model from the empirical studies, DeLone and McLean established the Updated D&M IS Success Model as shown in Figure 3.4 (DeLone and McLean 2003).

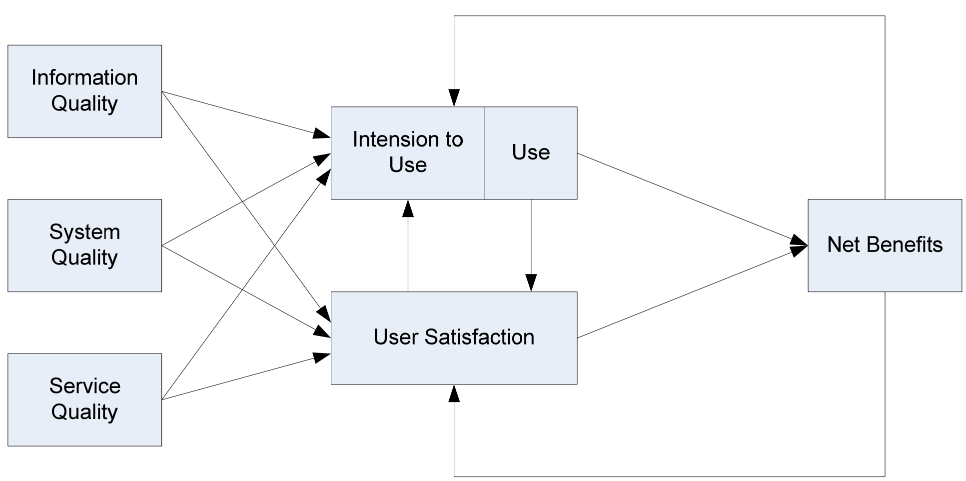


Figure 3.4 Updated D&M IS Success Model (DeLone and McLean 2003)

In their updated model, DeLone and McLean added ‘Service Quality’ to the “quality” dimensions in the original model, and collapsed ‘Individual Impact’ and ‘Organizational Impact’ into ‘Net Benefits’. ‘Service Quality’ is included as an important dimension of IS success given the importance of IS support, especially in the e-commerce environment where customer service is crucial. The choice of where the impacts should be measured, from individuals to national economic accounts, will depend on the systems and their purposes. DeLone and McLean grouped all the “impact” measures into a single impact category called “net benefit” rather than complicate the model with more success measures for the sake of parsimony.

3.1.3 Project Management Success Factors for ERP Implementation

What is considered a large project varies from one context to another depending on determinants including complexity, duration, budget and quality of the project. In ERP projects, the complexity depends on the project scope, including the number of business functions affected and the extent to which ERP implementation changes business processes. ERP projects achieving real transformation usually take from one to three years in duration. Resources required include hardware, software, consulting, training and internal staff, with estimates of their cost ranging from $0.4 million to $300 million, with an average of about $15 million (Koch 2002). Therefore, by viewing ERP implementation as a large project in general, we can adhere to the fundamentals of project management for achieving the success of ERP implementation.

There is vast project management literature in the field of organizational research.

Several researchers have developed sets of fundamental project success factors which can significantly improve project implementation chances (Pinto and Slevin 1987; Shenhar et al. 2002). In addition, several researchers have identified the best practices and risks related to IS projects such as ERP implementation. Akkermans et al. (2002) provided success factors for ERP implementation based on a broad literature review followed by a rating of the factors by 52 senior managers from the U.S. firms that had completed ERP implementations. Ewusi-Mensan (1997) identified reasons why companies abandon IS projects based on surveys of canceled projects in Fortune 500 companies in the U.S. Keil (1998) proposed significant software project risks based on a Delphi study of experienced software-project managers in Hong Kong, Finland, and the U.S. (Akkermans and Helden 2002; Ewusi-Mensah 1997; Keil et al. 1998). Based on this literature, Ferratt et al. (2006) grouped the best practice questions together forming four success factors for ERP implementation as follows (Ferratt et al. 2006):

1) top-management support, planning, training, and team contributions,
2) software-selection efforts,
3) information-systems area participation, and
4) consulting capability and support.

Ferratt et al. (2006) validated these success factors through the empirical study of ERP projects. They also provided five outcome questions, which were shown to be significantly correlated and should therefore be combined to form a single outcome factor, effectiveness. Their regression analysis identified that all the success factors can affect the outcome significantly, so now these factors can be considered the representative success factors in ERP implementation.

3.2 Conceptual ERP Success Model

3.2.1 Structure of Model

Figure 3.5 shows the proposed model, referred to as the conceptual ERP Success Model. As discussed in the previous sections, the success of ERP systems can be classified into two categories; the success of ERP adoption and the success of ERP implementation. For the successful ERP adoption, this research uses already proven user acceptance models for IS such as TAM and D&M IS Success Model as the starting point. The model hypothesizes the rationale for the relationships among variables based on these combined theoretical backgrounds and incorporates three main dimensions for identifying the truth about the success of ERP systems; success factors, intermediate constructs, and success indicators.

The model also considers the success of ERP implementation based on the reviews on the fundamentals of project management. The success factors suggested by Ferratt et al. (2006) are used in the model because these were already validated in previous research and confirmed by several experts interviewed. This research hypothesizes these factors directly affect perceived usefulness, and finally lead to ERP success or failure. Furthermore, “Project Success” is included as an additional success indicator to clarify its impact on the other success indicators. Project success will be evaluated in terms of time, budget, quality and scope as usual project management contexts applied.

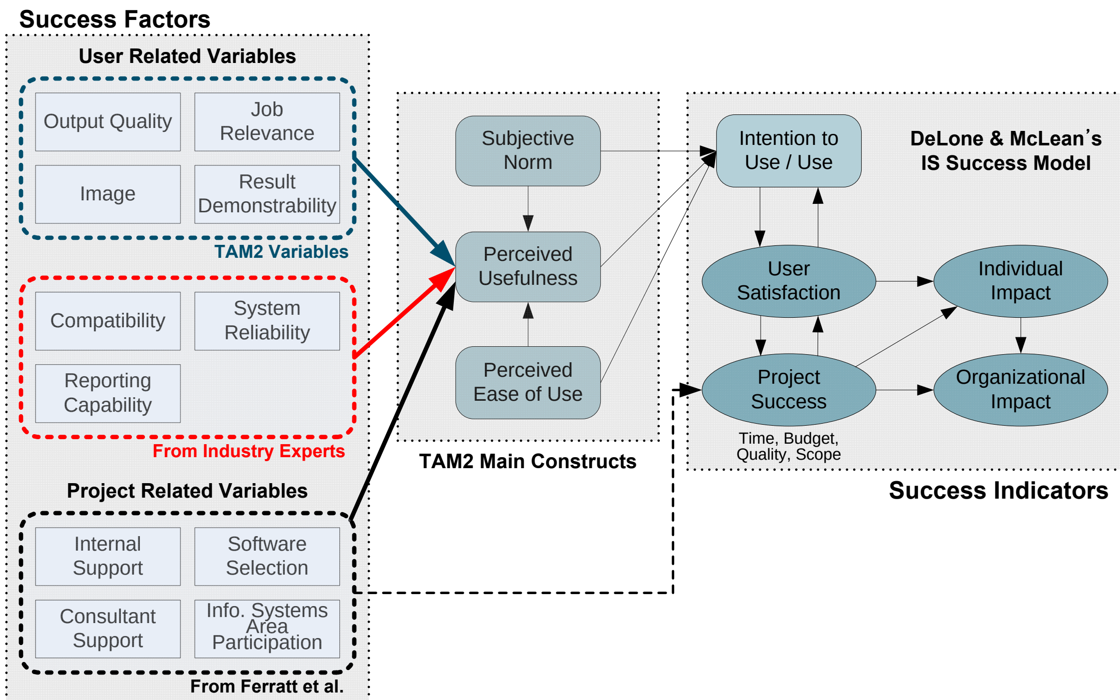


Figure 3.5 Conceptual ERP Success Model

One important point to be noted in this model is that "Subjective Norm" is included in the intermediate constructs because ERP systems are usually used in mandatory settings. The causal relationship related to this factor was also applied to TAM2, which was already validated. Based on the proposed model, this research developed the initial instrument for the empirical study to identify the success of ERP systems as shown in Appendix B.

3.2.2 Success Factors

1) User Related Variables

A total of seven user related variables are identified in this research. Among the user related variables, four of them are adopted from TAM2, which are output quality, job relevance, image, and result demonstrability. The other three variables including compatibility, system reliability and reporting capability are extracted from interviews with industry experts. All the user related variables are hypothesized to have a positive impact on perceived usefulness directly, and then their relationships will be verified later with the analysis of the following surveys.

Output Quality

Screen-based and printed outputs are often considered major products of an information system, and their quality and understandability are vital (Burch 1992; Srinivasan 1985). Output quality can be referred to as how well the system performs tasks matching the user's job goal (Venkatesh and Davis 2000). Davis et al. (1992), and Venkatesh and Davis (2000) showed the relationship between perceived output quality and perceived usefulness proving empirically that output quality can significantly impact on perceived usefulness in use of information systems. The same theory can be applied to ERP systems, so output quality should be included as one of success factors for them.

Job Relevance

Job relevance can be defined as an individual's perception regarding the degree to which the target system is applicable to his or her job. It is also referred to a function of the importance within one's job of the set of tasks the system is capable of supporting (Venkatesh and Davis 2000). Researchers empirically demonstrated the link between user acceptance and variables similar to job relevance, including job determined importance (Leonard-Barton and Deschamps 1988), involvement as personal importance and relevance (Hartwick and Barki 1994), task-technology fit (Goodhue 1995; Goodhue and Thompson 1995), and cognitive fit (Vessey 1991). TAM2 also shows that job relevance affects perceived usefulness significantly, so now it is included in this research as a success factor.

Image

Individuals often react to social influences to establish or maintain a favorable image within a reference group (Kelman 1958). Rogers (1983) argued that "undoubtedly one of the most important motivations for almost any individual to adopt an innovation is the desire to gain social status" (Rogers 1983). Image can be defined as the degree to which use of an information system is perceived to enhance one's image or status in one's social system (Moore and Benbasat 1991). TAM2 also verified that image impacts on perceived usefulness directly with other social influence factor, "subjective norm".

Result Demonstrability

Moore and Benbasat (1991) defined result demonstrability as "the tangibility of the results of using the system, including their observability and communicability" (Moore and Benbasat 1991). Agarwal and Prasad (1997) found that result demonstrability is one of the most significant factors affecting intentions to use in their regression analysis (Agarwal and Prasad 1997). TAM2 also theorized that result demonstrability directly influences perceived usefulness and verified the relationship empirically.

Compatibility

Moore and Benbasat (1991) defined compatibility as “the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters” (Moore and Benbasat 1991). In this research, however, compatibility is referred to as the capability of an information system to exchange data with other systems. Basically, an ERP system integrates all needed functions together, and each function can be different software (e.g. in-house developed software or third party product). Sometimes, users need to exchange data with stand alone programs they mostly use (e.g. Microsoft products, scheduling programs) with ERP systems. For these reasons, compatibility can have a strong relationship with perceived usefulness in use of ERP systems.

System Reliability

System reliability can be defined as the degree to which the system ensures the delivery of data to the users. It is an important component of the technical quality of IT systems, and partly affects how well a system performs its expected function (Kim 1988; Perry 1992). One of the most important advantages of ERP systems is to provide real-time and accurate information. This advantage can be corrupted if a system is not reliable. Therefore, system reliability is hypothesized to be a factor that affects the perceived usefulness of ERP systems in this research.

Reporting Capability

Several interviews with industry experts were conducted to identify success factors for ERP system use and implementation. One of the industry experts suggested that reporting capability of ERP system should be included as a main success factor for the use of ERP systems. He argued that the major benefits of ERP systems for the company are management reporting and measurement reporting such as Critical Success Factor (CSF) and Key Performance Indicator (KPI). Another interviewee also agreed to the importance of reporting capability of ERP systems. Therefore, this research hypothesized that reporting capability can have a significant influence on perceived usefulness and should be considered as a success factor for the ERP system use.

2) Project Related Variables

Ferratt et al. (2006) derived four major best-practice factors that can impact on the ERP project success: 1) Top-management support, planning, training, and team contributions; 2) Software-selection efforts; 3) Information-systems-area participation; 4) Consulting capability and support (Ferratt et al. 2006). This research assumes that these factors can impact both on “perceived usefulness” and “project success”.

Internal Support

Ferratt et al. (2006) found that top-management support, planning, training, and team contributions can be grouped together to form a single factor from the results of their factor analysis and scale-reliability analysis (Ferratt et al. 2006). This new factor is named “Internal support” in this research, and can be defined as the degree of the company’s internal support for the ERP implementation project (Top management support, Training, and Project planning).

The literature shows that all four items in this factor could significantly affect the success of an IT project. Karahanna (1999) asserted that top management support can have a positive impact on users’ behavioral intention about adopting an information system (Karahanna et al. 1999). Wilder and Davis (1998) identified that poor planning or poor project management is the main reason why IT projects fall behind schedule or fail (Wilder and Davis 1998). Nelson and Cheney (1987) verified the role of training to facilitate implementation of an IT project (Nelson and Cheney 1987). Crowley (1999) also asserted the importance of training to have successful ERP adoption (Crowley 1999). Barki and Hartwick (1994) verified empirically that users who participate in the development process are more likely to believe that a new system is good, important, and personally relevant (Barki and Hartwick 1994). Barker and Frolick (2003) also insisted on the importance of the selection of team members and their involvement in ERP implementation for avoiding failure (Barker and Frolick 2003).

Software Selection

Ferratt et al. (2006) verified that software selection efforts can be one of the factors affecting ERP implementation success (Ferratt et al. 2006). Umble and Umble (2002) advocated the importance of software capabilities. They mentioned that if the software capabilities and needs are mismatched with a company’s business processes, this can lead the ERP implementation to failure (Umble and Umble 2002). Therefore, this factor should be considered one of the most important factors that can impact directly on ERP implementation success or failure.

Consultant Support

Gargeya and Brady (2005) identified that consultant support is one of the success and failure factors in ERP system implementation (Gargeya and Brady 2005). Ferratt et al. (2006) also verified that it can affect the success of ERP implementation significantly (Ferratt et al. 2006). A large portion of ERP implementation costs are attributed to consulting. According to the SAP annual report, 26% of its revenue is created by consulting service (SAP 2005). For these reasons, consultant support should be considered one of the factors affecting ERP implementation success or failure.

Information Systems Area Participation

Defining what information system area should be included in ERP implementation is one of the most important factors for the success of ERP implementation projects. It should be matched with the company's essential business functions. The literature also indicates that this factor should be regarded as a top priority to avoid failure of ERP implementation (Gargeya and Brady 2005; Schlag 2006).

3) Intermediate Variables

Subjective norm and perceived ease of use can be classified into this category. These two variables can affect both perceived usefulness and intention to use / use directly as TAM previously verified.

Subjective Norm

Subjective norm is included as a direct determinant of behavioral intention in Theory of Reasoned Action (TRA) which was a key theoretical background for the original development of Technology Acceptance Model (TAM), and Theory of Planned Behavior (TPB) (Ajzen 1991). The rationale for a direct effect of subjective norm on intention is that although people are not favorable toward the behavior or its consequences, if they believe one or more important reference groups think they should and they are sufficiently motivated to comply with these groups, they may be inclined to perform a behavior (Venkatesh and Davis 2000). As described in the previous section, the literature shows that there are mixed findings about subjective norm with respect to the user acceptance of an information system (Davis et al. 1989; Mathieson 1991). Hartwick and Barki (1994), Venkatesh and Davis (2000) verified empirically that it can have a positive effect on user's intention in mandatory system use but not in voluntary settings (Hartwick and Barki 1994; Venkatesh and Davis 2000). Therefore, subjective norm should be considered the factor that can affect perceived usefulness and intention to use directly in the use of ERP systems which are usually used in mandatory settings.

Perceived Ease of Use

Perceived ease of use can be defined as "the degree to which the prospective user expects the target system to be free of effort (Davis et al. 1989). It is considered a fundamental aspect of the technical quality of an information system (Davis and Olson 1985). It is determined by several design issues including screen design, user interface, page layout, color, icons, help facilities, menus, user documentation, and on-screen prompts (Burch and Grudnitski 1989). These issues can increase the complexity of using the system significantly (Alter 1992).

Davis (1989) identified that perceived ease of use can be a direct determinant of perceived usefulness. He also argued that if all other things are equal, a particular system perceived easier to use is more likely to be accepted by users (Davis 1989). The extensive literature proved empirically that perceived ease of use is significantly linked to intention, both directly and indirectly via its impact on perceived usefulness (Venkatesh and Davis 2000).

3.2.3 Success Indicators

Perceived Usefulness

Perceived usefulness can be defined as "the degree to which a person believes that using a particular system would enhance his or her job performance". The word useful refers to "capable of being used advantageously" (Davis 1989). The strong relationship between perceived usefulness and actual system use has been empirically verified in many IS research contexts. All the success factors defined in this research are assumed to have a direct impact on perceived usefulness, which can lead users to intention to use or actual use of ERP systems.

Intention to Use / Use

Several researchers (Ein-Dor and Segev 1978; Hamilton and Chervany 1981; Ives et al. 1980; Lucas 1975) have proposed "use" as a success measure of information systems in the IS research contexts. Having adopted from their concept, intention to use / use is considered the main indicator of the success of ERP system adoption in this research. Its direct antecedents are perceived usefulness, perceived ease of use, and subjective norm as described in the previous section. This research assumes that the amount of use can have a positive impact on the degree of user satisfaction as well as the reverse being true as proposed in DeLone and McLean's IS success model.

User Satisfaction

The literature shows that user satisfaction is the one of the most widely used success measures of information system success (DeLone and McLean 1992). It is hard to deny the success of an information system with which its users are satisfied. It is hypothesized that user satisfaction is highly correlated with intention to use / use as well as project success in this research. These relationships will be examined from the analysis of the following surveys.

Individual Impact

It is very difficult to define the word "impact" among all the possible measures of information systems success. It is closely related to performance, so improving users' performance is certainly evidence that an information system has had a positive impact. Possible indications that an information system has a positive individual impact include:

better understanding of the decision context, improving user's decision making productivity, producing a change in user activity, and changing the decision maker's perception of usefulness of the system (DeLone and McLean 1992). It is assumed that user satisfaction will have a direct positive impact on individual impact which should eventually lead to some organizational impact in this research.

Organizational Impact

Organizational impact is considered the final dependent variable in the conceptual ERP success model in this research. DeLone and McLean (1992) found that field studies which dealt with the impact of information systems chose a variety of organizational performance measures. The possible measures of organizational impact include: cost reductions, revenue increase, profit increase, Return on Investment (ROI), the extent to which an information system is applied to major problem areas of the firm, and some other qualitative or intangible benefits.

Project Success

Project Success is considered the indicator of the success of an ERP implementation project in this research. To determine how successfully an implementation project has been completed, the degree of project success should be assessed in terms of time, cost, quality, and scope as usual project management contexts applied. This research assumes that its direct antecedents are project related variables including internal support, software selection, consultant support, and information systems area participation. Its relationship with other dependent variables will be empirically examined later at the following chapters.

3.3 Chapter Summary

In this chapter, the research formulated the conceptual ERP success model based on theories and knowledge gained from several industry practitioners. The conceptual model adapted the Technology Acceptance Model (TAM) as the starting point for the structure of relationships between factors and indicators. DeLone and McLean's IS success model was used for identifying success indicators. Finally, the fundamentals of project management were incorporated into the model for analyzing the success of ERP implementation. This chapter also describes success factors and success indicators with their definitions and theoretical background from the literature review. Therefore, the conceptual ERP success model is theoretically sound and can be helpful in providing better understanding about the success of ERP systems.

4 RESEARCH DESIGN

4.1 Survey Items

The survey instrument was designed based on the conceptual ERP success model proposed in the previous chapter. Each variable has at least two questions for reliability purposes. Most questions in the survey are primarily adapted from the relevant previous research related to IS acceptance or success. All items were measured on a 7-point Likert scale from strongly disagree to strongly agree. Items in the survey are described in Appendix B.

4.1.1 Success Factors

1) User Related Variables

Output Quality

The survey items about output quality are adapted from TAM2 by Venkatesh and Davis (2000). These questions attempt to ask respondents the degree of output quality from the ERP system that they currently use.

Job Relevance

There are three questions in regard to job relevance. Two of them are adapted from TAM2 items, and the other one is recommended by one of the interviewed industry experts. The questions are about how relevant usage of the ERP system is in each respondent's job.

Image

The items in variable "image" are also adapted from TAM2. The questions are asking respondents if people who use the ERP system in their organization can have a better image so that they would intend to enhance their social status among peers with use of the ERP system.

Result Demonstrability

There are three questions related to result demonstrability. All three questions are adapted from TAM2 items developed by Vankatesh and Davis (2000). These are about how easily users can explain the consequences and results of using the ERP system.

Compatibility

Two compatibility related questions are included in the survey. These questions ask respondents about the capability of their ERP systems in importing and exporting data from / to other systems or software they currently use.

System Reliability

There are three questions with respect to system reliability of the ERP system that respondents currently use. The questions ask about data loss and system errors as well as the overall reliability of the ERP system that respondents currently use.

Reporting Capability

Two questions were developed to measure the reporting capability of respondents' ERP systems. Items include questions about management and measurement reports such as CSF / KPI generated from respondents' ERP systems asking how useful these reports are.

2) Project Related Variables

Internal Support

Four questions were developed to identify the degree of internal support related to ERP system implementation. Items include questions about the degree of top-management support, planning, training, and team contributions with respect to respondents' ERP implementation projects.

Software Selection

There are two questions related to software selection. The questions ask about how well the ERP software that the respondent's company is using can support its business processes as well as the functionality of the software.

Consultant Support

Two questions were developed to assess the degree of consultant support for the ERP implementation project. One question asks about the consultant capability and the other is about the degree of the consultant support during the ERP implementation project.

Information Systems Area Participation

Two questions relate to the variable "information systems area participation". These questions ask respondents to evaluate how well the functions of their ERP system are defined and how well these are matched with their company's necessary business functions.

3) Intermediate Variables

Subjective Norm

The items in variable "subjective norm" are adapted from the survey items developed by Lucas and Spitler for the model of broker workstation use in a field setting (Lucas and Spitler 1999). There are four questions with respect to the impact of subjective norm on the use of the ERP system. Two of them are for identifying the impact of respondents' work group on their ERP system use, and the other two are about senior management's impact on use.

Perceived Ease of Use

There are three questions related to perceived ease of use. These questions are adapted from TAM and TAM2 survey items. All items are intended to ask respondents how easy users can use their ERP systems.

4.1.2 Success Indicators

Perceived Usefulness

There are four questions in regard to perceived usefulness. These questions are also adapted from TAM and TAM2 survey items. Questions include the degree of usefulness in improving respondents' performance, productivity, and effectiveness as well as overall perceived usefulness of the ERP system that they currently use.

Intention to Use / Use

There are a total of five questions to assess the degree of intention to use / use. Three of them are adopted from the survey items proposed in TAM2, which are directly related to user's behavior in intention to use and actual system use. Another two questions are to identify respondent's use hours and the most used functions of the system.

User Satisfaction

Three questions were developed to assess user satisfaction of respondent's ERP system. Items include questions about satisfaction with information quality and performance of the ERP system that the respondent uses as well as the degree of overall satisfaction with the system.

Individual Impact

Two questions are developed to identify the degree of individual impact thanks to the ERP system. Items include questions about increasing efficiency and making effective decisions from the use of the ERP system.

Organizational Impact

Three questions were developed to assess organizational impact of the ERP system. Two questions are about operations cost savings and revenue increases. Another interesting question in regard to organizational impact is about "stock price" as suggested by several interviewees. They mentioned that their companies' stock price went up after their ERP implementation, so they believed that there is a positive relationship between the company's stock price and ERP implementation.

Project Success

As described in the previous chapter, the degree of project success can be evaluated in terms of time, cost, quality, and scope as usual project management contexts applied. Therefore, four questions were developed to ask whether the ERP implementation project was completed on time, on budget, with good quality, and finally if the scope of the system is well matched with the company's needs.

4.2 Pilot Survey

A pilot survey was executed before conducting the main survey. The purpose of this pilot survey is to examine whether or not the proposed model was well developed to analyze ERP success. It is also examined how well the survey is designed for respondents to answer properly. The conceptual ERP success model and contents of the main survey will be modified based on the results of the pilot survey.

4.2.1 Data Collection

The pilot survey was developed by using Surveymonkey™ tools and was conducted as a web-based survey. The link to the survey was sent to the contacted individuals so that they can distribute it to other possible participants. A total of nine senior managers working for engineering and construction (E&C) companies which currently use ERP or ERP equivalent systems were contacted for conducting the pilot survey. They were asked to take the pilot survey and distribute it to their colleagues who currently use ERP systems and acquaintances who were involved in ERP implementation projects.

A total of 57 responses from 9 different E&C firms were received. Figure 4.1 shows the respondents' experience years in the construction industry. The average experience years was 8.5 years, and over 60% of respondents had at least 6 years or more experience in the construction industry. Among the respondents, about 56% of them are managers or higher level as illustrated in Figure 4.2. The average of use hours of the ERP system was

11.3 hours per week, and 67% of respondents used their ERP system at least 6 hours per week as shown in Figure 4.3.

There were some missing data in the responses of the pilot survey. Questions in the variables "consultant support", "organizational impact", and "project success" have relatively low response rate (i.e. less than 50 out of 57 responses). The reason is that respondents who have worked for the company after ERP implementation are not able to answer that type of fact question properly. The summary of responses for each item from the pilot survey is listed in Appendix C-1.

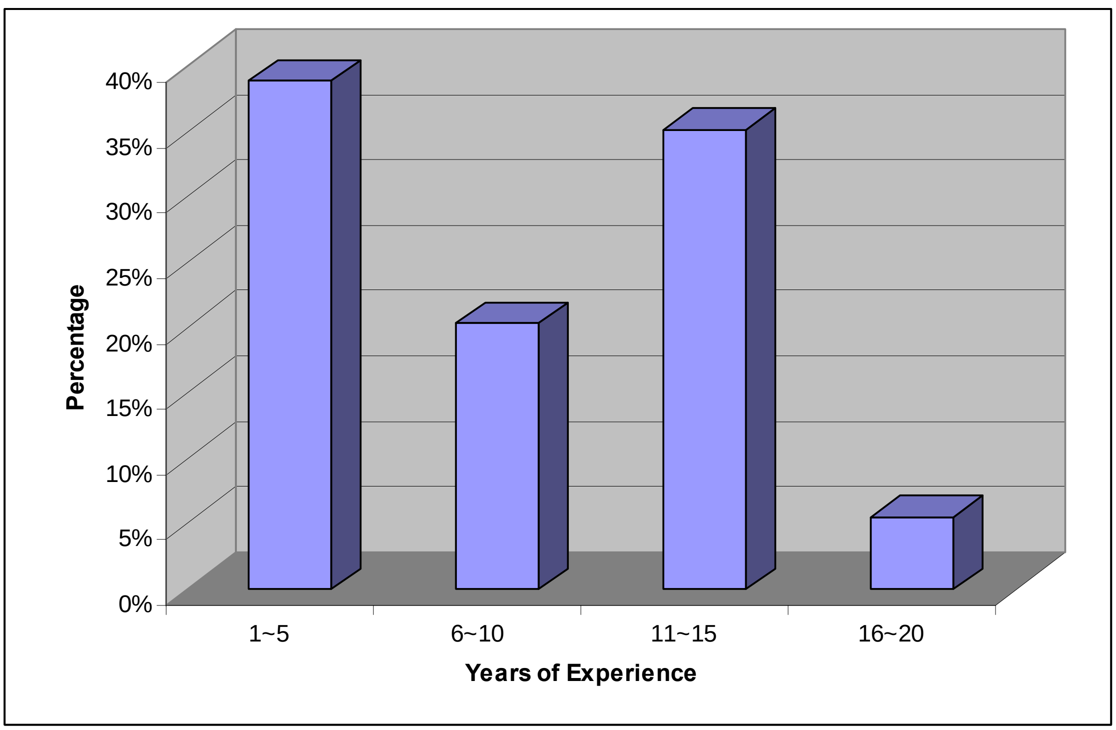


Figure 4.1 Pilot Survey Respondents' Years of Experience in the Construction Industry

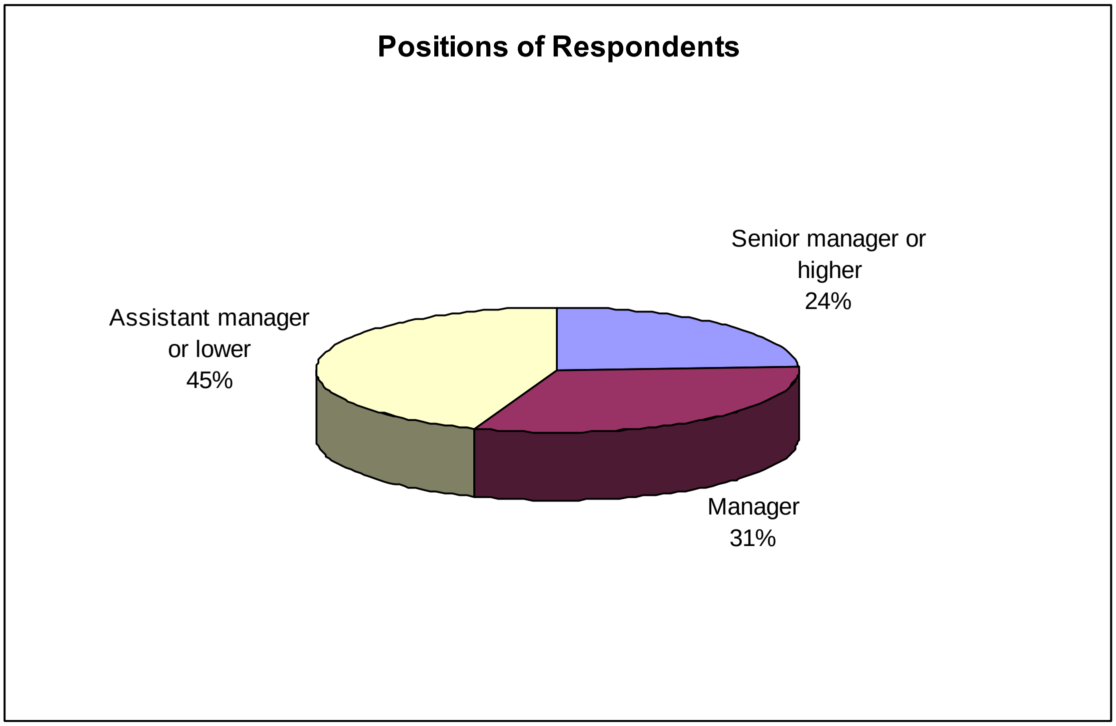


Figure 4.2 Pilot Survey Respondents' Position in their Company

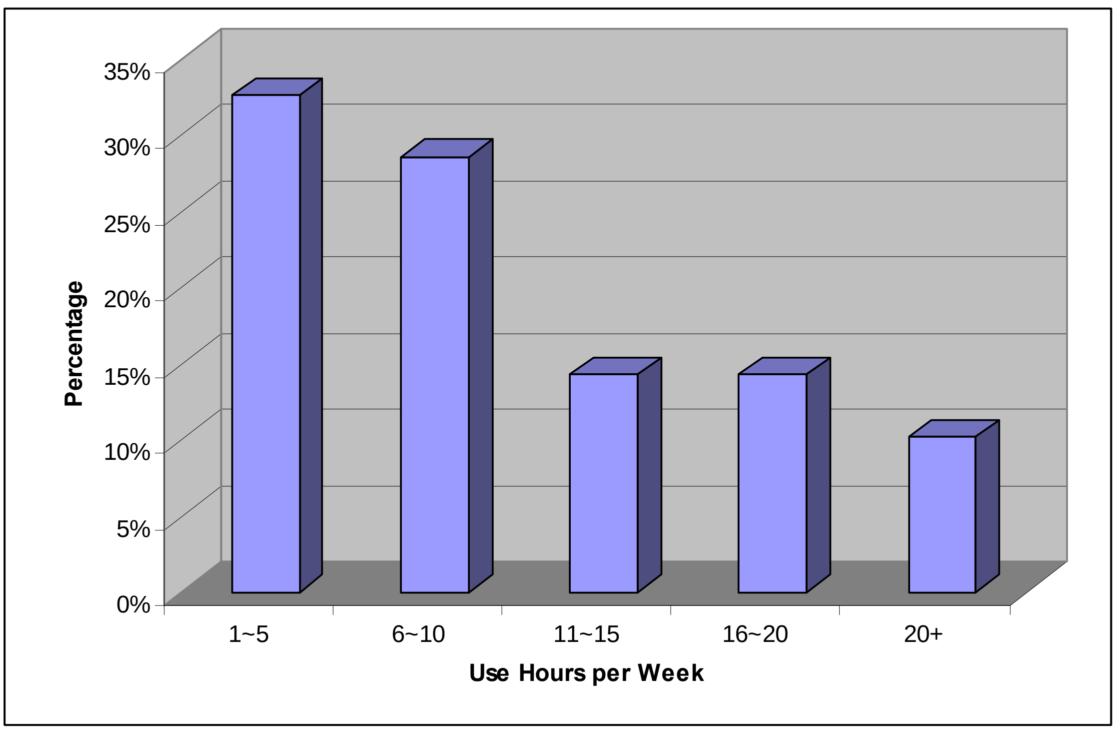


Figure 4.3 Pilot Survey Respondents' Use Hours of their ERP System

4.2.2 Data Analysis

Data analysis with the pilot survey consists of three separate steps described below:

Step 1 – Correlation & Reliability Analysis of Each Variable

Step 2 – Initial Adjustment Based on Factor Analysis

Step 3 – Redo Step 1 & 2 with New Variables

The first analysis done with the data of the pilot survey was looking at correlation and reliability between items within each variable so that we can identify which variables should be modified. Survey instruments used in the social science are generally considered reliable if they produce similar results regardless of who administer them and which forms are used. Cronbach's alpha is the most widely used as a measure of reliability. It indicates the extent to which a set of test items can be treated as measuring a single variable. Cronbach's alpha will generally increase when the correlations between the items increase. For this reason, items in each variable should be highly correlated to have higher internal consistency of the test. The lower acceptable limits of .50-.60 was suggested by Kaplan and Saccuzzo (1993), however, as a rule of thumb, a reliability of .70 or higher is required before an instrument will be used (George and Mallery 2007; Kaplan and Saccuzzo 1993).

The second step of data analysis with the pilot survey was initial adjustment with the result of factor analysis. Factor analysis attempts to identify underlying variables, or factors, that explain the pattern of correlations within a set of observed variables. It is most frequently used to identify a small number of factors representing relationships among sets of interrelated variables. For this reason, factor analysis is considered a statistical data reduction technique that takes a large number of observable instances to measure an unobservable construct or constructs. It generally requires four basic steps: 1) calculate a correlation matrix of all variables, 2) extract factors, 3) rotate factors to create a more understandable factor structure, 4) interpret results (George and Mallery 2007).

Varimax is the most popular rotation method used in factor analysis. It is an orthogonal rotation method that minimizes the number of variables that have high loadings on each factor. The goal of rotation is to achieve simple factor structure (i.e. high factor loadings on one factor and low loadings on all others), which simplifies the interpretation of the factors. Figure 4.4 shows the concept of the varimax rotation indicating how it can change the original factor structure to the more interpretable one.

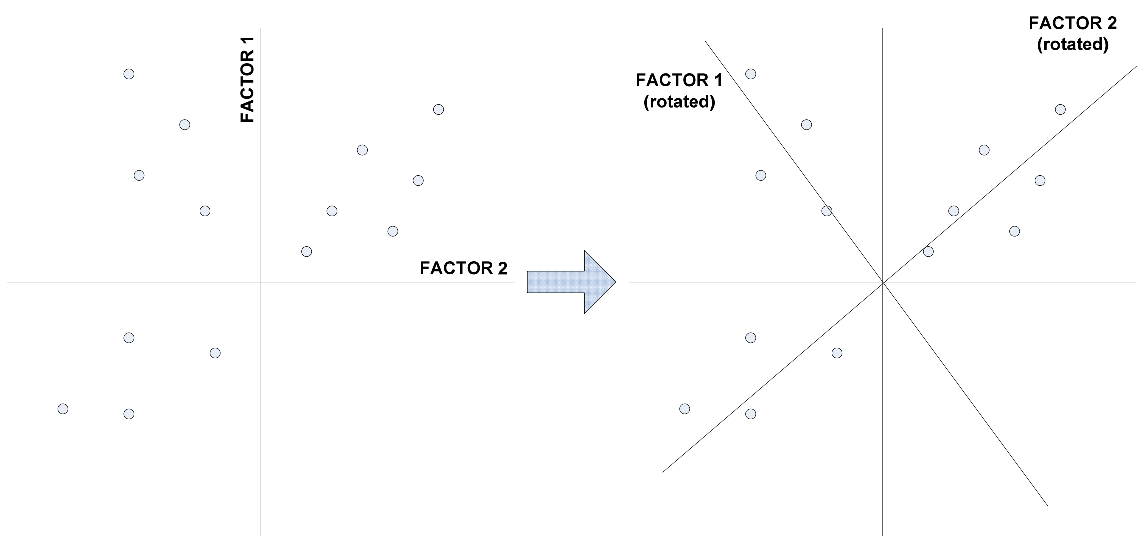
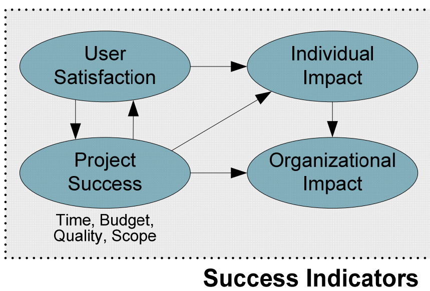


Figure 4.4 Concept of Varimax Rotation Method (George and Mallery 2007)

Figure 4.5 illustrates an example of data analysis done with the pilot survey. Initially, there were four factors and 11 items associated with them. After factor analysis, two factors were extracted. Based on the result of factor loadings, “User satisfaction”, “Individual Impact”, and “Organizational Impact” can be a single factor named as “ERP Benefits”, while “Project Success” remained as it was. The new factor, “ERP Benefits” was examined for its consistency by conducting correlation and reliability test, so now it can be used as a new variable in the main survey.



Rotated Component Matrix

	1	2
satis1	0.802	0.383
satis2	0.795	0.414
satis3	0.760	0.439
indimpa1	0.813	0.091
indimpa2	0.804	0.275
orgimpa1	0.684	0.385
orgimpa2	0.768	0.357
prosucc1	0.106	0.858
prosucc2	0.369	0.742
prosucc3	0.441	0.774
prosucc4	0.482	0.642

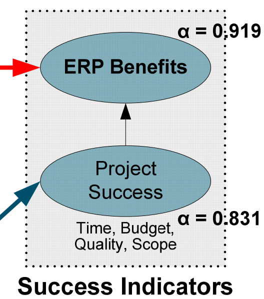


Figure 4.5 Example of Factor Analysis Process

The detailed data analysis with all variables in the pilot survey is presented in Appendix C. After completing a series of data analyses with the pilot survey, the final adjustments are summarized as below:

1) Items job3, result3, interna3, and orgimpa3 were eliminated,
2) Variables “Output quality” and “Reporting capability” were grouped together into the new variable “Output”,
3) Variables “Software Selection”, “Consultant Support”, and “System Area Participation” were merged into a single factor, “ERP Evaluation”

4) Variable "User Satisfaction", "Individual Impact", and "Organizational Impact" are merged into the new factor, "ERP Benefits"
5) The Question asking the most used functions of the ERP system was eliminated due to its low response rate.

The new survey instrument which has been used in the main survey is described in Table 4.1 showing the variables with their contents of items and reliability. The revised ERP success model after adjustment with the pilot survey shown in Figure 4.6 now looks much simpler than the conceptual model.

Table 4.1 Summary of Adjustment in Survey Instrument after Pilot Survey

Variable	# of Items	Items	Reliability (α)	Source of Items
Output	4	report1, report2, output1, output2	.81	Venkatesh & Davis 2000
Job Relevance	2	job1, job2	.91	Venkatesh & Davis 2000
Image	2	image1, image2	.82	Venkatesh & Davis 2000
Result Demonstrability	2	result1, result2	.71	Venkatesh & Davis 2000
Compatibility	2	compa1, compa2	.89	
System Reliability	3	reliabl1, reliabl2, reliabl3	.79	
Internal Support	3	interna1, interna2, interna4	.76	Ferratt et al. 2006
ERP Evaluation	6	softwar1, softwar2, consul1,consul2, sysfun1, sysfun2	.92	Ferratt et al. 2006
Subjective Norm	4	sn1, sn2, sn3, sn4	.84	Lucas & Spitler 1999
Perceived Usefulness	4	pu1, pu2, pu3, pu4	.94	Davis 1989, Venkatesh & Davis 2000
Perceived Ease of Use	3	eou1, eou2, eou3	.92	Davis 1989, Venkatesh & Davis 2000
Intention to Use / Use	3	use1, use2, use3	.78	Venkatesh & Davis 2000
ERP Benefits	7	satis1,satis2, satis3, indimpa1, indimpa2, orgimpa1,orgimpa2	.92	DeLone & McLean 1992
Project Success	4	prosucc1, prosucc2, prosucc3, prosucc4	.83	

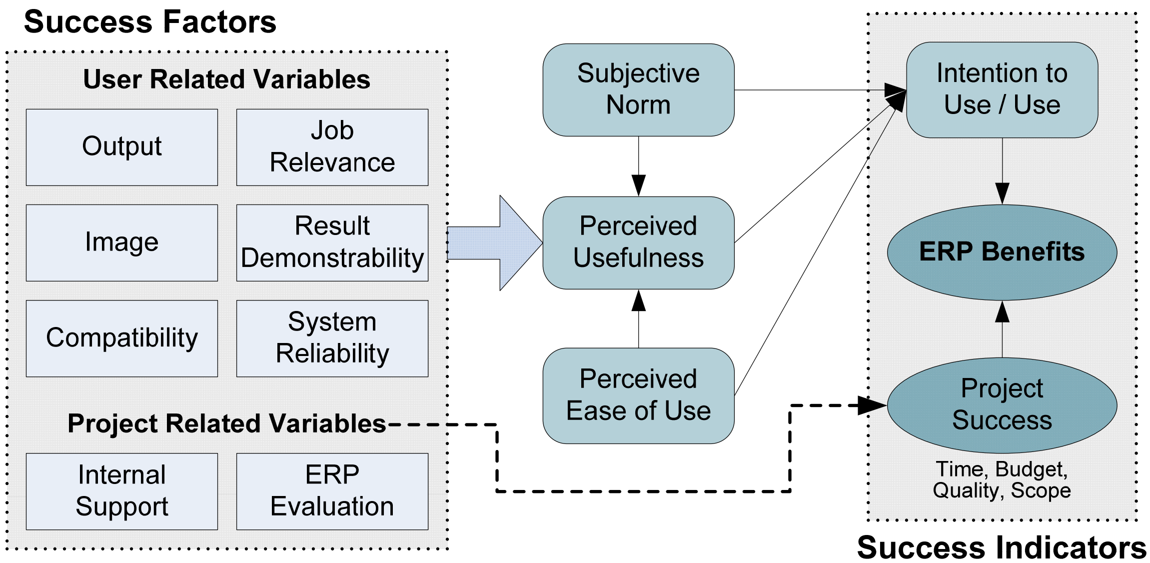


Figure 4.6 Modified ERP Success Model after Pilot Survey

4.3 Chapter Summary

The survey instrument was designed based on the conceptual ERP success model, and most items in the survey were primarily adapted from the relevant previous research in the IS contexts. It was tested before conducting the main survey to examine whether or not the proposed model was well developed to analyze ERP success. Data analysis including correlation, reliability test, and factor analysis was conducted to adjust survey items and extract factors associated with the success of ERP systems. The new survey instrument which has been used in the main survey and the revised ERP success model after adjustment with the pilot survey are proposed in this chapter. The revised model looks much simpler than the conceptual model.

5 ANALYSIS OF ERP SUCCESS MODEL

5.1 Data Collection

5.1.1 Administration of Main Survey

The targeted respondents of the survey were ERP system users who are currently working for the construction industry regardless of their company's main business area. The list of targeted respondents was obtained from several sources, i.e., construction-related organizations, trade magazines, AEC-related websites, ERP vendor websites, and ERP related newsgroups. About 3,000 individuals were listed from these sources, but not all of them can be identified as targeted respondents. It is impossible to know who they are, what they do, and whether they use ERP systems or not. In most cases, even though the company uses the ERP system, there is relatively small number of users among the employees. For instance, some companies only use ERP modules related to financial accounting and HR, but have not integrated other core functions. That made the response rate of the survey significantly lower than expected. For this reason, a total of approximately 100 senior managers, vice presidents and IT manager working for the construction industry were contacted additionally and asked to take and distribute the survey.

The main survey was administered through the web survey tool, Surveymonkey™. This tool provided several necessary functions such as tracking responses, managing the list of respondents, exporting data, etc. The link to the survey was emailed to the listed individuals so that they could take the survey at their convenient time. The problem was that about 30% of email distributed to the listed individuals was bouncing back because their email addresses were no longer available or the invitation email was considered spam mail by their company's server. Even many of respondents said that they did not know what the ERP system is or did not use it, so they eventually wanted to opt out from the survey list. This anonymous nature of the listed individuals made the administration of the survey more difficult. Additional email was sent to no-response individuals and partial-response ones to encourage them to complete the survey several times. Thank you mail was sent to each participant after completing the survey asking them to distribute it to their colleagues or acquaintances who can do the survey.

To increase the response rate, a monetary incentive was offered to each participant, because he or she was generally reluctant to spend time to take the survey otherwise. This incentive increased the response rate and even improved the quality of responses as well. The literature also supports this fact, identifying that monetary incentives can improve data quality and response rates through several experiments (Brennan et al. 1991; Downes-LeGuin et al. 2002; Gajraj et al. 1990; Kaplan and White 2002; Li 2006; Paolillo and Lorenzi 1984; Warriner et al. 1996; Wilk 1993). The average time spent on the survey by participants who received the incentive exceeded that of participants with no-incentive. It should be noted that the incentive also reduced to some extent item non-response and bad answers, such as "don't know" or "no answer". Some of the participants who received incentive pay even left comments on their company's ERP implementation or opinions about the success of ERP based on their experience. The other benefit of the incentive was that it encouraged participants to distribute the survey to other possible participants. That was tremendous help to administer the survey more efficiently.

5.1.2 Sample Characteristics

The main survey was conducted between May 14 and June 24, 2007, and a total of 281 responses were received. As mentioned earlier, the survey was emailed to about 3,000 individuals, and about 30% of email was bouncing back, so it was finally sent to approximately 2,100 individuals. Additionally, a total of approximately 100 directly contacted senior managers, vice presidents and IT manager distributed the survey to 5 to 10 individuals per each, so we assumed that each distributed it to an average of 7.5 individuals. Therefore, the survey was sent to a total of approximately 2,850 individuals, and the response rate was about 10%.

18 respondents did not leave their company name, and among the rest of 263 responses, a total of 80 different companies were involved in the survey. It consists of 60 U.S. firms, 14 Korean firms, and 6 firms from other different countries including Argentina, China, France, Iran, and the Netherlands. Several respondents asked not to disclose their company name to the public, so this research cannot show the names of participant companies. However, the majority of companies focused on the Engineering & Construction business area. Figure 5.1 shows the respondents' country indicating that of

281 responses, 141 responses from the U.S. (50%), 131 responses from Korea (47%), and 9 responses from other different countries (3%).

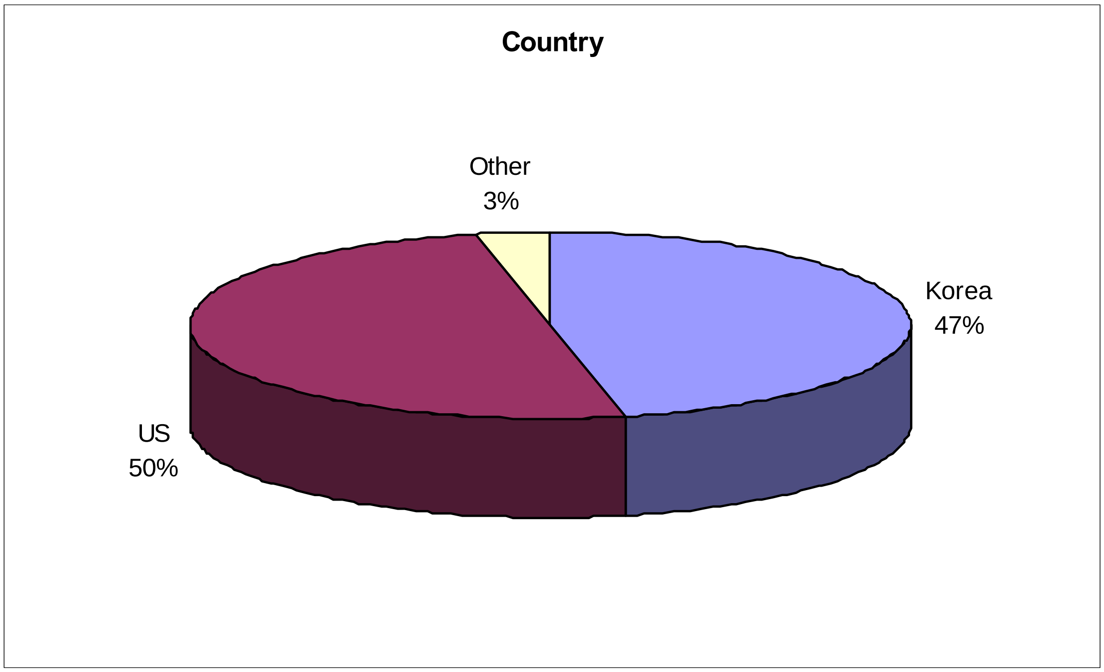


Figure 5.1 Respondents' Country of Core Business

The main survey includes a question about the ERP software the respondent's company currently uses. 18 respondents did not answer this question, and among the rest of 263 respondents, 59 respondents use SAP (22%), 114 respondents use Oracle (44%), and 90 respondents use different software other than SAP or Oracle (34%) including mostly in-house developed software, CMiC, Deltek, Microsoft, and Timberline as shown in Figure 5.2.

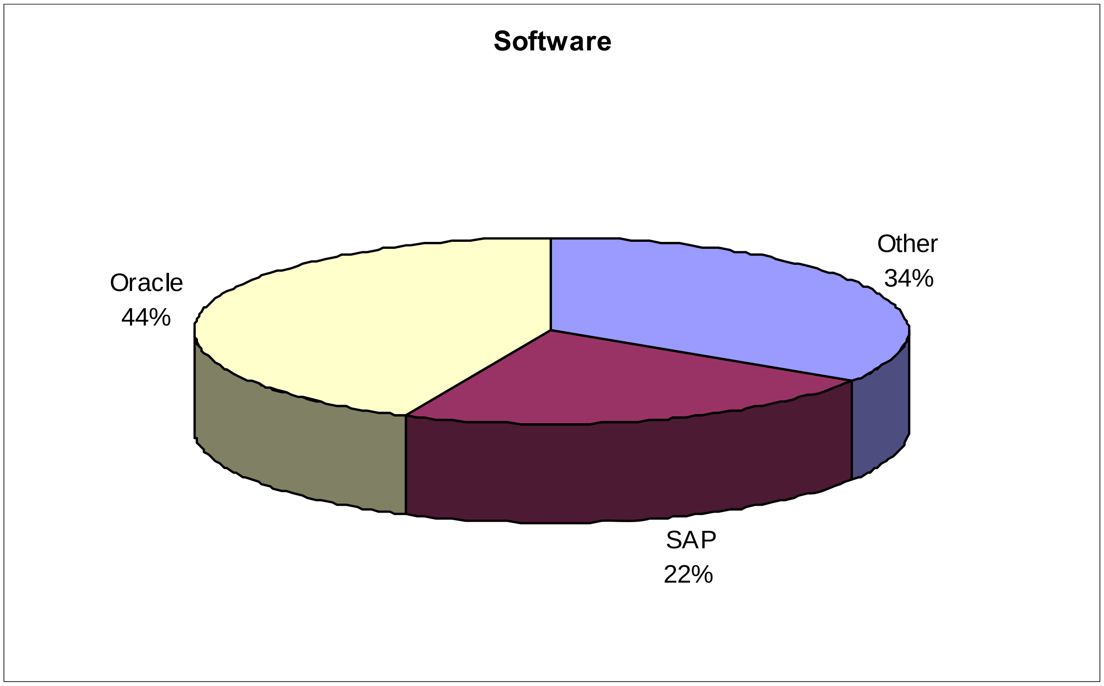


Figure 5.2 ERP Software Used by Respondents

Figure 5.3 illustrates the respondents' years of experience in the construction industry. The average of experience years was 13.9 years, and about 80% of respondents have at least 6 years of experience in the construction industry. Compared to the result of the pilot survey (average: 8.5 years), the participants of the main survey are more experienced. It implies that more high-ranking individuals were involved in the main survey, and they were supposed to know more about their ERP implementation.

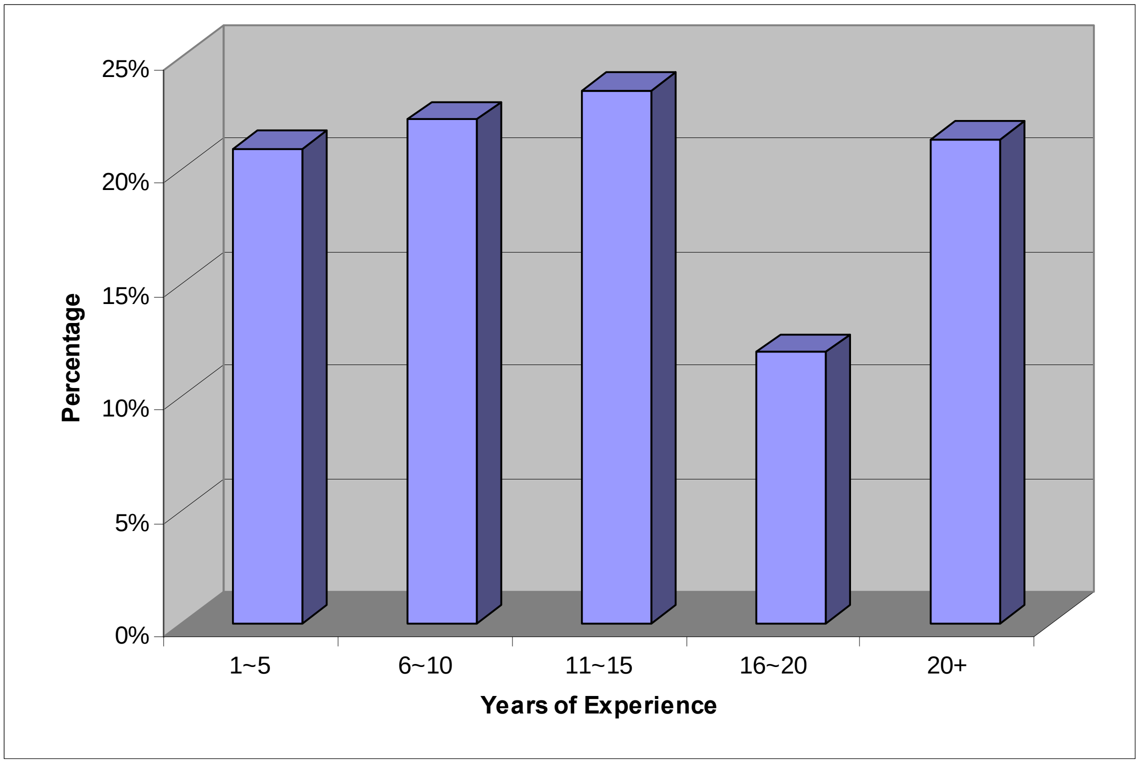


Figure 5.3 Respondents' Years of Experience in the Construction Industry

The average of respondent's use hours of the ERP system was 13.4 hours per week, and 68% of respondents used their ERP system at least 6 hours per week as shown in Figure 5.4. Compared to the result of the pilot survey (average: 11.3 hours), the respondents who participated in the main survey used their ERP system slightly more. However, 106 of 281 respondents (38%) did not answer the question about their use hours of the ERP system, so "use hours" cannot be used as a measure of the amount of use. It should be used in complementary analysis such as T-test.

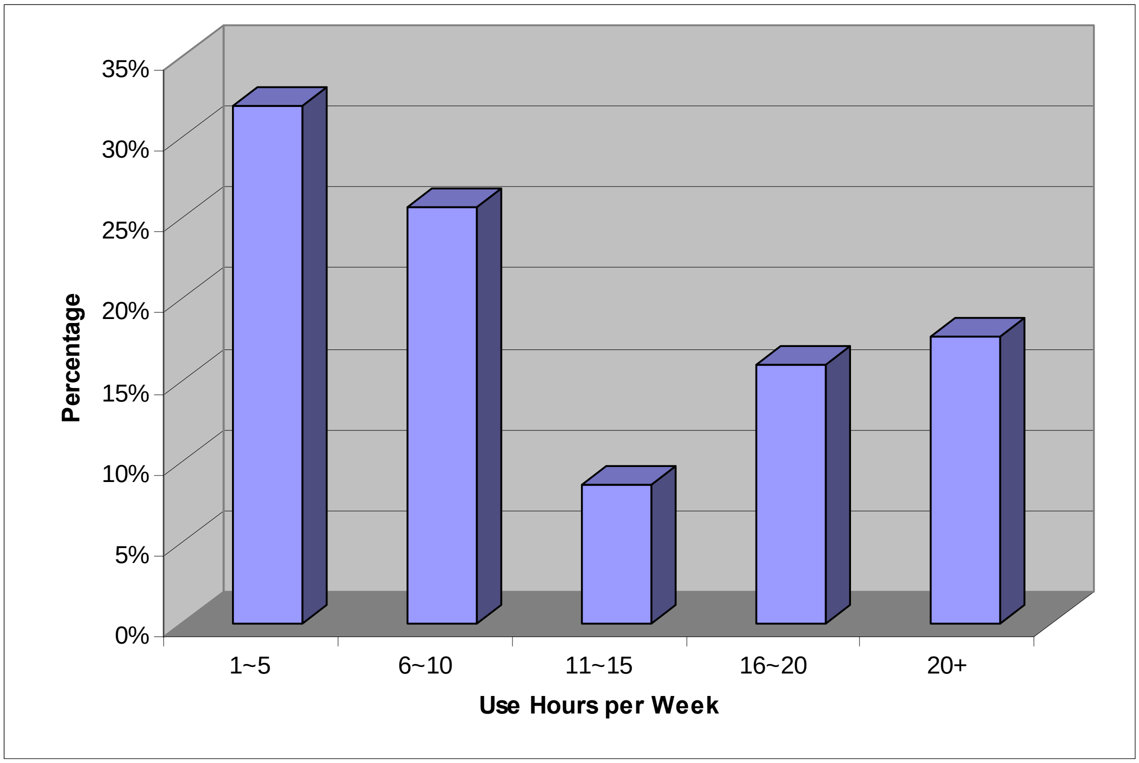


Figure 5.4 Respondents' Use Hours of their ERP System

5.1.3 Summary of Data

There are some missing data in the responses of the main survey similar to the pilot survey. Items in the variables "consultant support" have relatively low response rate (i.e. both of them have 82% of response rate), and items related to project progress also have somewhat low response rate (questions about completion on time: 73%, question about completion within budget: 67%). The reason is that respondents who were not involved in the ERP implementation project have no firsthand knowledge of the situation, although they might have heard limited information from various sources. Even respondents who joined the company after ERP implementation have more difficulty answering these questions properly.

Items related to organizational impact including cost savings and revenue increases also have relatively low response rate (81%, 79% respectively). Respondents can guess approximately whether or not such benefits from the ERP system exist, but they cannot assess these benefits exactly. That made some respondents reluctant to answer these questions. The summary of responses in each items from the main survey are listed in Appendix D-1.

5.2 Final ERP Success Model

5.2.1 Data Analysis

Data analysis with the main survey was conducted with the same steps as the pilot survey. The first analysis was looking at correlation and reliability between items within each variable to identify which variables should be modified. Then, variables were modified based on the result of factor analysis. SPSS® 15 was used for all the data analysis done with the main survey. The detailed data analysis with all variables in the main survey is presented in Appendix D. After completing a series of data analyses with the main survey, the final adjustments are summarized below:

1) The new variable after the pilot survey “ERP Evaluation” was divided into two factors “Function” and “Consultant Support”. The new factor “Functions” includes the items related to software selection and information systems area participation in the conceptual ERP success model.
2) Items in the factor “Project Success” was divided into two groups “Progress” and “Quality”. The new factor “Progress” includes questions about project completion on time and within budget, while “Quality” has questions related to system quality and the scope matched with the company’s needs.
3) The other variables remained the same as they were in the pilot survey.

Compared to the result of the pilot survey, there were not many changes in the main survey. It indicates that the survey instrument was well developed to maintain the consistency of responses. Table 5.1 describes the summary of final factor adjustment showing the variables with their contents of items and reliability.

Table 5.1 Summary of Final Factors Adjustment

Variable	# of Items	Items	Reliability (α)	Source of Items
Output	4	report1, report2, output1, output2	.84	Venkatesh & Davis 2000
Job Relevance	2	job1, job2	.90	Venkatesh & Davis 2000
Image	2	image1, image2	.87	Venkatesh & Davis 2000
Result Demonstrability	2	result1, result2	.84	Venkatesh & Davis 2000
Compatibility	2	compa1, compa2	.88	
System Reliability	3	reliabl1, reliabl2, reliabl3	.83	
Internal Support	3	interna1, interna2, interna4	.69	Ferratt et al. 2006
Function	4	softwar1, softwar2, sysfun1, sysfun2	.90	Ferratt et al. 2006
Consultant Support	2	consul1,consul2,	.75	Ferratt et al. 2006
Subjective Norm	4	sn1, sn2, sn3, sn4	.83	Lucas & Spitler 1999
Perceived Usefulness	4	pu1, pu2, pu3, pu4	.96	Davis 1989, Venkatesh & Davis 2000
Perceived Ease of Use	3	eou1, eou2, eou3	.93	Davis 1989, Venkatesh & Davis 2000
Intention to Use / Use	3	use1, use2, use3	.85	Venkatesh & Davis 2000
ERP Benefits	7	satis1,satis2, satis3, indimpa1, indimpa2, orgimpa1,orgimpa2	.92	DeLone & McLean 1992
Project Success – Progress	2	prosucc1, prosucc2,	.88	
Project Success – Quality	2	prosucc3, prosucc4	.89	

Table 5.2 shows the correlation between the final variables fixed with the data analysis. Most independent variables (i.e. success factors) except "Image" are highly correlated. It is understandable that most IT related success factors can affect each other to some extent so that they are supposed to be correlated. However, it should be noted that there can be multicollinearity problems related to this issue, which can lead to erroneous models.

Table 5.2 Correlation Matrix of All Scaled Variables

	output	job	image	result	compatib	reliable	internal	function	consult	sn	pu	eou	use	erp_bene	progress	quality
output	1															
job	.37**	1														
image	.08	.06	1													
result	.47**	.47**	-.03	1												
compatib	.34**	.20**	.09	.39**	1											
reliable	.50**	.37**	.01	.42**	.36**	1										
internal	.48**	.32**	.11	.43**	.23**	.45**	1									
function	.69**	.45**	.03	.52**	.40**	.64**	.58**	1								
consult	.44**	.13*	.10	.23**	.11	.37**	.47**	.50**	1							
sn	.39**	.44**	.10	.40**	.27**	.40**	.55**	.57**	.29**	1						
pu	.61**	.46**	.09	.54**	.37**	.52**	.50**	.71**	.38**	.55**	1					
eou	.58**	.38**	-.01	.48**	.43**	.56**	.45**	.72**	.44**	.46**	.63**	1				
use	.47**	.61**	.01	.59**	.34**	.49**	.45**	.62**	.30**	.56**	.74**	.60**	1			
erp_bene	.70**	.44**	.06	.52**	.45**	.65**	.51**	.80**	.48**	.55**	.80**	.73**	.68**	1		
progress	.32**	.03	.12	.09	.07	.19**	.46**	.31**	.39**	.25**	.26**	.28**	.19**	.32**	1	
quality	.64**	.42**	.03	.44**	.39**	.58**	.48**	.80**	.49**	.49**	.66**	.68**	.62**	.78**	.44**	1

*: Correlation is significant at the .05 level (2-tailed)
**: Correlation is significant at the .01 level (2-tailed)

5.2.2 Final Adjustment of Research Model

The ERP success model after final adjustment with the main survey is shown in Figure 5.5. The description of each variable including its abbreviated name and detailed explanation can be found in Table 5.3. These abbreviated names will be used in all the following analysis since the original names need to be simplified for the proper use of SPSS®.

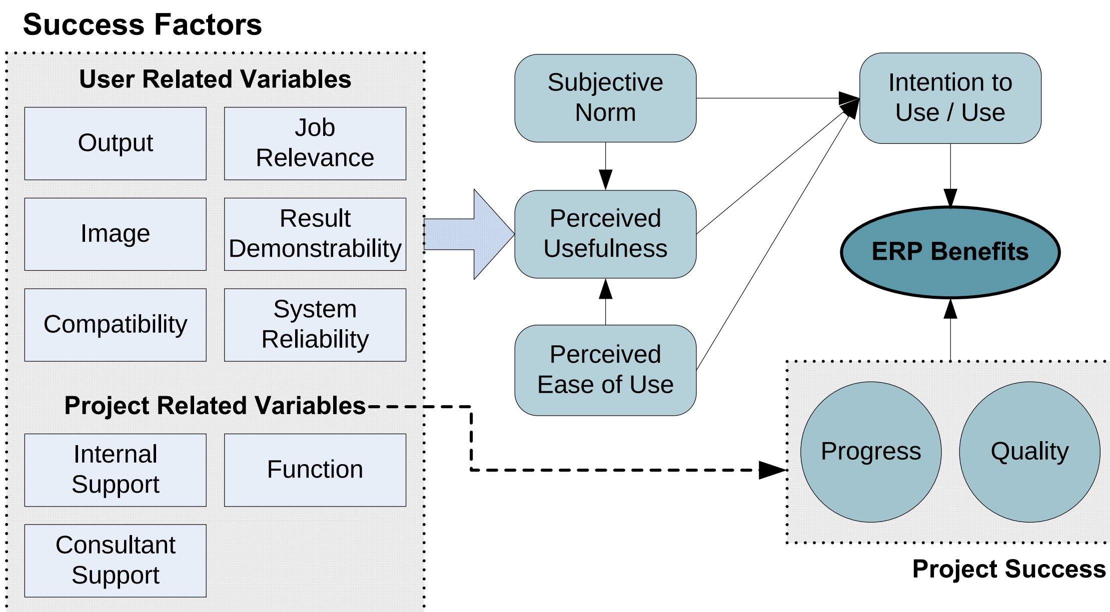


Figure 5.5 Final ERP Success Model

Table 5.3 Description of Variables in ERP Success Model

Variable	Abbreviated Name	Explanation
Output	output	Quality of the system output including management and performance report (KPI / CSF)
Job Relevance	job	An individual's perception regarding the degree to which the target system is applicable to his or her job
Image	image	The degree to which use of the system is perceived to enhance one's image or status in one's social system
Result Demonstrability	result	The tangibility of the results of using the system, including their observability and communicability
Compatibility	compatib	Quality of the system in exchanging data with other systems
System Reliability	reliable	The degree to which the system ensures the delivery of data to the users
Internal Support	internal	The degree of the company's internal support for the ERP implementation project (Top management support, Training, and Project planning)
Function	function	The functionality of the ERP software and its matching with the company's necessary business functions
Consultant Support	consult	The degree to which consultant support helps to make ERP implementation successful
Subjective Norm	sn	The person's perception that most people who are important to him think he should or should not perform the behavior in question
Perceived Usefulness	pu	The degree to which a person believes that using a particular system would enhance his or her job performance
Perceived Ease of Use	eou	The degree to which a person believes that using a particular system would be free of effort
Intention to Use / Use	use	User behavior in intention to use and actual system use
ERP Benefits	erp_bene	The degree of user satisfaction with the ERP system and Individual & Organizational impacts from the ERP system
Project Success - Progress	progress	The degree to which the implementation project was completed on time, and within the budget as initially planned
Project Success - Quality	quality	The degree of the quality of the ERP system and matching the scope of the ERP system with the company's needs

5.3 Comparison of Samples

In this section, differences between independent samples were examined using t tests or analysis of variance (ANOVA). The difference between t tests and ANOVA is that t test compares only two distributions while ANOVA is able to compare more than two (George and Mallery 2007). Four different comparisons in terms of respondents' country, software, years of experience, and use hours are presented in the following subsections.

5.3.1 Country

The independent samples t test is generally used for comparing sample means to see if there is sufficient evidence to infer that the means of the two sample distributions differ significantly from each other. The two samples are measured on some variable of interest in common, but there is no overlap of membership between the two groups (George and Mallery 2007).

The survey was conducted mainly in two countries: the U.S. and Korea. Both two groups have similar sample size: the U.S. has 141, and Korea has 131 responses. The detailed result of this test can be found in Appendix E-1, and the summary result is shown in Table 5.4. The actual t value refers to the difference between means divided by the standard error. The significance (2-tailed) indicates the probability that the difference in means could happen by chance, so the means differ significantly at the $p<.05$ level if this index is less than .05.

All the means of responses from the U.S. except “Image” were higher than responses from Korea, especially in system related variables such as “Compatibility”, “System Reliability”, “Function”, and “Quality”. It indicates that the U.S. respondents were satisfied with the overall quality of their ERP system more than Korean respondents, which eventually made the U.S. respondents give higher scores in ERP benefits, i.e. better user satisfaction, higher individual impact and organizational impact. A more extensive comparison between these two samples will be followed in the regression analysis section.

Table 5.4 Summary of Comparison in Country

Variable	t	Sig. (2-tailed)	Mean			
			Korea	the U.S.	Difference	Std. Error Difference
output	-.54	.59	5.06	5.13	-.07	.13
job	-4.32	**.00**	5.27	5.93	-.65	.15
image	3.52	**.00**	4.47	3.87	.60	.17
result	-3.95	**.00**	4.84	5.38	-.54	.14
compatib	-2.54	**.01**	3.78	4.23	-.45	.18
reliable	-4.15	**.00**	4.39	4.99	-.60	.14
internal	-.27	.79	5.00	5.04	-.04	.15
function	-3.03	**.00**	4.72	5.18	-.46	.15
consult	-.54	.59	4.48	4.57	-.09	.16
sn	-4.36	**.00**	4.42	5.03	-.61	.14
pu	-1.17	.24	5.17	5.36	-.19	.16
eou	-2.67	**.01**	4.16	4.60	-.44	.16
use	-1.53	.13	5.43	5.66	-.23	.15
erp_bene	-3.26	**.00**	4.50	4.94	-.44	.14
progress	1.88	.06	4.40	4.02	.37	.20
quality	-3.34	**.00**	4.62	5.19	-.58	.17

5.3.2 Software

Analysis of variance (ANOVA) is generally used for comparing sample means to infer that the means of the sample distributions differ significantly from each other if there are three or more samples (George and Mallery 2007). This research classified the ERP software into three different groups: SAP, Oracle, and Other than these two. The third group includes mostly respondent company's in-house developed software, but it also includes CMiC which was developed specifically for construction companies, Deltek, and so on.

The summary result of this analysis is shown in Table 5.5. This research used LSD (Least Significant Difference) method in post hoc multiple comparisons, which is most popular because it is simply a series of t tests. The significance indicates the probability of the observed value happening by chance, so the means differ significantly at the $p<.05$ level if this index is less than .05. According to the result of this analysis, there is little difference in responses with respect to software used. There is a difference between the means of SAP and Oracle in "Subjective Norm", but it is unlikely to relate to the software. However, SAP users thought that their ERP systems are not easy to use compared to Oracle or other software. Another interesting finding was that the respondents in other software group used their ERP systems more than SAP or Oracle users. We can guess that their applications were mostly developed in-house, so the users were more accustomed to using them than other commercially available software like SAP or Oracle.

Table 5.5 Summary of Comparison in Software

Variable	Mean				Significance		
	Others	SAP	Oracle	Total	Others - SAP	Others - Oracle	SAP - Oracle
output	5.14	5.13	5.12	5.13	.97	.89	.93
job	5.74	5.51	5.71	5.67	.29	.89	.32
image	4.38	3.97	4.13	4.18	.08	.21	.46
result	5.25	5.19	5.19	5.21	.76	.71	.99
compatib	4.10	3.84	4.16	4.07	.31	.79	.19
reliable	4.69	4.86	4.73	4.75	.40	.80	.51
internal	4.99	5.05	5.13	5.06	.77	.38	.65
function	5.06	4.83	4.90	4.94	.26	.35	.72
consult	4.59	4.52	4.55	4.56	.78	.83	.91
sn	4.70	4.45	4.92	4.74	.21	.18	**.02**
pu	5.47	5.25	5.23	5.32	.29	.16	.93
eou	4.62	3.90	4.46	4.40	**.00**	.40	**.01**
use	5.84	5.28	5.51	5.58	**.00**	**.04**	.23
erp_bene	4.75	4.70	4.72	4.73	.78	.84	.91
progress	4.26	4.07	4.09	4.15	.52	.48	.95
quality	4.98	4.72	4.87	4.88	.29	.56	.54

5.3.3 Experience

This research divided the respondents in their years of experience into two different groups: respondents who have up to 10 years of experience and over 10 years of experience. These two groups can be defined to “less experienced group” and “more experienced group” respectively. Approximately 83% of respondents answered with their years of experience, and both groups have similar sample size: up to 10 years group has 101, and over 10 years group has 133 responses. The detailed result of this test can be found in Appendix E-2, and the summary result is shown in Table 5.6.

An interesting finding here was that all the means of responses from more experienced group were higher than responses from less experienced group in variables with a significant difference. It indicates that respondents in more experienced group consider their ERP system as good and useful, so they would more inclined to use their ERP system and believe ERP benefits are higher than the less experienced group do. Particularly, they tended to give higher scores in variables related to ERP implementation project. The reason is that they were possibly responsible for their ERP implementation since many of this group were senior mangers or higher level.

Table 5.6 Summary of Comparison in Years of Experience

Variable	t	Sig. (2-tailed)	Mean			
			Up to 10 years	Over 10 years	Difference	Std. Error Difference
output	-2.38	**.02**	4.93	5.27	-.34	.14
job	-2.20	**.03**	5.49	5.85	-.36	.17
image	.04	.97	4.19	4.18	.01	.18
result	-2.38	**.02**	5.04	5.38	-.34	.14
compatib	.18	.86	4.04	4.00	.04	.20
reliable	-3.88	**.00**	4.43	5.04	-.61	.16
internal	-3.15	**.00**	4.80	5.26	-.47	.15
function	-3.33	**.00**	4.65	5.17	-.52	.15
consult	-2.96	**.00**	4.23	4.75	-.52	.18
sn	-1.88	.06	4.57	4.86	-.29	.15
pu	-2.17	**.03**	5.13	5.48	-.34	.16
eou	-.96	.34	4.31	4.47	-.16	.17
use	-3.08	**.00**	5.31	5.78	-.46	.15
erp_bene	-2.12	**.04**	4.57	4.86	-.30	.14
progress	-.40	.69	4.06	4.14	-.09	.21
quality	-2.93	**.00**	4.56	5.10	-.53	.18

5.3.4 Use Hours

This research divided the respondents in their use hours of the ERP system into two different groups: respondents who have up to 10 hours and over 10 hours per week. These two groups can be defined to "normal use group" and "heavy use group" respectively. The problem was that only about 62% of respondents answered in their use hours per week, so the sample size was 175 out of 281. There were 101 respondents in the normal use group and 74 respondents in the heavy use group. The detailed result of this test can be found in Appendix E-3, and the summary result is shown in Table 5.7.

According to the result of the t test, the respondents in the heavy use group gave higher scores in all the variables except "System Reliability" than the normal use group. Among the user related variables, "Job Relevance" and "Result Demonstrability" have significant differences between these two groups, but there is no significant difference in project related variables such as "Internal Support", "Function", and "Consultant Support". Because use hours can represent the amount of use, the variables which have significant differences between these two groups are directly related to "Intention to Use / Use". Referring to the correlation matrix of all scaled variables in Table 5.2, "Job Relevance" and "Result Demonstrability" were the most significant correlated variables with "Intention to Use / Use" among the user related variables, so that is why significant differences of the means exist in these variables.

The same reason applies to the variables "Subjective Norm", "Perceived Usefulness", "Perceived Ease of Use", and "Intention to Use / Use". It is taken for granted that responses from the heavy use group have higher scores than the normal use group in "Intention to Use / Use". As mentioned in the previous chapter, "Subjective Norm", "Perceived Usefulness" and "Perceived Ease of Use" are direct antecedents of "Intention to Use / Use", so these variable should be expected to have significant differences between these two groups. The respondents in the heavy use group also gave higher scores in "ERP Benefits" and "Project Success - Quality" than the normal use group. These are quite expectable results since these two variables are highly correlated with "Intention to Use / Use".

Table 5.7 Summary of Comparison in Use Hours

Variable	t	Sig. (2-tailed)	Mean			
			Up to 10 hours	Over 10 hours	Difference	Std. Error Difference
output	-1.65	.10	5.02	5.27	-.25	.15
job	-5.16	**.00**	5.40	6.28	-.88	.17
image	-.06	.96	4.29	4.30	-.01	.22
result	-1.99	**.05**	5.11	5.45	-.34	.17
compatib	-1.56	.12	3.82	4.18	-.36	.23
reliable	.26	.80	4.72	4.67	.05	.19
internal	-.49	.63	5.06	5.14	-.08	.17
function	-1.14	.26	4.89	5.09	-.20	.17
consult	-.59	.56	4.44	4.56	-.11	.19
sn	-2.07	**.04**	4.64	5.00	-.37	.18
pu	-2.78	**.01**	5.18	5.65	-.47	.17
eou	-3.83	**.00**	4.11	4.80	-.69	.18
use	-5.16	**.00**	5.35	6.14	-.78	.15
erp_bene	-2.26	**.03**	4.61	4.96	-.35	.16
progress	-1.13	.26	3.97	4.24	-.27	.24
quality	-3.24	**.00**	4.63	5.27	-.64	.20

5.4 Regression Analysis

Multiple regression analysis is the technique of developing predictive equations when there is more than one independent variable present. It is used to compute multiple correlations identifying the strength of relationship between several independent variables and a single dependent variable. It should be noted that correlation does not imply causation. Although correlations can provide valuable clues with respect to causal relationships among variables, a high correlation between two variables does not represent adequate evidence that changing one variable may result from changes of other variables (George and Mallery 2007; Sirkin 1999).

In this research, there are five different dependent variables associated with identifying the ERP success: "Perceived Usefulness", "Intention to Use / Use", "Project Success – Progress", "Project Success – Quality", and "ERP Benefits". This section investigates how the factors act together to affect these dependent variables and the relationships between these dependent variables by using multiple regression analysis.

5.4.1 Analysis of Responses Combined for All Respondent Countries

Enter method (i.e. putting at one time all specified variables regardless of significance levels) was used among the method of entering variables in regression analysis. Table 5.8 shows the summary of regression analysis on the dependent variables indicating that all R^2 values except regression on "Progress" are very high. However, there is no standard of

R^2 that can be considered high in the IS research. As a rule of thumb, an R^2 of 20% might be considered high in social science research, but totally unacceptable in biological science project or a precision instrument testing (Lucas 2007). R^2, which is called to the coefficient of determination, is interpreted as the proportion of variation in the dependent variable that potentially could be explained by the independent variable (Sirkin 1999). For instance, R^2 of regression on "Perceived Usefulness" was .62, indicating that approximately 62% of the variance in "Perceived Usefulness" can be explained by the proposed regression model.

Table 5.8 Summary of Regression Analysis – All Responses

Dependent Variable	Predictors	R	R^2	Adjusted R^2	Std. Error of the Estimate
pu	output, job, image, result, compatib, reliable, internal, function, consult, sn, eou	.79	.62	.60	.78
use	sn, pu, eou	.78	.60	.60	.74
erp_bene	use, progress, quality	.83	.69	.68	.63
progress	internal, function, consult	.49	.24	.23	1.27
quality	internal, function, consult	.80	.64	.64	.86

All the results of the regression analysis were put together in the ERP success model as shown in Figure 5.6, and the regression equations associated with each regression analysis are listed as follows:

- $$pu = \underset{(3.47)^{***}}{.28 \ast function} + \underset{(2.77)^{**}}{.17 \ast sn} + \underset{(2.53)^{**}}{.17 \ast output} + \underset{(2.48)^{**}}{.15 \ast eou} + \underset{(1.94)^{*}}{.11 \ast result} + \underset{(1.60)^{+}}{.08 \ast job}$$
  $$+ \underset{(1.15)}{.07 \ast internal} - \underset{(-.86)}{.05 \ast consult} + \underset{(.86)}{.03 \ast image} + \underset{(.83)}{.03 \ast compatib} + \underset{(.34)}{.02 \ast reliable} + .07 \qquad (5.1)$$

- use = .50*pu + .19*sn + .16*eou + 1.34
  (9.58)*** (3.87)*** (3.37)*** (5.2)

- erp_bene = .45*quality + .34*use + .001*progress + .62
  (10.58)*** (7.18)*** (.03) (5.3)

- progress = .44*internal +.26*consult - .006*function + .81
  (4.46)*** (3.08)** (-.07) (5.4)

- quality = .87*function + .12*consult - .02*internal + .15
  (14.26)*** (2.11)* (-.35) (5.5)

Note: Numbers are (t value), $^{***}p<.001$; $^{**}p<.01$; $^{*}p<.05$; $^{+}p<.10$

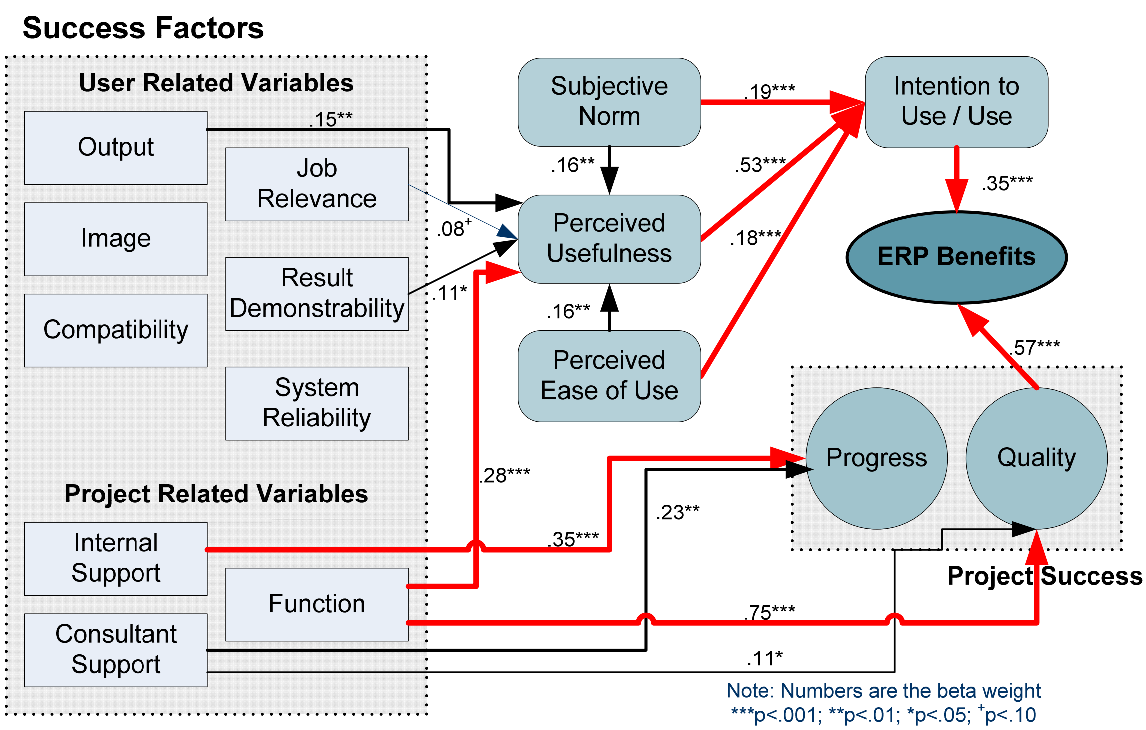


Figure 5.6 ERP Success Model with Results of Regressions – All Responses

Perceived Usefulness

Table 5.9 shows the effects of the success factors on perceived usefulness. In this table, B values indicate the coefficients and constant for the regression equation that measures predicted value for perceived usefulness, while Beta values refer to the standardized regression coefficients which allow for an equal comparison of the coefficient weights. The t value refers to the value of B divided by the standard error of B. The significance indicates the probability that the t value could happen by chance, so it is considered significant at the $p<.05$ level if this index is less than .05. Collinearity statistics were included for detecting multicollinearity. Multicollinearity is defined as any linear relationship among the predictor variables in the regression model, and it can be associated with an unstable estimated regression coefficient (Chatterjee and Hadi 2006). The tolerance indicates the percentage of the variance in a given predictor that cannot be explained by the other predictors, so a small tolerance means that the variable has high multicollinearity. The other index, the variance inflation factor (VIF) greater than 2 is usually considered problematic in multicollinearity.

Table 5.9 Result of Regression on Perceived Usefulness – All Responses

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.07	.37		.18	.86		
output	.17	.07	.15	2.53	**.01**	.49	2.05
job	.08	.05	.08	1.60	.11	.70	1.44
image	.03	.04	.04	.86	.39	.93	1.08
result	.11	.06	.11	1.94	**.05**	.61	1.65
compatib	.03	.04	.04	.83	.41	.74	1.36
reliable	.02	.06	.02	.34	.74	.52	1.94
internal	.07	.06	.07	1.15	.25	.50	2.00
function	.28	.08	.28	3.47	**.00**	.28	3.63
consult	-.05	.05	-.05	-.86	.39	.62	1.61
sn	.17	.06	.16	2.77	**.01**	.55	1.81
eou	.15	.06	.16	2.48	**.01**	.44	2.27

Among the predictors, "Function" has high multicollinearity, but overall, the regression model looks fine. However, according to its t value and significance, "Function" is the most important factor in this regression model. "Output Quality", "Result Demonstrability", "Subjective Norm", and "Perceived Ease of Use" also impact on "Perceived Usefulness" significantly.

Intention to Use / Use

According to the indices of tolerance and VIF shown in Table 5.10, multicollinearity is not an issue in this regression model. All three independent variables impact on "Intention to Use / Use" significantly. This model is also supported by Technology Acceptance Models (i.e. TAM and TAM2). Among these variables, "Perceived Usefulness" is the most important factor affecting "Intention to Use / Use".

Table 5.10 Result of Regression on Use – All Responses

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.34	.23		5.95	.00		
sn	.19	.05	.19	3.87	**.00**	.68	1.48
pu	.50	.05	.53	9.58	**.00**	.51	1.95
eou	.16	.05	.18	3.37	**.00**	.59	1.71

ERP Benefits

Table 5.11 shows the detailed results of the regression on "ERP Benefits" showing that there is no problem in multicollinearity. Both "Use" and "Quality" impact on the final dependent variable "ERP Benefits" significantly, but "Progress" does not. It indicates that respondents did not care much whether or not their ERP implementation had been completed on time and within the budget. The result shows that improving the quality and scope of the ERP system should be considered as the top priority to increase the possible ERP benefits rather than focusing on the progress of the project during the implementation period.

Table 5.11 Result of Regression on ERP Benefits – All Responses

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.62	.23		2.67	.01		
use	.34	.05	.35	7.18	**.00**	.65	1.55
progress	.00	.03	.00	.03	.97	.81	1.24
quality	.45	.04	.57	10.58	**.00**	.54	1.84

Project Success - Progress

According to the result shown in Table 5.12, both "Internal Support" and "Consultant Support" can affect the progress (on time & on budget) of ERP implementation significantly, but "Function" does not. It is the expected result because completing the project properly should be affected by top management support, good planning, and consultant support. This regression model does not have multicollinearity either.

Table 5.12 Result of Regression on Progress – All Responses

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.81	.45		1.81	.07		
internal	.44	.10	.35	4.46	**.00**	.64	1.57
function	-.01	.09	-.01	-.07	.95	.62	1.63
consult	.26	.09	.23	3.08	**.00**	.69	1.45

Project Success - Quality

Table 5.13 shows that multicollinearity is not an issue in this regression model. "Function" is the most important factor for "Quality" of the ERP system. It indicates that selecting the right software and defining the necessary functions should be given the most consideration to enhance the overall quality of the ERP system. "Consultant Support" can also impact on "Quality, but there is no impact expected from "Internal Support".

Table 5.13 Result of Regression on Quality – All Responses

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.15	.29		.50	.62		
internal	-.02	.06	-.02	-.35	.73	.62	1.61
function	.87	.06	.75	14.26	**.00**	.59	1.68
consult	.12	.06	.11	2.11	**.04**	.66	1.51

Regression Analysis with Dummy Variable

One of the limitations of multiple regression analysis is that it contains only quantitative explanatory variables. Qualitative or categorical variables represented by indicator or dummy variables can be very useful as predictors in regression analysis. These variables can be used to incorporate qualitative explanatory variables into a linear regression model, substantially expanding the range of application of regression analysis (Ashenfelter et al. 2003; Chatterjee and Hadi 2006). Dummy variables allow the intercept of the regression line to vary for different groups, so that they can explain the difference between groups in the population. This research did regression analysis with the dummy variable to identify any difference across responses from different countries. The name of the dummy variable was "Country", where 0 indicates the response from the U.S.; 1 indicates the response from Korea. The responses from other different countries were considered missing data in this research. The detailed results can be found in Appendix F, and the equations with the dummy variable “Country” are listed below:

- $$\begin{aligned} pu = {} & \underset{(3.89)^{***}}{.24*sn} + \underset{(3.50)^{***}}{.29*function} + \underset{(2.17)^{*}}{.15*output} + \underset{(2.15)^{*}}{.13*eou} + \underset{(2.13)^{*}}{.11*job} + \underset{(1.60)^{+}}{.10*result} - \underset{(-1.31)}{.08*consult} \\ & + \underset{(1.20)}{.05*compatib} + \underset{(.94)}{.06*reliable} + \underset{(.77)}{.05*internal} + \underset{(.19)}{.01*image} + \underset{(2.13)^{*}}{.26*country} - .22 \end{aligned} \qquad (5.6)$$

- $$use = \underset{(9.29)^{***}}{.51*pu} + \underset{(3.39)^{***}}{.16*eou} + \underset{(3.35)^{***}}{.18*sn} + \underset{(.54)}{.05*country} + 1.31 \qquad (5.7)$$

- $$erp\_bene = \underset{(10.67)^{***}}{.47*quality} + \underset{(6.58)^{***}}{.31*use} + \underset{(.46)}{.02*Progress} - \underset{(-1.07)}{.10*country} + .71 \qquad (5.8)$$

- $$Progress = \underset{(4.89)^{***}}{.48*Internal} + \underset{(2.82)^{**}}{.25*Consult} - \underset{(-.22)}{.02*function} + \underset{(2.31)^{*}}{.42*country} + .55 \qquad (5.9)$$

- $$quality = \underset{(14.31)^{***}}{.87*function} + \underset{(2.08)^{*}}{.12*Consult} - \underset{(-.07)}{.004*Internal} - \underset{(-1.90)^{+}}{.21*country} + .21 \qquad (5.10)$$

Note: Numbers are (t value), $^{***}p<.001$; $^{**}p<.01$; $^{*}p<.05$; $^{+}p<.10$

According to the regression equations above, the dummy variable “Country” in the regression models on “Perceived Usefulness” and “Progress” was considered significant at the p<.05 level. It indicates that there are significant differences between these two groups with respect to the regression models on “Perceived Usefulness” and “Progress”. If we assume that the slopes of independent variables are the same in the two groups, the coefficient of “Country” represents the constant separation between the lines. For instance, the expected value of “Perceived Usefulness” in the Korea group (where country = 1) will be higher than that of the U.S. group by .26. The regression on

"Quality" has a marginal difference between these two groups as shown in Equation 5.10. Additional regression analysis with these groups will be followed in the next two sections.

5.4.2 Analysis of Responses from the U.S.

Table 5.14 shows the summary of regression analysis on the dependent variables and all the results of regression analysis was put together in the ERP success model as shown in Figure 5.7. The regression equations associated with each regression analysis are listed as follows:

- $$\begin{array}{l} pu = .31*sn + .21*job + .20*eou + .24*function + .13*output - .08*consult \\ \quad (3.33)^{***}\ (2.74)^{**}\ (2.50)^{**}\ (2.02)^{*}\ (1.42)\ (-1.11) \\ \quad + .06*compatib + .05*image + .07*reliable + .05*internal + .003*result - .86 \\ \quad (1.05)\ (.87)\ (.77)\ (.60)\ (.04) \end{array} \qquad (5.11)$$

- $$\begin{array}{l} use = .41*pu + .27*sn + .19*eou + 1.22 \\ \quad (5.49)^{***}\ (3.52)^{***}\ (3.24)^{**} \end{array} \qquad (5.12)$$

- $$\begin{array}{l} erp\_bene = .49*quality + .29*use - .005*progress + .81 \\ \quad (8.04)^{***}\ (4.16)^{***}\ (-.10) \end{array} \qquad (5.13)$$

- $$\begin{array}{l} progress = .53*internal + .23*consult - .14*function + 1.04 \\ \quad (3.55)^{***}\ (1.78)^{+}\ (-1.01) \end{array} \qquad (5.14)$$

- $$\begin{array}{l} quality = .90*function + .12*consult - .04*internal + .19 \\ \quad (11.30)^{***}\ (1.70)^{+}\ (-.52) \end{array} \qquad (5.15)$$

Note: Numbers are (t value), $^{***}p<.001;^{**}p<.01;^{*}p<.05;^{+}p<.10$

Table 5.14 Summary of Regression Analysis – Responses from the U.S.

Dependent Variable	Predictors	R	R^2	Adjusted R^2	Std. Error of the Estimate
pu	output, job, image, result, compatib, reliable, internal, function, consult, sn, eou	.85	.71	.68	.79
use	sn, pu, eou	.83	.68	.68	.72
erp_bene	use, progress, quality	.83	.69	.68	.67
progress	internal, function, consult	.47	.22	.20	1.48
quality	internal, function, consult	.82	.68	.67	.85

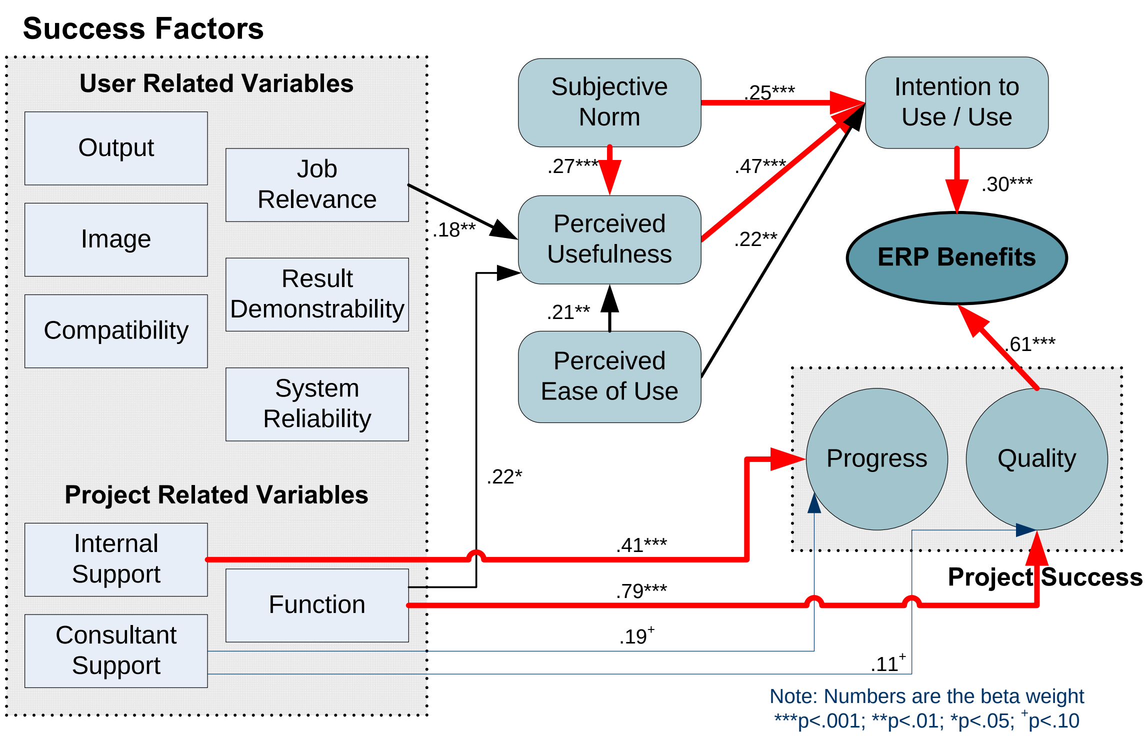


Figure 5.7 ERP Success Model with Results of Regressions – Responses from the U.S.

Perceived Usefulness

Table 5.15 shows the effects of the success factors on perceived usefulness. Similar to the analysis of all responses provided in the previous section, "Function" has high multicollinearity and several other variables have VIF of 2.0 or higher. This is an effect of the reduced sample size. There are several differences between all responses and the U.S. sample as described below:

1) "Subjective Norm" is the most important factor in the U.S. sample, while "Function" is the one in all responses.
2) "Output Quality" and "Result Demonstrability" are not the factors affecting "Perceived Usefulness" in the U.S. sample.
3) "Job Relevance" has a significant impact in the U.S. sample, but it has a marginal impact in all responses.
4) "Perceived Ease of Use" and "Function" also impact on "Perceived Usefulness" significantly at the .05 level.

Table 5.15 Result of Regression on Perceived Usefulness – Responses from the U.S.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.86	.56		-1.54	.13		
output	.13	.09	.11	1.42	.16	.44	2.27
job	.21	.08	.18	2.74	**.01**	.70	1.42
image	.05	.05	.05	.87	.39	.89	1.13
result	.00	.08	.00	.04	.97	.52	1.91
compatib	.06	.05	.06	1.05	.30	.75	1.33
reliable	.07	.09	.06	.77	.44	.47	2.15
internal	.05	.09	.05	.60	.55	.46	2.18
function	.24	.12	.22	2.02	**.05**	.23	4.33
consult	-.08	.07	-.08	-1.11	.27	.61	1.63
sn	.31	.09	.27	3.33	**.00**	.44	2.26
eou	.20	.08	.21	2.50	**.01**	.41	2.42

Intention to Use / Use

According to the indices of tolerance and VIF shown in Table 5.16, "Perceived Usefulness" has multicollinearity. However, it is acceptable because "Perceived Usefulness" is the dependent variable of "Subjective Norm" and "Perceived Ease of Use". Similar to the analysis with all responses, all three independent variables impact on "Intention to Use / Use" significantly. Among these variables, "Perceived Usefulness" is the most important factor affecting "Intention to Use / Use".

Table 5.16 Result of Regression on Use – Responses from the U.S.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.22	.29		4.17	.00		
sn	.27	.08	.25	3.52	**.00**	.50	1.99
pu	.41	.08	.47	5.49	**.00**	.36	2.79
eou	.19	.06	.22	3.24	**.00**	.55	1.83

ERP Benefits

Table 5.17 supports that the result of this regression model is almost identical with that of all responses. Both "Use" and "Quality" have a significant impact on "ERP Benefits", but "Progress" has no impact on that.

Table 5.17 Result of Regression on ERP Benefits – Responses from the U.S.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.81	.34		2.39	.02		
use	.29	.07	.30	4.16	**.00**	.61	1.64
progress	-.01	.04	-.01	-.10	.92	.87	1.16
quality	.49	.06	.61	8.04	**.00**	.55	1.83

Project Success - Progress

Different from the analysis of all responses, “Internal Support” is the only factor significantly affecting the progress of ERP implementation as shown in Table 5.18. “Consultant Support” has a marginal impact on “Progress”, but there is no impact from “Function”.

Table 5.18 Result of Regression on Progress – Responses from the U.S.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.04	.70		1.50	.14		
internal	.53	.15	.41	3.55	**.00**	.59	1.69
function	-.14	.14	-.11	-1.01	.32	.63	1.58
consult	.23	.13	.19	1.78	.08	.74	1.36

Project Success - Quality

Table 5.19 shows that “Function” is the most important factor for “Quality” of the ERP system similar to the analysis of all responses. The only difference between all responses and the U.S. sample is that the impact of “Consultant Support” on “Quality” decreases to the lower level in the U.S. sample.

Table 5.19 Result of Regression on Quality – Responses from the U.S.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.19	.39		.49	.63		
internal	-.04	.08	-.04	-.52	.61	.58	1.71
function	.90	.08	.79	11.30	**.00**	.61	1.63
consult	.12	.07	.11	1.70	.09	.72	1.40

5.4.3 Analysis of Responses from Korea

Table 5.20 shows the summary of regression analysis on the dependent variables and all the results of regression analysis were put together in the ERP success model as shown in Figure 5.8. The regression equations associated with each regression analysis are listed as follows:

- $$pu = \underset{(3.09)^{**}}{.42*function} + \underset{(2.33)^{*}}{.22*result} + \underset{(1.93)^{+}}{.18*sn} + \underset{(1.45)}{.15*output} - \underset{(-.77)}{.05*image} + \underset{(.68)}{.04*compatib}$$
$$- \underset{(-.61)}{.07*consult} + \underset{(.48)}{.04*reliable} + \underset{(.29)}{.03*eou} + \underset{(.18)}{.02*internal} + \underset{(.10)}{.007*job} + .45 \quad (5.16)$$

- $$use = \underset{(6.93)^{***}}{.58*pu} + \underset{(1.72)^{+}}{.13*eou} + \underset{(1.55)}{.12*sn} + 1.36 \quad (5.17)$$

- $$erp\_bene = \underset{(6.18)^{***}}{.42*quality} + \underset{(5.28)^{***}}{.34*use} + \underset{(1.23)}{.08*progress} + .43 \quad (5.18)$$

- $$progress = \underset{(3.68)^{***}}{.42*internal} + \underset{(1.82)^{+}}{.25*function} + \underset{(1.38)}{.18*consult} + .35 \quad (5.19)$$

- $$quality = \underset{(7.49)^{***}}{.80*function} + \underset{(1.29)}{.13*consult} + \underset{(.66)}{.06*internal} - .05 \quad (5.20)$$

Note: Numbers are (t value), $^{***}p<.001$; $^{**}p<.01$; $^{*}p<.05$; $^{+}p<.10$

Table 5.20 Summary of Regression Analysis – Responses from Korea

Dependent Variable	Predictors	R	R^2	Adjusted R^2	Std. Error of the Estimate
pu	output, job, image, result, compatib, reliable, internal, function, consult, sn, eou	.74	.55	.50	.72
use	sn, pu, eou	.70	.49	.48	.78
erp_bene	use, progress, quality	.83	.69	.68	.55
progress	internal, function, consult	.66	.44	.42	.85
quality	internal, function, consult	.82	.68	.67	.70

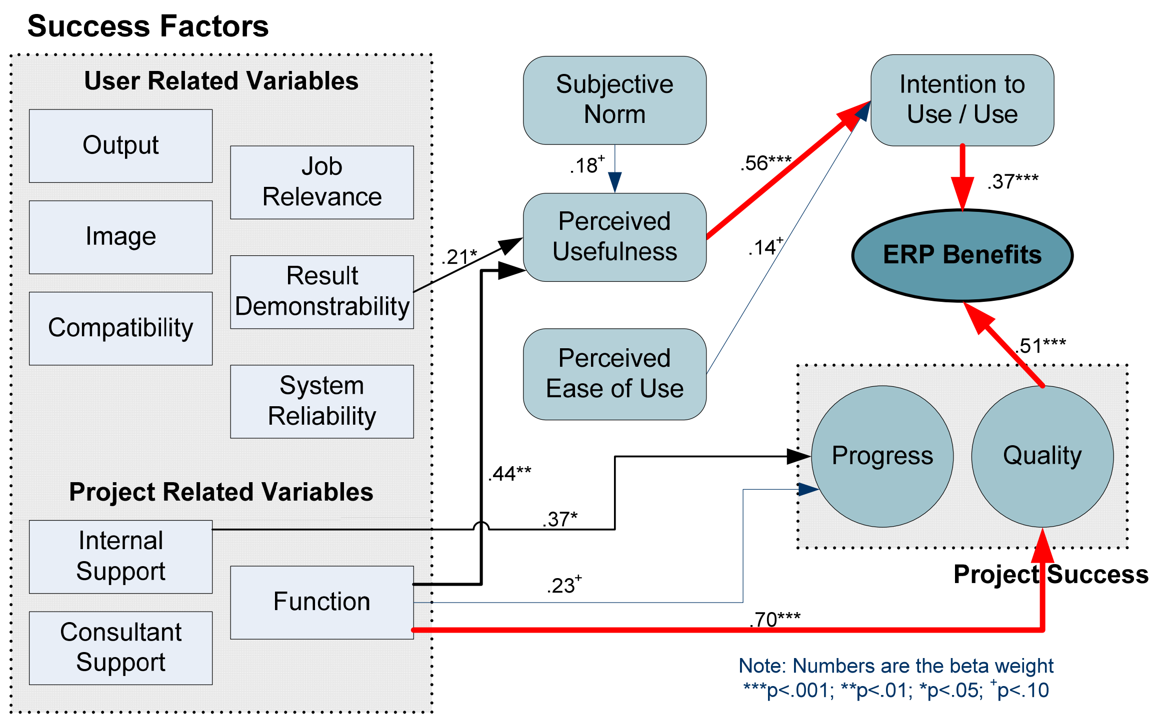


Figure 5.8 ERP Success Model with Results of Regressions – Responses from Korea

Perceived Usefulness

Table 5.21 shows the effects of the success factors on perceived usefulness. Similar to the analysis of all responses, "Function" is the most important factors among the independent variables. "Result Demonstrability" also has a significant impact on "Perceived Usefulness" at the .05 level. There are several differences between all responses and the Korean sample as described below:

1) "Output Quality" is not the factor affecting "Perceived Usefulness" in the Korean sample.
2) The impact of "Subjective Norm" is much lower in the Korean sample compared to the analysis of all responses.

3) Surprisingly, there is no impact from "Perceived Ease of Use" on "Perceived Usefulness" in the Korean sample.

Table 5.21 Result of Regression on Perceived Usefulness – Responses from Korea

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.45	.52		.88	.38		
output	.16	.11	.15	1.45	.15	.46	2.16
job	.01	.07	.01	.10	.92	.62	1.61
image	-.05	.07	-.06	-.77	.44	.68	1.48
result	.22	.10	.21	2.33	**.02**	.61	1.65
compatib	.04	.06	.06	.68	.50	.69	1.45
reliable	.04	.09	.05	.48	.64	.53	1.88
internal	.02	.11	.02	.18	.86	.43	2.31
function	.42	.14	.44	3.09	**.00**	.24	4.20
consult	-.07	.11	-.07	-.61	.54	.38	2.64
sn	.18	.09	.18	1.93	.06	.58	1.73
eou	.03	.09	.03	.29	.77	.43	2.32

Intention to Use / Use

According to Table 5.22, only "Perceived Usefulness" has a significant impact on "Intention to Use / Use". "Perceived Ease of Use" has a marginal impact, but "Subjective Norm" has less impact than the .10 significance level. This regression model with the Korean sample does not support Technology Acceptance Model (TAM & TAM2) well, so more discussions will be provided in the next chapter.

Table 5.22 Result of Regression on Use – Responses from Korea

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.36	.41		3.33	.00		
sn	.12	.08	.11	1.55	.12	.81	1.23
pu	.58	.08	.56	6.93	**.00**	.66	1.53
eou	.13	.08	.14	1.72	.09	.65	1.55

ERP Benefits

Table 5.23 supports that the result of this regression model is similar to that of all responses. Both "Use" and "Quality" have a significant impact on "ERP Benefits", but "Progress" has little impact on that.

Table 5.23Result of Regression on ERP Benefits – Responses from Korea

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.43	.32		1.35	.18		
use	.34	.06	.37	5.28	**.00**	.69	1.44
progress	.08	.06	.09	1.23	.22	.64	1.57
quality	.42	.07	.51	6.18	**.00**	.49	2.03

Project Success - Progress

Different from the analysis of all responses, "Internal Support" is the only factor affecting significantly the progress of ERP implementation in the Korean sample as shown in Table 5.24. "Function" has a marginal impact on "Progress", but there is little impact from "Consultant Support".

Table 5.24 Result of Regression on Progress – Responses from Korea

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.35	.49		.72	.48		
internal	.42	.11	.37	3.68	**.00**	.63	1.58
function	.25	.14	.23	1.82	.07	.38	2.61
consult	.18	.13	.17	1.38	.17	.43	2.33

Project Success - Quality

Table 5.25 shows that "Function" is the most important factor for "Quality" of the ERP system similar to the analysis of all responses. The difference between all responses and the Korean sample is that there is little impact from "Consultant Support" on "Quality" in the Korean sample.

Table 5.25 Result of Regression on Quality – Responses from Korea

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.05	.38		-.13	.90		
internal	.06	.09	.05	.66	.51	.60	1.67
function	.80	.11	.70	7.49	**.00**	.38	2.66
consult	.13	.10	.12	1.29	.20	.41	2.43

5.5 Analysis with Structural Equation Modeling

This research conducted Structural Equation Modeling (SEM) to examine the validity of the proposed research model as a complementary analysis. It is a powerful technique of model building associated with exiting theories, but it is relatively new and still not popular in most research areas. The results using SEM are compared with those of regression analysis provided in the previous section to see if there are any differences or additional findings with respect to the research model.

5.5.1 Overview of Structural Equation Modeling

Structural Equation Modeling (SEM) is considered as a second generation data analysis technique that can be used to test the extent to which IS research meets recognized standards for high quality analysis by examining for statistical conclusion validity. It is a hybrid technique including aspects of confirmatory factor analysis, path analysis and regression. Most first generation tools such as linear regression can analyze only one level of relationship between independent and dependent variables at a time. However, SEM is able to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis by modeling the relationships among multiple independent and dependent constructs simultaneously (Gefen et al. 2000; Gerbing and Anderson 1988).

There are two primary methods of SEM analysis: covariance analysis and partial least squares. LISREL, EQS and AMOS are representative software using covariance analysis, while PLS is the software employing partial least squares. These two different types of SEM vary in the objectives of their analyses, their statistical assumptions, and the nature of the fit statistics they produce. Table 5.26 summarizes the comparison of these SEM and linear regression.

Table 5.26 Comparison between Statistical Techniques (Gefen et al. 2000)

Issue	Covariance based SEM	PLS	Linear Regression
Objective of Overall Analysis	Show that the null hypothesis of the entire proposed model is plausible, while rejecting path-specific null hypotheses of no effect.	Reject a set of path specific null hypotheses of no effect.	Reject a set of path specific null hypotheses of no effect.
Objective of Variance Analysis	Overall model fit, such as insignificant Chi-square.	Variance explanation (high R-square)	Variance explanation (high R-square)
Required Theory Base	Requires sound theory base. Supports confirmatory research.	Does not necessarily require sound theory base. Supports both exploratory and confirmatory research.	Does not necessarily require sound theory base. Supports both exploratory and confirmatory research.
Assumed Distribution	Multivariate normal, if estimation is through Maximum Likelihood. Deviations from multivariate normal are supported with other estimation techniques.	Relatively robust to deviations from a multivariate distribution.	Relatively robust to deviations from a multivariate distribution, with established methods of handling non-multivariate distributions.
Required Minimal Sample Size	At least 100-150 cases.	At least 10 times the number of items in the most complex constructs.	Supports smaller sample sizes, although a sample of at least 30 is required.

Covariance based SEM techniques emphasize the overall fit of the proposed model as opposed to a best possible fit covariance structure providing indices and residuals. Therefore, they are best suited for confirmatory research like theory testing. However, PLS is designed to explain variance examining the significance of the relationships and their resulting R square, so it is more suited for predictive applications and theory building. For this reason, the literature suggests that PLS should be regarded as a complementary technique to covariance based SEM techniques (Gefen et al. 2000; Thompson et al. 1995).

In the use of SEM, independent variables are usually called exogenous variables, while dependent variables are called endogenous variables. Observed variables are directly measured by researchers, while latent variables are not directly observed but are inferred by the relationships among measured variables in the model. SEM uses path diagrams which can represent relationships among observed and latent variables. Rectangles or squares represent observed variables, while ovals or circles represent latent variables. Residuals are always unobserved, so they are represented by ovals or circles. Bidirectional arrows represent correlations and covariances, which indicate relationships without an explicitly defined causal direction.

5.5.2 Best Fit Model with Goodness of Fit Test

One type of covariance based SEM software, AMOS™ 7.0, was used in this research because of its compatibility with SPSS® and graphical interface. The good thing of AMOS™ 7.0 is that its user can build and test a model using AMOS Graphics which does not require any specific programming language. Figure 5.9 shows the path diagram of ERP success model provided in the section 5.2. Since all the variables in the model are observed variables (i.e. directly measured from survey items), they are represented by rectangle shapes. Each dependent variable has a residual variable represented by a circle because they cannot be observed. A residual is equivalent to the constant in the regression equation of a dependent variable, so it is only associated with a dependent variable.

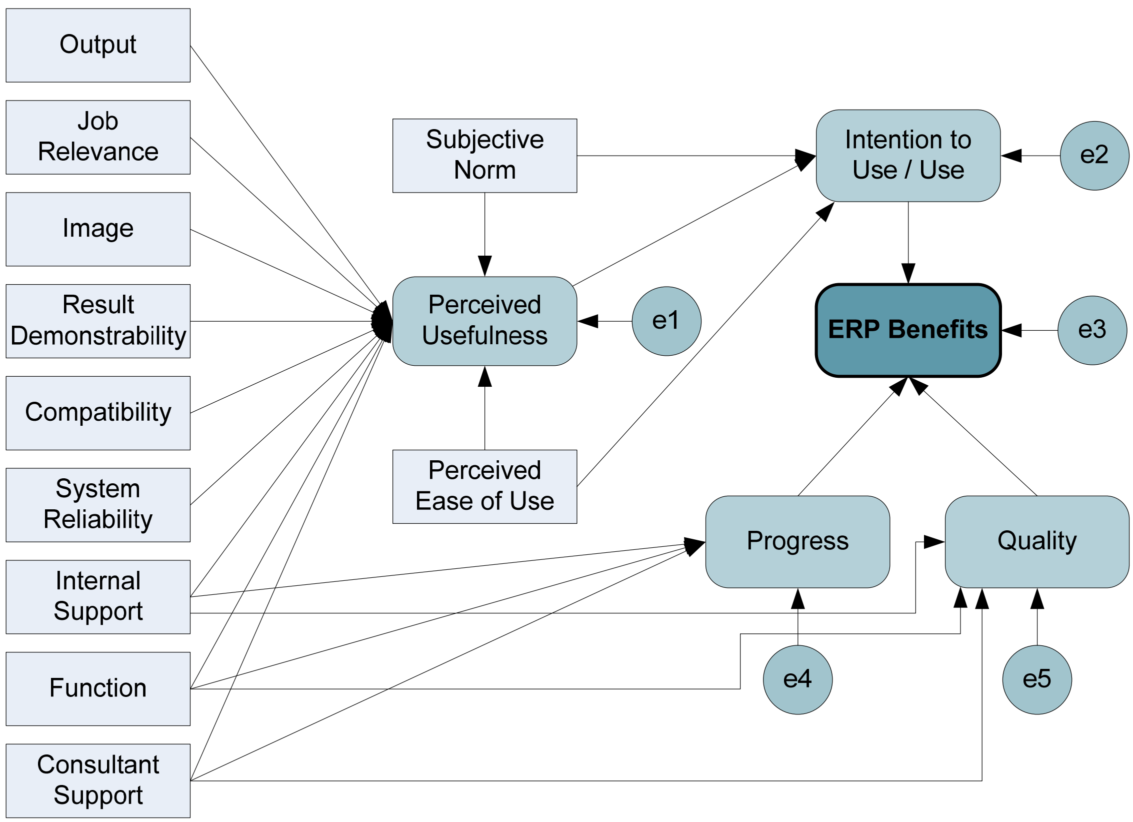


Figure 5.9 Path Diagram of ERP Success Model in SEM

The detailed results using SEM can be found in Appendix G-1, showing that there is little difference between the results of SEM and regression analysis. However, with the nature of covariance based SEM, they provided more results such as fit indices, total effects on dependent variables, and other necessary analyses simultaneously. Among the fit indices they produced, chi-square test (χ^2 /df), RMSEA, NFI, CFI, and TLI were chosen to examine the goodness of fit of proposed ERP success model and the detailed descriptions of these indices are as follows:

1) χ^2: Chi-square, the minimum value of the discrepancy. In AMOS, it is defined as CMIN. The smaller, the better.
2) df: the number of degrees of freedom for testing the model
3) χ^2 / df: the minimum discrepancy divided by its degrees of freedom. As a rule of thumb, its desired level has been suggested as low as 3 as an acceptable fit (Chin and Todd 1995; Hair et al. 1998).
4) NFI: Normed Fix Index. The normed difference in χ^2 between a single factor null model and a proposed multi factor model. .9 or higher is considered good fit (Hair et al. 1998).
5) TLI: Tucker-Lewis Index. Also known as the non-normed fit index (NNFI). TLI values close to 1 indicate a very good fit. Its desired level is .9 or higher (Arbuckle 2006; Teo et al. 2003)
6) CFI: Comparative Fit Index. CFI values close to 1 indicate a very good fit. Its desired level is .9 or higher (Arbuckle 2006; Teo et al. 2003)
7) RMSEA: Root Mean Square Error of Approximation. One of the measures based on the population discrepancy. .05 - .08 or less would indicate a reasonable error of approximation (Arbuckle 2006; Teo et al. 2003).

Table 5.27 presents one of the main results of SEM, goodness of fit indices for the measurement model. The indices of the original ERP success model indicate that the model does not fit well according to the ratio of χ^2 / df, RMSEA, and TLI. The reason is that χ^2 statistics are sensitive to sample size and non-normality of the distribution of the input variables. The number of parameters and the complexity of the model also affect these fit indices. The original model has a total of 16 variables including 11 independent variables and 5 dependent variables. Its structure is pretty complex since the main causal relationship to the final dependent variable consists of three levels, i.e. success factor – perceived usefulness – intention to use / use – ERP benefits. Therefore, in order to achieve better goodness of fit indices for the original model, we may have more data points or simplify the model structure. However, we cannot say the model is not good because of bad fit indices. It is a good idea to keep this model and compare it with a better fitting model obtained from SEM.

Table 5.27 Goodness of Fit Indices for the Measurement Model

Goodness of Fit Indices	Original Model	Revised Model	Desired Levels
χ^2 / df	292.19	114.25	Smaller
df	42	45	-
χ^2 / df	6.96	2.54	< 3.0
RMSEA	.15	.07	.05 - .08
NFI	.89	.96	> .90
CFI	.90	.97	> .90
TLI	.66	.91	> .90

AMOS has the function providing modification indices to generate the expected reduction in the overall model fit (χ^2) for each possible path that can be added to the model. According to the medication indices, four bidirectional arrows are added to the model: e1-e2, e2-e3, e4-e5, and e5-Function. SEM does not allow adding a bidirectional arrow between dependent variables, so their residuals are connected via a bidirectional arrow if they have covariance. Therefore, the new model includes covariance between the following variables: “Perceived Usefulness”- “Intention to Use / Use”, “Intention to Use / Use” – “ERP Benefits”, “Progress” – “Quality”, and “Quality” – “Function”. AMOS also provides the function “specification search”, with which optional arrows are added or removed to find the best fit model. The final revised model is illustrated in Figure 5.10, showing its more parsimonious structure than the original model. According to Table 5.27, all the indices of the revised model are within the desired range, so now it can be considered “Best Fit Model”. The detailed estimates and analysis results associated with this model can be found in Appendix G-2.

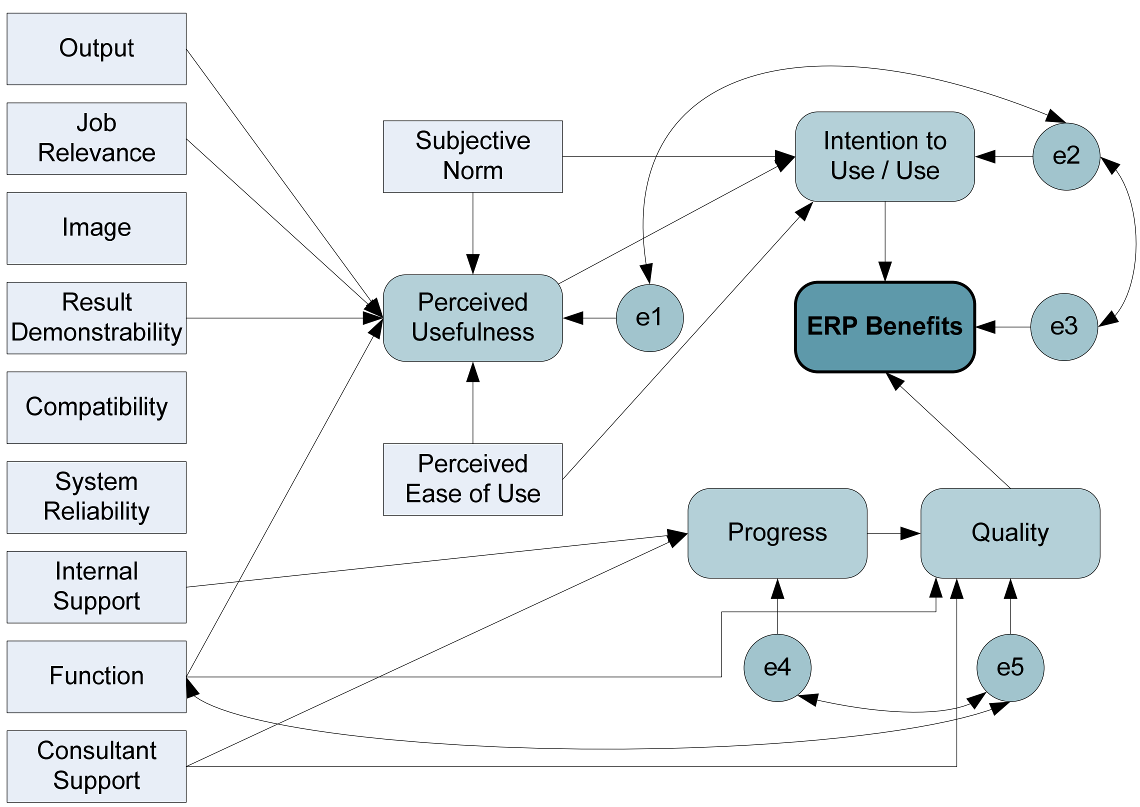


Figure 5.10 Path Diagram of Revised ERP Success Model in SEM

5.6 Chapter Summary

The main survey was conducted between May 14 and June 24, 2007, and a total of 281 responses were received with the response rate was about 10%. With extensive data analysis, the proposed model was revised, and factors were fixed by reflecting a series of factor analyses before the main analysis was started. The first main analysis done in this research was a comparison of samples using t tests or analysis of variance (ANOVA). Four different comparisons in terms of respondents' country, software, years of experience, and use hours are presented. The regression analysis was conducted to examine the relationships between factors and indicators. Five different regression models were presented to identify relationships between factors and each dependent variable attributed to ERP success. The research also found that there are significant differences in the regression analysis between the U.S. and Korean samples.

This research conducted Structural Equation Modeling (SEM) to examine the validity of the proposed research model as a complementary analysis. The results using SEM were compared with those of regression analysis to see if there are any differences or additional findings with respect to the research model. The detailed results using SEM show that there is little difference between the results of SEM and regression analysis. The goodness of fit indices of the original ERP success model indicates that the model does not fit well, so "Best Fit Model" is proposed, in which all the indices are within the desired range. The best fit model has a more parsimonious structure than the proposed success model.

6 RESEAERCH FINDINGS & DISCUSSIONS

6.1 Relationship between Factors and Success Indicators

This section discusses relationships between success factors and indicators in more detail describing the reason behind their relationships. Each subsection presents interpretations of the results about each dependent variable along with its independent variables based on its regression analysis and other relevant data from the survey.

6.1.1 Perceived Usefulness

According to the regression analysis on "Perceived Usefulness", the order of significance among the factors that have a significant impact at the .05 or higher level was "Function", "Subjective Norm", "Output", "Perceived Ease of Use", and "Result Demonstrability". The main research finding here is that the new factor postulated from this research, "Function", is the most important factor to be positively associated with perceived usefulness. It can be interpreted that most users believe that if the functionality of their ERP system is good enough to support their necessary business functions, they think their system is useful. In other words, how to define the functions of the ERP system to match the business requirements is the most important thing to make the ERP system more useful. Unlike other information systems, the ERP system needs to integrate all the necessary functions across the departments within an organization to be fully beneficial. This specific feature causes "Function" to have the largest impact on "Perceived

Usefulness”. It should be noted that the ERP system should be considered part of business processes or functions rather than an information system.

Another interesting finding is that “Subjective Norm” has a significant impact on “Perceived Usefulness”. It was hypothesized to have an impact on both “Perceived Usefulness” and “Use”. However, it was expected to have a marginal impact on “Perceived Usefulness” because TAM2 showed that “Subjective Norm” had just a marginal impact on “Perceived Usefulness” in the three month post-implementation phase. The reason behind the significance of “Subjective Norm” is that sharing more accurate data and timely information with others is one of the biggest advantages of ERP systems, so users may think that they should use ERP systems because of their work group or senior management.

As theorized, “Perceived Ease of Use”, “Output”, and “Result Demonstrability” have a significant impact on “Perceived Usefulness”. However, “Job Relevance” has a marginal impact on “Perceived Usefulness”. Even though it has a strong correlation with “Perceived Usefulness”, its impact is not significant because other more significant factors offset its significance. The same reason applies to “Compatibility”, “System Reliability”, “Internal Support”, and “Consultant Support”. Their correlations with “Perceived Usefulness” are significant, but they have little impact on it. It may be because there are too many independent variables associated with “Perceived Usefulness”, in spite of the relatively large sample size.

6.1.2 Intention to Use / Use

All three predictors have a significant impact on "Intention to Use / Use" as initially expected. Among them, "Perceived Usefulness" is the main predictor on "Use", which means that users like to use ERP systems because they think ERP systems are useful. It can be concluded that in order to encourage users to use the ERP system more, we should make the ERP system more useful. In other words, if we want to have the success of ERP adoption, we should focus on increasing the usefulness of the ERP system. With its degree of significance, "Perceived Usefulness" fully mediates the effects of its determinants (i.e. "Function", "Output", "Result Demonstrability", etc.) on "Intention to Use / Use". "Perceived Ease of Use" also has a significant impact on "Intention to Use / Use" both directly and indirectly via "Perceived Usefulness". Therefore, the proposed model in this research supports TAM quite well.

Another major finding is that "Subjective Norm" is also significant on "Intention to Use / Use" in the setting of ERP system use. It was initially assumed that ERP systems are usually used in mandatory settings, so "Subjective Norm" was involved in the research model as a predictor of use, just at it was in TAM2. Since "Subjective Norm" is significant on use at the .001 level, it indicates that ERP system use is more mandatory than voluntary. It does not make sense if a several million dollar system is used in a voluntary setting. For this reason, users may feel some pressure that they should use their ERP system because their peers or boss think that they should use it. Decision makers should pay more attention to "Subjective Norm" to encourage the use of ERP systems.

6.1.3 ERP Benefits

It was assumed that the success indicator of ERP adoption (i.e. "Intention to Use / Use") and two project success indicators (i.e. "Progress" and "Quality") have a positive impact on the final dependent variable, "ERP Benefits". The results indicate that more use and better quality of ERP systems can increase the benefits of ERP. Both of two predictors are significant at the .001 level, so their relationships with "ERP Benefits" have been validated without any problem.

However, the interesting finding here is that the progress of ERP implementation project has no impact on ERP benefits even though it is correlated with ERP benefits. This indicates that although an ERP implementation project was not completed on time and within budget, a company still has a chance to get the full benefits from the ERP system if its quality and scope are satisfactory. The best case scenario is if an implementation project is completed on time, within budget, with good quality and matching the scope, but realistically, this may not happen frequently. If the progress of the ERP project is good, but the quality is bad, it will eventually fail because users may be reluctant to use it. If both progress and quality of the project are bad, it will be abandoned, even before the system is materialized. Therefore, to minimize the risk of ERP implementation, we should focus more on improving the quality and scope of the ERP system than the progress of the ERP project.

6.1.4 Project Success (Progress & Quality)

The progress and quality of the ERP implementation project are the main indicators of ERP project success in this research. As a result, "Internal Support" and "Consultant Support" are direct determinants of the progress of the ERP project, and both have a significant impact on it. The vast literature has identified the importance of these two predictors on project success. This result can be interpreted that in order to complete the ERP project on time and within the budget as initially planned, internal support including top management commitment, good project planning, and training would be mandatory as well as high-quality consultant support. "Function" may not be considered a predictor of the progress of the ERP project according to the regression analysis. However, the adjusted R square on this model is .23, which indicates that 23% of the variance in the progress of the ERP project can be accounted for by these factors. Therefore, we can assume that other external factors, e.g. financial limitation, market change, main business area change, etc., can impact on "Progress" in a case by case fashion.

Even though "Consultant Support" is significant at the .05 level, the significance of "Function" is so high that it can be considered the main predictor of the quality and scope of the ERP system. It indicates that selecting the right software and defining the necessary functions properly determines the project success in terms of overall quality and scope. With this result, we can conclude that "Function" is the most important factor in both the success of ERP adoption and implementation project, both of which will finally influence heavily on the final dependent variable, "ERP Benefits".

Another finding should be noted; “Consultant Support” has a significant impact on both “Progress” and “Quality” for the project success. This result confirms the importance of the role of consultants in successful ERP implementation. Decision makers in the company should pay attention to choosing the right consultant when they consider implementing or upgrading their ERP system.

6.2 Differences between Results from the U.S. and Korean Samples

This section mainly focuses on analyzing the difference between the U.S. and Korean samples based on the results of t tests and the regression analysis. The section discusses why a difference exists in a particular variable, and interprets its meaning with respect to ERP success.

6.2.1 Comparison of Means

According to the t tests between the U.S. and Korean samples, there are quite large differences between the two groups, especially in system related variables. The difference in "Output" is not significant, but the mean values of "Result Demonstrability", "Compatibility", "System Reliability", "Function", "Perceived Ease of Use", and "Quality" in the U.S. sample are higher than those of the Korean sample. It indicates that the average overall quality of ERP systems used in the U.S. is perceived as being better than that of Korea. Several IT managers in Korean companies had been interviewed when the main survey was conducted. They were asked to evaluate their ERP systems and implementation, and give their opinions about the ERP success. Many of them said that their current ERP system was still evolving, and needs to be upgraded. Several years ago, many big construction companies in Korea implemented their ERP systems with the full package provided by SAP or Oracle and tried to integrate all the functions together. But some of them were not satisfied, so now they are in process of switching to their in-house developed software in several modules, especially project management related modules.

This contributed to the respondents in Korea giving lower scores than the U.S. respondents did in regard to the system related variables. This reason can also explain the difference in "Job Relevance" and "ERP Benefits". Since "Job Relevance" is highly correlated with "Function", if someone is not satisfied with functions of the system, he or she may think that it is not relevant to his or her job. "ERP Benefits" are directly related to the system quality, so that is why the score of "ERP Benefits" in the Korean sample was lower than that of the U.S. sample. The current trend in ERP implementation for engineering and construction firms in Korea is adopting a best-of-breed approach. They generally use SAP or Oracle software for core functions like Financial Accounting or HR and piece them together with their own in-house developed software such as Project Management Information System (PMIS).

The other variables that have significant differences between the two groups are social factors: "Image" and "Subjective Norm". Since "Image" is not highly correlated with any other variable, the difference in "Image" cannot be explained by the relationship with other variables. This difference can be explained by cultural differences between the U.S. and Korea. It may be interpreted as Koreans being more likely to care about their image than Americans. However, "Subjective Norm" can be explained by both cultural differences and its relationship with other variables. Among the success factors, "Function" and "Job Relevance" have the highest correlations with "Subjective Norm". This indicates that if someone thinks that functions of the system are not good or not very relevant to his or her job, he or she may not think that their peers or boss think he or she should use it. As described earlier, the scores of "Function" and "Job Relevance" are higher in the U.S. sample, so that is why the mean of “Subjective Norm” in the U.S. sample is higher than that of the Korean sample. Maybe it can be explained in a different way, applying the cultural differences that Americans are more likely to care about an organizational factor, “Subjective Norm” than Koreans.

6.2.2 Comparison of Regression Analyses

The main hierarchical relationships of the regression model in both the U.S. and Korean samples are about the same: Success Factors – Perceived Usefulness – Intention to Use / Use – ERP Benefits; Function – Quality – ERP Benefits; Internal Support – Progress. However, the significance of each independent variable on the specific dependent variable is quite different between the two samples. This section compares these two groups, describing the main differences based on the regression analysis associated with each dependent variable. Table 6.1 summarizes the comparison of these two samples in the regression analysis on each dependent variable.

Table 6.1 Main Determinants of Dependent Variables

Dependent Variable	The U.S.	Korea	Total Responses
Perceived Usefulness	Subjective Norm Job Relevance Perceived Ease of Use Function	Function Result Demonstrability	Function Subjective Norm Output Perceived Ease of Use Result Demonstrability
Intention to Use / Use	Perceived Usefulness Subjective Norm Perceived Ease of Use	Perceived Usefulness	Perceived Usefulness Subjective Norm Perceived Ease of Use
ERP Benefits	Quality Intention to Use / Use	Quality Intention to Use / Use	Quality Intention to Use / Use
Progress	Internal Support	Internal Support	Internal Support Consultant Support
Quality	Function	Function	Function Consultant Support

Perceived Usefulness

There are significant differences between the U.S. and Korean samples with respect to the regression on “Perceived Usefulness”. The main difference is that “Function” and “Result Demonstrability” are the main determinants of “Perceived Usefulness” in the Korean sample, but “Subjective Norm” and “Job Relevance” are the main determinants in the U.S. sample. As defined in the study, “Function” and “Result Demonstrability” are more system related factors, while “Subjective norm” and “Job Relevance” have more organization related features. Therefore, this research can conclude that Korean respondents think that system related factors can have more effect on the usefulness of the ERP system, while the U.S. respondents consider organizational factors more to increase the usefulness of the system.

Another main difference is evident from the comparison in “Perceived Usefulness”. That is, “Perceived Ease of Use” is significant in the U.S. sample, but not in the Korean sample. It can be interpreted that Koreans think that the system is useful regardless of its ease of use as long as it functions well. However, there is a possibility that “Perceived Ease of Use” was affected by other independent variables due to the smaller sample size compared to the total population of responses. Since eleven independent variables are associated with “Perceived Usefulness”, the regression may misrepresent their effects on “Perceived Usefulness” with this sample size.

One very interesting finding here is that “Output” is not significant in either sample, but it becomes significant in regard to all responses. A regression analysis generally presents the relative importance of each independent variable on the dependent variable. The coefficient of each variable does not represent its absolute amount of effect on the dependent variable, so it can be changed depending on the number of independent variables or other more significant variables. For this reason, the relative importance of “Output” was reduced by other significant variables, e.g. “Function” and “Result Demonstrability” in the Korean sample, and “Subjective Norm”, “Job Relevance” and “Perceived Ease of Use” in the U.S. sample, although it is highly correlated with “Perceived Usefulness” in both samples. However, according to the results from the t tests, “Output” shows little difference between the two samples independent from other variables associated with “Perceived Usefulness”. Variables like “Job Relevance” and “Result Demonstrability” that have significant differences in their means and effects between the two samples have a strong impact in one sample but little impact in the other, so eventually they become insignificant in the total population because their impact in each sample offsets the other. The lower impact of these variables makes “Output” have a more significant impact on “Perceived Usefulness” than these variables in total population of responses.

Intention to Use / Use

Regarding the regression on “Intention to Use / Use”, “Perceived Usefulness” is the most important factor in both samples. The difference between the two groups is that “Subjective Norm” and “Perceived Ease of Use” impact on “Use” significantly in the U.S.

sample, but not in the Korean sample. This can be interpreted such that Koreans are inclined to use the ERP system if they think it is useful regardless of its ease of use and organizational importance. However, it is not easy to identify the reason why “Perceived Ease of Use” and “Subjective Norm” have no significant impact on “Intention to Use / Use” in the Korean sample. We can only guess it may be caused by cultural differences.

ERP Benefits

There is little difference between the U.S. and Korean samples with respect to the regression on “ERP Benefits”. These two samples have almost identical results with respect to total responses. “Use” and “Quality” are main predictors of “ERP Benefits”, but “Progress” has little impact in both samples

Project Success

According to the regression analysis on project success, only a marginal difference exists in “Progress” and “Quality”. “Internal Support” is the most important factor for “Progress” in both samples, but is more significant in the U.S. sample. “Function” is the most important factor for “Quality” of ERP system in both samples, and its significance does not differ between samples. Compared to the analysis of all responses, the main determinants of each group and their relationships related to project success are about the same.

The main difference between the U.S. and Korean samples is the effects of “Consultant Support” on dependent variables associated with project success. “Consultant Support” impacts on both “Progress” and “Quality” in the U.S. sample even though the effects are marginal, but there is little impact of “Consultant Support” in the Korean sample. With this result, we can conclude that Korean companies generally do not rely much on the consultant support during or before ERP implementation to the same extent that the U.S. companies do.

6.3 Implications for Successful ERP Implementations

The structured ERP success model is provided to identify and analyze the relationships between success factors and indicators in this research. The model has a hierarchical structure in which success factors impact indirectly on the final dependent variable, "ERP Benefits", by influencing intermediate success indicators. The main structure of their relationships is identified as follows: Success Factors – Perceived Usefulness – Intention to Use / Use – ERP Benefits; Function – Quality – ERP Benefits; Internal Support – Progress. The question arising from this result is "How can we interpret these relationships for the real world?" So now this section will suggest recommendations for ERP success based on the relationships identified through the extensive analysis in this research.

This research considers ERP benefits as a final measure of ERP success, which means that the more successful the ERP system, the more ERP benefits the company can gain. It is true that the main reason companies want to use ERP systems is to increase their business value so that they can improve their efficiency and eliminate waste factors. Without a doubt, these benefits can only be achieved by successful ERP implementation and adoption, so how can we reach the success associated with these tremendous ERP benefits? The research identifies that "Intention to Use / Use" and "Quality" are main determinants of "ERP Benefits". It indicates that more use and better quality is the sign of ERP success which can increase ERP benefits. The next question arising from the statement is “What makes users use the ERP system?” The answer is that the ERP system should be useful, so decision makers should consider the factors affecting usefulness, which finally leads to ERP success. The research suggests some recommendations to improve usefulness of the ERP system as described below:

1) The functions of the ERP system should be well defined to cover the company’s necessary business functions. It is also important to choose the right software considering whether or not it can support the defined functions as well as its functionality.
2) All the members in the company should be encouraged to use the ERP system because their use can increase the company’s business value.
3) To make the ERP system more useful, the company should focus more on enhancing the quality of output during its implementation, especially in regard to the management reports and measurement reports.
4) The ERP system should be easy to use. A complex system decreases its usefulness, which also make users reluctant to use it. The system should be carefully designed to be user friendly, considering screen design, user interface, page layout, help facilities, menus, etc.
5) The company should clearly define what positive results can be expected from the use of the ERP system before or during ERP implementation. This can make the system more useful, and help users understand why they should use the ERP system.

Another main finding of the research is about the ERP project success. Project success is generally evaluated in terms of time, cost, quality and scope. The research found that the progress of the ERP implementation project does not have an impact on ERP benefits while the quality and scope of the ERP system has a significant impact. It does not mean that the progress of the project is not important to the company. It really means that the progress should not hurt the quality of the project because "Quality" is one of the main predictors of ERP benefits. The question is "What should we do to ensure successful ERP implementation?" The research proposes recommendations to achieve the ERP project success as described below:

1) To maximize ERP benefits, the company should focus more on the quality and scope of the ERP system matching with the company's needs. For this purpose, well defined functions and the right software are mandatory, similar to increasing usefulness of the system.
2) A more realistic schedule and budget should be planned to minimize the negative effects on the quality of the system. This method can satisfy the company in both progress and quality of the ERP project.
3) Choosing strong consulting partners is required for ERP project success. They can lead the company in the right direction to have a successful ERP implementation in both progress and quality.
4) Internal support is the main determinant of the progress of the ERP project. To complete the project on time and within the budget as initially planned, top management support, training and good project planning are required during ERP implementation.

There are several comments on ERP implementation from the survey participants. Among their comments, here are the most interesting ones:

"Be sure that you understand what you are buying before you sign a contract. Salespeople for software will show you the latest version that is not totally finished or debugged. We ended up installing a product that had a totally new and untested payroll module and that delayed our implementation. We did not know that the payroll module was beta when we bought the product."

- Senior Application Support Analyst, C Construction

"We just implemented CMiC software in January 2006. It probably took the implementing team a year to prepare for the switchover and training sessions for nearly all employees. The system is improving for us, but productivity has reduced in the 1 1/2 years implementing this new system."

- Project Manager, J Construction

"ERP success requires the full engagement of the business... executive management, operations, corporate support departments, and IT department. If it is implemented and viewed primarily as an IT project it will fail. If it is viewed as only an accounting system it will fail. If it is viewed as a one-time implementation it will fail. The business must embrace the ERP and be willing to commit to its long term use and on-going development."

- VP, Senior Operations Analyst, B Construction

These comments provide helpful information for better understanding of ERP implementation success as well.

6.4 Chapter Summary

Chapter 6 discusses relationships between success factors and indicators in more detail, describing the reason behind their relationships. Interpretations of the results about each dependent variable are presented along with its independent variables based on its regression analysis and other relevant data from the survey. This chapter also analyzes the difference between the U.S. and Korean samples based on the results of t tests and the regression analysis. The section discusses why a difference exists in a particular variable, and interprets its meaning with respect to ERP success. Finally, the research suggested several recommendations for the success of ERP systems based on the results of identifying the relationships between factors and indicators. These recommendations should allow engineering and construction firms to have a better understanding of ERP success and help them to avoid failure considering critical factors attributed to successful ERP implementation.

7 CONCLUSIONS & RECOMMENDATIONS

This chapter presents contributions of this study to the existing body of knowledge in the area of IS research. Limitations of the research are also discussed. Finally, it proposes possible future research topics and recommendations for advanced studies.

7.1 Contributions & Limitations

Most IT related research in the area of construction business management generally proposes research models without theories. Furthermore, since this type of research is still relatively new to construction related research, many surveys have been developed without sound theoretical background. They usually identify the importance of factors simply comparing the mean values of factors, and rank factors in accordance with their importance showing the higher mean value as the more important factor. However, the relationships cannot be defined through such an analysis. Regression analysis should be used in analyzing the relationships of variables and finding the significance of each factor associated with the dependent variable. Another problem is that researchers in the area of construction management usually try to identify only direct relationships between independent and dependent variables, e.g. success factors – success, due to the lack of theoretical background. However, realistically, this is not possible. Chances are most factors indirectly impact on a given dependent variable by directly influencing mediating variables instead of directly affecting the dependent variable. For this reason, in most social science and IS related research, theories must be used in formulating the research model. This research is the first study identifying the factors affecting ERP success with strong background theories in construction business related research. The proposed model adapted three theoretically validated models including TAM, D&M IS Success Model, and the fundamentals of project management in ERP implementation. Therefore, the academic contribution of the research can be found in a deliberate attempt to formulate the ERP success model.

There have been few studies attempting to validate empirically the factors affecting both ERP implementation and user adoption. The factors identified in literature were mostly based on the experiences of IT professionals or senior managers involved in ERP implementation projects. For these reasons, this research focused on identifying the factors for the ERP success from both implementation project and user adoption perspectives. Then, identified factors were examined to verify their relationships with success indicators associated with the redefined ERP success, i.e. the success of the project and the success of use. Furthermore, the research suggested recommendations for the ERP success showing how to approach ERP implementation to avoid failure and what we should do considering the significance of each factor to a given dependent variable based on the findings of the study. These recommendations can provide helpful information to engineering and construction firms when they consider implementing or upgrading their ERP systems. This information should help companies reduce tremendous ERP implementation risks so that companies can have more chances to improve their business value with the success of EPR systems. Such practical implications can be applied to most engineering and construction firms for a better understanding about the factors that can lead to the success of ERP systems. This approach should be valuable information for decision makers of companies before or during their ERP implementation.

Although the research delivered valid conclusions and findings, there are several limitations associated with data collection and analysis. The main limitations are as follows:

- The response rate was less than 10%, which can mislead the results in the other way. Finding targeted respondents was not easy since many respondents were not sure that they were in the targeted group. They did not know the exact definition of ERP systems, so they were not sure that the system they were using can be considered an ERP system. That made the response rate lower than initially expected, so the research needs to define ERP systems more clearly for better responses, especially in regard to the construction industry specific solutions.
- Another limitation related to data collection was missing data in the responses. Items related to the ERP implementation project have relatively low response rates since some respondents who were not involved in the implementation project may not be familiar with the relevant facts, especially for items about the progress of the project. For this reason, the R square of the regression on the project progress was lower than any other regression models provided in this research.
- The sample size of the responses was large enough to verify the proposed ERP success model statistically, but more data points are required for better results. As

a rule of thumb, at least 10 responses per variable are required to verify the research model properly but, realistically, more data were needed to have better results for this study. For instance, compared to the regression analysis with total responses, the regressions with different country samples have different results, which may be biased by the reduced sample size.

- Even though the research made every effort to identify the factors affecting ERP success based on the comprehensive literature and interviews with industry experts, there is a chance that additional important factors exist that merit serious consideration. Since there are many reasons that can lead to success or failure of ERP systems and the fact that these may differ case by case, it is not easy to consider all the possible factors associated with ERP success. This can negatively impact the parsimony of the proposed model.

7.2 Future Research

The research deals with one of the key issues in ERP related research and has provided both academic and practical implications to the construction business domain. Ideas for possible future studies raised by the main findings of this research are as follows:

- This research found that the most important factor for ERP success is "Function", which can increase both perceived usefulness and the quality of the system significantly, and eventually lead to having ERP benefits. "Function" was defined as the functionality of ERP software and its capability of matching with the company's necessary business functions. The question that arises from this finding is "How can we define our necessary business functions properly and how does the ERP system match our requirements for the necessary functions?" Without doubt, if we can address this issue properly, we should have better chance to have ERP success and more benefits from successful implementation.
- Most ERP vendors suggested that minimal customization of their software is the best way to gain full benefits of ERP systems for the company insisting on changing the company's business processes. However, most companies want to keep their business processes with minimal changes and ask the ERP vendor to customize its software. This might necessitate a balance point between customization of software and changing business processes. The questions arising from this situation are: "How many of our processes will we have to change and what is the impact of changing them?", "To what extent will we have to modify the ERP system? At what level of effort? At what cost? What is the impact of

modifications on our ability to upgrade to future versions of the package?" These questions can be the most important issues that should be considered in the early stage of the company's decision making in ERP implementation.

- The current trend of ERP implementation approach is using a best-of-breed option in which separate software packages were selected for each process or function. However, ERP vendors usually suggest their customers take their entire software package to ensure better support and improved results of ERP implementation. The questions come up from this situation are: "What are the differences between these two approaches? Which approach is more suitable to our company? If we combine these two approaches, how can we decide which ERP modules should be included and which functions should be used in best-of-breed solutions?" The answers to these questions will be valuable information to most engineering and construction firms when they consider integrating ERP software with their current user solutions such as project management.

APPENDIX A: FUNCTIONAL MODULES OF ERP VENDORS

A-1: SAP Modules

A-2: Oracle Modules

Appendix A-1: SAP Modules

1) Logistics

   - Sales and Distribution (SD)

   - Materials Management (MM)

   - Production Planning and Controlling (PP)

   - Quality Management (QM)

   - Plant Maintenance (PM)

2) Financials

   - Financial Accounting (FI)

   - Controlling (CO)

   - Asset Management (AM)

   - Project System (PS)

3) Common Systems

   - Workflow (WF)

   - Industry Solutions (IS)

4) Human Resources

   - Human Resources (HR)

Appendix A-2: Oracle Modules

1) Corporate Performance Management

   - Activity-Based Management

   - Balanced Scorecard

   - Business Intelligence Solution

   - Daily Business Intelligence

   - Demand Planning

   - Enterprise Planning and Budgeting

   - Financial and Sales Analyzers

   - Financial Consolidation Hub

   - Performance Analyzer

   - Profitability Manager

2) Customer Relationship Management

   - Channel Management

   - Marketing

   - Order Management

   - Sales

   - Service

3) Human Capital Management

   - Advanced Benefits

   - Daily Business Intelligence for Human Resources

- Human Resources
- Incentive Compensation
- iRecruitment
- Learning Management
- Payroll
- Self-Service Human Resources
- Time and Labor
- Tutor

4) Financial Management
   - Asset Lifecycle Management
   - Financial Analytics
   - Financial Management

5) Procurement
   - Daily Business Intelligence for Procurement
   - iProcurement
   - iSupplier Portal
   - Supplier Network
   - Procurement Contracts
   - Purchasing
   - Services Procurement
   - Sourcing

6) Project Management
   - Daily Business Intelligence for Projects

- Grants
- Project Billing
- Project Collaboration
- Project Contracts
- Project Costing
- Project Management
- Project Portfolio Analysis
- Project Resource Management
- Time and Labor

7) Supply Chain Management
   - Advanced Procurement
   - Logistics
   - Maintenance
   - Manufacturing
   - Order Management
   - Product Lifecycle Management
   - Supply Chain Execution
   - Supply Chain Planning
   - Transportation Management

APPENDIX B: ITEMS IN THE SURVEY INSTRUMENT

(Response choices – 7 point scale from strongly disagree to strongly agree)
Note: Items with red bold characters indicate that they were not used in the main survey.

SUCCESS FACTORS

User Related Variables

Output Quality

output1: The quality of the output I get from the ERP system is high.
output2: I have no problem with the quality of the ERP system's output.

Job Relevance

job1: In my job, usage of the ERP system is important.
job2: In my job, usage of the ERP system is relevant.
job3: I have access to the ERP system, but I prefer to use non-ERP tools.

Image

image1: People in my organization who use the ERP system have more prestige than those who do not.
image2: People in my organization who use the ERP system have a high profile.

Result Demonstrability

result1: I have no difficulty telling others about the results of using the ERP system.
result2: I believe I could communicate to others the consequences of using the ERP system.
result3: I would have difficulty explaining why using the ERP system may or may not be beneficial.

Compatibility

compa1: I have no difficulty in exporting data from the ERP system to other systems or software I currently use.
compa2: I have no difficulty in importing data to the ERP system from other systems or software I currently use.

System Reliability

reliabl1: I think the ERP system is very reliable.
reliabl2: I don't worry about data loss when I use the ERP system.
reliabl3: I don't find system errors very often when I use the ERP system.

Reporting Capability

report1: The management reports from the ERP system are very useful.
report2: The measurement reports (CSF/KPI) from the ERP system are very useful.

Project Related Variables

Internal Support

interna1: Our top management supported ERP implementation project well.
interna2: Training for the ERP system was very helpful for me to understand and use it.
interna3: Someone asked me some questions and opinions related to the ERP system during its implementation.
interna4: Our ERP implementation progressed well as was originally planned.

Software Selection

softwar1: The ERP software our company is using can support our business processes well.
softwar2: The functionality of the ERP software our company is using is very good.

Consultant Support

consul1: I think consultants led us to a right direction during ERP implementation.
consul2: I think consultants can help us to have a successful ERP implementation.

Information Systems Area Participation

sysfun1: The business functions of the ERP system are well defined.
sysfun2: The ERP system covers our necessary business functions very well.

Intermediate Variables

Subjective Norm

sn1: Others in my work group strongly support my using the ERP system.
sn2: I would like very much to use the ERP system because others in my work group think I should use it.
sn3: Senior management strongly supports my using the ERP system.
sn4: I would like very much to use the ERP system because senior management thinks I should use it.

Perceived Usefulness

pu1: Using the ERP system improves my performance.
pu2: Using the ERP system improves my productivity.
pu3: Using the ERP system improves my effectiveness.
pu4: Overall, using the ERP system is very useful in my job.

Perceived Ease of Use

eou1: I find the ERP system easy to use.
eou2: I find it easy to get the ERP system to do what I want it to do.
eou3: My interaction with the ERP system is clear and understandable.

SUCCESS INDICATORS

Intention to Use / Use

use1: Assuming I have access to the ERP system, I intend to use it.
use2: I have access to the parts of the ERP system when I need to do my job.
use3: I heavily use the ERP system whenever I need it.
usehour: About how many hours a week do you use the ERP system?
usefunc: What are the three functions of the ERP system you use the most?

User Satisfaction

satis1: I am very satisfied with Information quality of the ERP system.
satis2: I am very satisfied with performance of the ERP system.
satis3: Overall, I am very satisfied with the ERP system.

Individual Impact

indimpa1: With the ERP system, I don't need to do "repetitive work" again.
indimpa2: The ERP system can help me make effective decisions.

Organizational Impact

orgimpa1: With the ERP system, my organization saves operating costs.
orgimpa2: With the ERP system, my organization increases revenues.
orgimpa3: After ERP implementation, the stock price of my organization went up.

Project Success

prosucc1: The ERP implementation project was completed on time.
prosucc2: The ERP implementation project was completed within the budget as initially planned.
prosucc3: I think the quality of our ERP system is very good.
prosucc4: The scope of our ERP system is well matched with our company's needs.

USER INFORMATION

1. What is your company's name?
2. What is your company's main business area?
3. How many years have you been working for the industry in which you are currently active?
4. What is your position in the company?
5. What business functions are you currently involved in?
6. Does your company use full ERP packages provided by a large vendor like SAP or Oracle?
7. What ERP software does your company currently use?

APPENDIX C: RESULTS OF PILOT SURVEY

C-1: Summary Data

C-2: Initial Data Analysis

C-3: Detailed Procedures of Factor Adjustment

C-4: Results of Factor Analysis after Adjustment

Appendix C-1: Summary Data

Variable	Item	N	Mean	Std. Dev.
Reporting Capability	report1	54	5.37	1.07
	report2	54	5.33	1.01
Output Quality	output1	55	4.98	1.03
	output2	53	4.34	1.16
Job Relevance	job1	56	5.45	1.31
	job2	55	5.16	1.32
	job3	54	3.80	1.38
Image	image1	55	4.71	1.51
	image2	54	4.28	1.27
Result Demonstrability	result1	56	4.66	1.01
	result2	56	4.79	1.04
	result3	55	4.15	1.38
Compatibility	compa1	55	3.96	1.45
	compa2	54	3.67	1.36
System Reliability	reliabl1	55	4.22	.98
	reliabl2	54	4.37	1.45
	reliabl3	55	4.02	1.25
Internal Support	interna1	51	5.25	1.13
	interna2	52	4.94	1.07
	interna3	50	4.10	1.57
	interna4	49	4.61	1.12
Software Selection	softwar1	53	4.38	1.06
	softwar2	51	4.41	1.13
Consultant Support	consul1	46	4.33	.97
	consul2	45	4.36	.88
Business Functions	sysfun1	52	4.58	.96
	sysfun2	52	4.92	.95
Subjective Norm	sn1	52	4.50	1.09
	sn2	52	4.29	1.33
	sn3	51	4.39	1.34
	sn4	52	4.50	1.35
Perceived Usefulness	pu1	52	5.19	1.05
	pu2	51	5.00	1.18
	pu3	52	5.13	1.17
	pu4	53	4.91	1.24
Perceived Ease of Use	eou1	52	4.17	1.29
	eou2	52	4.29	1.19
	eou3	53	4.25	1.13
Intention to Use / Use	use1	51	5.24	1.05
	use2	54	5.30	1.25
	use3	54	4.85	1.39
User Satisfaction	satis1	52	4.54	.96
	satis2	53	4.57	1.01
	satis3	52	4.37	1.14
Individual Impact	indimpa1	52	4.40	1.26
	indimpa2	51	4.51	1.03
Organizational Impact	orgimpa1	48	4.52	1.35
	orgimpa2	48	3.92	1.16
	orgimpa3	46	4.11	1.18
Project Success	prosucc1	42	4.14	.87
	prosucc2	40	3.98	1.03
	prosucc3	48	4.40	1.11
	prosucc4	49	4.45	1.16

Appendix C-2: Initial Data Analysis

User Related Variables

Variable	Reliability (α)		Inter Correlation		
Reporting Capability	.80		report1	report2	
		report1	1	.67	
		report2	.67	1	
Output Quality	.78		output1	output2	
		output1	1	.64	
		output2	.64	1	
Job Relevance	**.49**		job1	job2	job3
		job1	1	.84	-.07
		job2	.84	1	-.01
		job3	**-.07**	**-.01**	1
Image	.82		image1	image2	
		image1	1	.70	
		image2	.70	1	
Result Demonstrability	**.62**		result1	result2	result3
		result1	1	.55	.27
		result2	.55	1	.32
		result3	**.27**	**.32**	1
Compatibility	.89		compa1	compa2	
		compa1	1	.81	
		compa2	.81	1	
System Reliability	.79		reliabl1	reliabl2	reliabl3
		reliabl1	1	.55	.48
		reliabl2	.55	1	.64
		reliabl3	.48	.64	1

Project Related Variables

Variable	Reliability (α)		Inter Correlation			
Internal Support	**.69**		interna1	interna2	interna3	interna4
		interna1	1	.51	.23	.65
		interna2	.51	1	.23	.38
		interna3	**.23**	**.23**	1	.28
		interna4	.65	.38	**.28**	1
Software Selection	.82		softwar1	softwar2		
		softwar1	1	.70		
		softwar2	.70	1		
Consultant Support	.96		consul1	consul2		
		consul1	1	.93		
		consul2	.93	1		
Business Functions	.81		sysfun1	sysfun2		
		sysfun1	1	.68		
		sysfun2	.68	1		

Intermediate Variables

Variable	Reliability (α)	Inter Correlation				
			sn1	sn2	sn3	sn4
Subjective Norms	.84	sn1	1	.67	.62	.43
		sn2	.67	1	.56	.45
		sn3	.62	.56	1	.72
		sn4	.43	.45	.72	1
			pu1	pu2	pu3	pu4
Perceived Usefulness	.94	pu1	1	.79	.73	.74
		pu2	.79	1	.84	.80
		pu3	.73	.84	1	.89
		pu4	.74	.80	.89	1
			eou1	eou2	eou3	
Perceived Ease of Use	.92	eou1	1	.75	.82	
		eou2	.75	1	.79	
		eou3	.82	.79	1	

Success Indicators

Variable	Reliability (α)	Inter Correlation				
			use1	use2	use3	
Intention to Use / Use	.78	use1	1	.43	.53	
		use2	.43	1	.69	
		use3	.53	.69	1	
			satis1	satis2	satis3	
User Satisfaction	.93	satis1	1	.81	.80	
		satis2	.81	1	.86	
		satis3	.80	.86	1	
			indimpa1	indimpa2		
Individual Impact	.78	indimpa1	1	.65		
		indimpa2	.65	1		
			orgimpa1	orgimpa2	orgimpa3	
Organizational Impact	.82	orgimpa1	1	.78	.38	
		orgimpa2	.78	1	.62	
		orgimpa3	**.38**	.62	1	
			prosucc1	prosucc2	prosucc3	prosucc4
Project Success	.83	prosucc1	1	.64	.53	.45
		prosucc2	.64	1	.63	.43
		prosucc3	.53	.63	1	.74
		prosucc4	.45	.43	.74	1

Appendix C-3: Detailed Procedures of Factor Adjustment

User Related Variables

Rotated Component Matrix

	1	2	3
job1	0.898	0.108	-0.094
job2	0.880	0.206	0.014
job3	0.362	0.677	0.068
image1	-0.023	0.091	0.905
image2	-0.036	-0.164	0.917
result1	0.378	0.585	-0.001
result2	0.336	0.673	0.230
result3	0.223	0.681	0.196

job1, job2 → Job Relevance (α = 0.910)

	job1	job2
job1	1	0.835
job2	0.835	1

image1, image2 → Image

result1, result2 → Result Demonstrability (α = 0.710)

	result1	result2
result1	1	0.551
result2	0.551	1

Rotated Component Matrix

	1	2	3
report1	0.022	0.891	0.118
report2	0.145	0.816	0.087
output1	0.389	0.699	0.119
output2	0.723	0.447	0.072
compa1	0.160	0.128	0.932
compa2	0.159	0.114	0.909
reliabl1	0.784	0.343	-0.012
reliabl2	0.738	0.191	0.331
reliabl3	0.847	-0.148	0.208

report1, report2, output1, output2 → Output (α = 0.811)

	report1	report2	output1	output2
report1	1	0.670	0.553	0.349
report2	0.670	1	0.458	0.447
output1	1	0.458	1	0.639
output2	0.349	0.447	0.639	1

compa1, compa2 → Compatibility

reliabl1, reliabl2, reliabl3 → System Reliability

Rotated Component Matrix

	1	2	3	4	5
report1	-0.083	0.653	0.506	0.099	0.330
report2	0.055	0.629	0.484	0.056	0.088
output1	0.144	0.834	0.105	0.156	-0.105
output2	0.509	0.727	-0.112	0.106	-0.038
job1	-0.018	0.135	0.871	0.117	-0.100
job2	0.206	0.257	0.792	0.022	-0.001
image1	0.054	-0.020	0.030	0.094	0.903
image2	-0.051	0.014	-0.033	-0.031	0.909
result1	0.688	-0.037	0.415	0.074	-0.043
result2	0.539	-0.159	0.606	0.041	0.145
compa1	0.197	0.054	0.144	0.921	0.031
compa2	0.121	0.173	0.018	0.917	0.051
reliabl1	0.683	0.493	0.126	-0.008	-0.125
reliabl2	0.638	0.334	0.122	0.338	-0.097
reliabl3	0.823	0.120	-0.084	0.180	0.119

report1–output2 → Output

job1, job2 → Job Relevance

image1, image2 → Image

result1, result2 → Result Demonstrability

compa1, compa2 → Compatibility

reliabl1–reliabl3 → System Reliability

Project Related Variables

Rotated Component Matrix

	1	2
interna1	0.167	0.850
interna2	0.065	0.815
interna3	0.270	0.397
interna4	0.589	0.615
softwar1	0.740	0.291
softwar2	0.862	0.097
consul1	0.888	0.200
consul2	0.910	0.228

α = 0.758

Internal Support

	interna1	interna2	interna4
interna1	1	0.510	0.651
interna2	0.510	1	0.375
interna4	0.651	0.375	1.000

Rotated Component Matrix

	1	2
interna1	0.161	0.870
interna2	0.134	0.779
interna4	0.569	0.624
softwar1	0.758	0.267
softwar2	0.877	0.059
consul1	0.847	0.212
consul2	0.889	0.196
sysfun1	0.844	0.263
sysfun2	0.667	0.207

α = 0.758

Internal Support

α = 0.916

ERP Evaluation

	softwar1	softwar2	consul1	consul2	sysfun1	sysfun2
softwar1	1	0.699	0.584	0.646	0.692	0.572
softwar2	0.699	1	0.695	0.720	0.802	0.545
consul1	0.584	0.695	1	0.927	0.650	0.489
consul2	0.646	0.720	0.927	1	0.686	0.574
sysfun1	0.692	0.802	0.650	0.686	1	0.675
sysfun2	0.572	0.545	0.489	0.574	0.675	1

Intermediate Variables

Rotated Component Matrix

	1	2	3
sn1	0.388	0.232	0.722
sn2	0.098	0.203	0.784
sn3	0.184	0.070	0.872
sn4	-0.039	-0.036	0.867
pu1	0.773	0.314	0.257
pu2	0.834	0.298	0.182
pu3	0.883	0.221	0.105
pu4	0.861	0.374	0.096
eou1	0.384	0.828	0.132
eou2	0.350	0.822	0.221
eou3	0.235	0.930	0.050
use1	0.700	0.344	0.185
use2	0.733	0.014	-0.021
use3	0.729	0.294	0.178

Subjective Norm

Perceived Usefulness

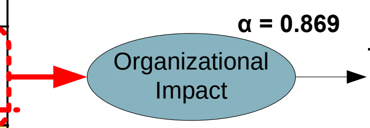
Perceived Ease of Use

Intention to Use / Use

Success Indicators

Rotated Component Matrix

	1	2
satis1	0.809	0.373
satis2	0.794	0.410
satis3	0.756	0.443
indimpa1	0.822	0.100
indimpa2	0.790	0.302
orgimpa1	0.665	0.397
orgimpa2	0.735	0.432
orgimpa3	0.448	0.593
prosucc1	0.100	0.816
prosucc2	0.357	0.737
prosucc3	0.414	0.791
prosucc4	0.442	0.694

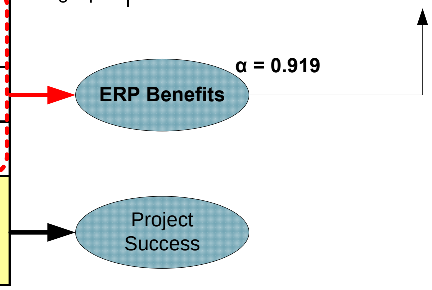


	orgimpa1	orgimpa2
orgimpa1	1	0.779
orgimpa2	0.779	1

	satis1	satis2	satis3	indimpa1	indimpa2	orgimpa1	orgimpa2
satis1	1	0.807	0.804	0.589	0.627	0.433	0.424
satis2	0.807	1	0.860	0.478	0.635	0.618	0.527
satis3	0.804	0.860	1	0.560	0.624	0.611	0.569
indimpa1	0.589	0.478	0.560	1	0.650	0.486	0.391
indimpa2	0.627	0.635	0.624	0.650	1	0.624	0.564
orgimpa1	0.433	0.618	0.611	0.486	0.624	1	0.779
orgimpa2	0.424	0.527	0.569	0.391	0.564	0.779	1

Rotated Component Matrix

	1	2
satis1	0.802	0.383
satis2	0.795	0.414
satis3	0.760	0.439
indimpa1	0.813	0.091
indimpa2	0.804	0.275
orgimpa1	0.684	0.385
orgimpa2	0.768	0.357
prosucc1	0.106	0.858
prosucc2	0.369	0.742
prosucc3	0.441	0.774
prosucc4	0.482	0.642



Appendix C-4: Results of Factor Analysis after Adjustment

User Related Variables

Variable	Item	Component				
		1	2	3	4	5
Output	report1	-.08	**.65**	.51	.10	.33
	report2	.06	**.63**	.48	.06	.09
	output1	.14	**.83**	.11	.16	-.11
	output2	.51	**.73**	-.11	.11	-.04
Job Relevance	job1	-.02	.14	**.87**	.12	-.10
	job2	.21	.26	**.79**	.02	.00
Image	image1	.05	-.02	.03	.09	**.90**
	image2	-.05	.01	-.03	-.03	**.91**
Result Demonstrability	result1	**.69**	-.04	.42	.07	-.04
	result2	**.54**	-.16	**.61**	.04	.15
Compatibility	compa1	.20	.05	.14	**.92**	.03
	compa2	.12	.17	.02	**.92**	.05
Reliability	reliabl1	**.68**	.49	.13	-.01	-.13
	reliabl2	**.64**	.33	.12	.34	-.10
	reliabl3	**.82**	.12	-.08	.18	.12
Eigenvalue		2.71	2.56	2.50	1.92	1.85
% of Variance		18.04	17.06	16.66	12.76	12.31
Cumulative %		18.04	35.10	51.76	64.52	76.83

Project Related Variables

Variable	Item	Component	
		1	2
Internal Support	interna1	.16	**.87**
	interna2	.13	**.78**
	interna4	.57	**.62**
ERP Evaluation	softwar1	**.76**	.27
	softwar2	**.88**	.06
	consul1	**.85**	.21
	consul2	**.89**	.20
	sysfun1	**.84**	.26
	sysfun2	**.67**	.21
Eigenvalue		4.38	2.02
% of Variance		48.62	22.47
Cumulative %		48.62	71.09

Intermediate Variables

Variable	Item	Component		
		1	2	3
Subjective Norm	sn1	.39	.23	**.72**
	sn2	.10	.20	**.78**
	sn3	.18	.07	**.87**
	sn4	-.04	-.04	**.87**
Perceived Usefulness	pu1	**.77**	.31	.26
	pu2	**.83**	.30	.18
	pu3	**.88**	.22	.11
	pu4	**.86**	.37	.10
Perceived Ease of Use	eou1	.38	**.83**	.13
	eou2	.35	**.82**	.22
	eou3	.24	**.93**	.05
Intention to Use / Use	use1	**.70**	.34	.19
	use2	**.73**	.01	-.02
	use3	**.73**	.29	.18
Eigenvalue		4.89	2.91	2.90
% of Variance		34.96	20.78	20.73
Cumulative %		34.96	55.74	76.48

Success Indicators

Variable	Item	Component	
		1	2
ERP Benefits	satis1	**.80**	.38
	satis2	**.80**	.41
	satis3	**.76**	.44
	indimpa1	**.81**	.09
	indimpa2	**.80**	.28
	orgimpa1	**.68**	.39
	orgimpa2	**.77**	.36
Project Success	prosucc1	.11	**.86**
	prosucc2	.37	**.74**
	prosucc3	.44	**.77**
	prosucc4	.48	**.64**
Eigenvalue		4.79	3.17
% of Variance		43.58	28.81
Cumulative %		43.58	72.39

APPENDIX D: DATA ANALYSIS OF MAIN SURVEY

D-1: Summary Data

D-2: Inter-correlation & Reliability

D-3: Factor Analysis

D-4: Correlation Matrix – the U.S. & Korea

Appendix D-1: Summary Data

Variable	Item	N	Mean	Std. Dev.
Output	report1	263	5.47	1.28
	report2	250	5.28	1.37
	output1	274	5.09	1.17
	output2	265	4.60	1.40
Job Relevance	job1	276	5.70	1.32
	job2	272	5.54	1.35
Image	image1	278	4.27	1.56
	image2	274	4.03	1.48
Result Demonstrability	result1	279	5.13	1.31
	result2	278	5.19	1.20
Compatibility	compa1	274	4.24	1.58
	compa2	273	3.85	1.54
System Reliability	reliabl1	276	4.78	1.30
	reliabl2	274	4.88	1.53
	reliabl3	273	4.48	1.44
Internal Support	interna1	249	5.49	1.38
	interna2	254	5.05	1.48
	interna4	242	4.50	1.47
Function	softwar1	253	4.97	1.48
	softwar2	252	4.75	1.47
	sysfun1	255	4.90	1.31
	sysfun2	255	5.06	1.32
Consultant Support	consul1	231	4.31	1.39
	consul2	231	4.71	1.39
Subjective Norm	sn1	257	4.98	1.34
	sn2	257	4.37	1.41
	sn3	257	5.07	1.46
	sn4	257	4.47	1.45
Perceived Usefulness	pu1	258	5.33	1.27
	pu2	257	5.23	1.34
	pu3	256	5.32	1.33
	pu4	258	5.29	1.34
Perceived Ease of Use	eou1	256	4.33	1.45
	eou2	257	4.37	1.37
	eou3	258	4.44	1.36
Intention to Use / Use	use1	254	5.66	1.21
	use2	259	5.66	1.29
	use3	258	5.33	1.48
ERP Benefits	satis1	254	4.84	1.28
	satis2	254	4.71	1.31
	satis3	253	4.73	1.35
	indimpa1	254	4.57	1.42
	indimpa2	252	4.83	1.24
	orgimpa1	228	4.95	1.46
	orgimpa2	221	4.35	1.45
Project Success – Progress	prosucc1	205	4.21	1.50
	prosucc2	187	3.99	1.51
Project Success – Quality	prosucc3	238	4.86	1.49
	prosucc4	240	4.91	1.44

Appendix D-2: Inter-correlation & Reliability

User Related Variables

Variable	Reliability (α)	Inter Correlation				
Output	.84		report1	report2	output1	output2
		report1	1	.80	.62	.44
		report2	.80	1	.51	.42
		output1	.62	.51	1	.71
		output2	.44	.42	.71	1
Job Relevance	.90		job1	job2		
		job1	1	.82		
		job2	.82	1		
Image	.87		image1	image2		
		image1	1	.77		
		image2	.77	1		
Result Demonstrability	.84		result1	result2		
		result1	1	.72		
		result2	.72	1		
Compatibility	.88		compa1	compa2		
		compa1	1	.79		
		compa2	.79	1		
System Reliability	.83		reliabl1	reliabl2	reliabl3	
		reliabl1	1	.60	.58	
		reliabl2	.60	1	.68	
		reliabl3	.58	.68	1	

Project Related Variables

Variable	Reliability (α)	Inter Correlation				
Internal Support	.69		interna1	interna2	interna4	
		interna1	1	.46	.34	
		interna2	.46	1	.47	
		interna4	.34	.47	1	
Function	.90		softwar1	softwar2	sysfun1	sysfun2
		softwar1	1	.77	.64	.71
		softwar2	.77	1	.66	.68
		sysfun1	.64	.66	1	.73
		sysfun2	.71	.68	.73	1
Consultant Support	.75		consul1	consul2		
		consul1	1	.60		
		consul2	.60	1		

Intermediate Variables

Variable	Reliability (α)	Inter Correlation				
Subjective Norm	.83		sn1	sn2	sn3	sn4
		sn1	1	.49	.70	.44
		sn2	.49	1	.45	.65
		sn3	.70	.45	1	.60
		sn4	.44	.65	.60	1
Perceived Usefulness	.96		pu1	pu2	pu3	pu4
		pu1	1	.88	.87	.82
		pu2	.88	1	.93	.84
		pu3	.87	.93	1	.87
		pu4	.82	.84	.87	1
Perceived Ease of Use	.93		eou1	eou2	eou3	
		eou1	1	.83	.81	
		eou2	.83	1	.83	
		eou3	.81	.83	1	

Success Indicators

Variable	Reliability (α)	Inter Correlation							
Intention to Use / Use	.85		use1	use2	use3				
		use1	1	.65	.64				
		use2	.65	1	.71				
		use3	.64	.71	1				
ERP Benefits	.92		satis1	satis2	satis3	indimpa1	indimpa2	orgimpa1	orgimpa2
		satis1	1	.80	.84	.58	.66	.56	.41
		satis2	.80	1	.89	.51	.63	.62	.45
		satis3	.84	.89	1	.58	.68	.65	.49
		indimpa1	.58	.51	.58	1	.67	.55	.34
		indimpa2	.66	.63	.68	.67	1	.64	.49
		orgimpa1	.56	.62	.65	.55	.64	1	.66
		orgimpa2	.41	.45	.49	.34	.49	.66	1
Project Success - Progress	.88		prosucc1	prosucc2					
		prosucc1	1	.79					
		prosucc2	.79	1					
Project Success - Quality	.89		prosucc3	prosucc4					
		prosucc3	1	.81					
		prosucc4	.81	1					

Appendix D-3: Factor Analysis

User Related Variables – Total

Variable	Item	Component				
		1	2	3	4	5
Output	report1	**.87**	.05	.18	.16	.08
	report2	**.88**	-.01	.12	.03	.15
	output1	**.72**	.38	.17	.11	-.08
	output2	**.56**	.55	.14	.13	-.12
Job Relevance	job1	.10	.11	**.88**	.00	.05
	job2	.14	.22	**.85**	-.02	.08
Image	image1	.07	-.01	-.03	.03	**.93**
	image2	.03	.05	.03	.04	**.93**
Result Demonstrability	result1	.24	.17	**.55**	.43	-.19
	result2	.27	.08	**.61**	.41	-.10
Compatibility	compa1	.09	.19	.12	**.89**	.05
	compa2	.11	.11	.02	**.89**	.08
Reliability	reliabl1	.38	**.65**	.31	.25	-.12
	reliabl2	.05	**.83**	.19	.14	.04
	reliabl3	.05	**.88**	.05	.07	.09
Eigenvalue		2.67	2.47	2.42	2.09	1.85
% of Variance		17.81	16.44	16.13	13.92	12.36
Cumulative %		17.81	34.25	50.38	64.30	76.66

Project Related Variables – Total

Variable	Item	Component	
		1	2
Internal Support	interna1	.37	.45
	interna2	**.59**	.30
	interna4	.34	**.59**
Function	softwar1	**.86**	.21
	softwar2	**.85**	.20
	sysfun1	**.74**	.34
	sysfun2	**.82**	.28
Consultant Support	consul1	.18	**.87**
	consul2	.19	**.77**
Eigenvalue		3.35	2.27
% of Variance		37.27	25.19
Cumulative %		37.27	62.46

Intermediate Variables – Total

Variable	Item	Component		
		1	2	3
Subjective Norm	sn1	.45	.25	**.61**
	sn2	.12	.20	**.80**
	sn3	.39	.10	**.72**
	sn4	.13	.06	**.88**
Perceived Usefulness	pu1	**.84**	.25	.20
	pu2	**.85**	.30	.15
	pu3	**.87**	.27	.15
	pu4	**.85**	.31	.25
Perceived Ease of Use	eou1	.37	**.85**	.11
	eou2	.31	**.88**	.19
	eou3	.33	**.85**	.21
Intention to Use / Use	use1	**.75**	.28	.23
	use2	**.69**	.17	.25
	use3	**.65**	.32	.27
Eigenvalue		5.11	2.86	2.72
% of Variance		36.48	20.42	19.43
Cumulative %		36.48	56.90	76.33

Success Indicators – Total

Variable	Item	Component	
		1	2
ERP Benefits	satis1	**.87**	.11
	satis2	**.88**	.13
	satis3	**.91**	.13
	indimpa1	**.72**	.07
	indimpa2	**.83**	.05
	orgimpa1	**.78**	.26
	orgimpa2	**.62**	.29
Project Success - Progress	prosucc1	.15	**.92**
	prosucc2	.18	**.93**
Project Success - Quality	prosucc3	**.83**	.30
	prosucc4	**.79**	.29
Eigenvalue		5.90	2.10
% of Variance		53.63	19.06
Cumulative %		53.63	72.69

User Related Variables – the U.S.

Variable	Item	Component				
		1	2	3	4	5
Output	report1	**.87**	.01	.06	.15	-.01
	report2	**.88**	-.09	.09	-.01	.11
	output1	**.71**	.36	.19	.11	-.13
	output2	**.58**	.49	.07	.19	-.23
Job Relevance	job1	.07	-.01	**.94**	.06	.01
	job2	.10	.08	**.92**	-.01	.07
Image	image1	.00	.03	.04	.01	**.94**
	image2	-.02	.03	-.04	.07	**.93**
Result Demonstrability	result1	.25	.21	.44	.44	-.39
	result2	.28	.14	**.53**	.38	-.29
Compatibility	compa1	.06	.18	.09	**.91**	.02
	compa2	.13	.07	.02	**.92**	.09
Reliability	reliabl1	.43	**.62**	.28	.31	-.14
	reliabl2	.00	**.87**	.14	.09	.05
	reliabl3	.05	**.87**	-.09	.08	.07
Eigenvalue		2.76	2.36	2.36	2.19	2.10
% of Variance		18.41	15.76	15.76	14.57	14.02
Cumulative %		18.41	34.17	49.93	64.50	78.51

Project Related Variables – the U.S.

Variable	Item	Component	
		1	2
Internal Support	interna1	.30	**.60**
	interna2	**.64**	.31
	interna4	.42	.39
Function	softwar1	**.89**	.10
	softwar2	**.88**	.11
	sysfun1	**.64**	.37
	sysfun2	**.86**	.24
Consultant Support	consul1	.22	**.79**
	consul2	.04	**.77**
Eigenvalue		3.44	2.05
% of Variance		38.23	22.79
Cumulative %		38.23	61.01

Intermediate Variables – the U.S.

Variable	Item	Component		
		1	2	3
Subjective Norm	sn1	**.80**	.19	.21
	sn2	.14	.23	**.90**
	sn3	**.78**	.03	.28
	sn4	.35	.07	**.85**
Perceived Usefulness	pu1	**.74**	.43	.26
	pu2	**.68**	.51	.27
	pu3	**.73**	.49	.24
	pu4	**.79**	.45	.25
Perceived Ease of Use	eou1	.30	**.89**	.03
	eou2	.21	**.91**	.22
	eou3	.36	**.84**	.13
Intention to Use / Use	use1	**.77**	.37	.12
	use2	**.80**	.29	.02
	use3	**.59**	.50	.23
Eigenvalue		5.41	3.75	2.05
% of Variance		38.63	26.81	14.66
Cumulative %		38.63	65.44	80.10

Success Indicators – the U.S.

Variable	Item	Component	
		1	2
ERP Benefits	satis1	**.87**	.11
	satis2	**.91**	.07
	satis3	**.93**	.09
	indimpa1	**.65**	.12
	indimpa2	**.79**	.14
	orgimpa1	**.77**	.23
	orgimpa2	.49	.38
Project Success - Progress	prosucc1	.13	**.91**
	prosucc2	.13	**.93**
Project Success - Quality	prosucc3	**.88**	.20
	prosucc4	**.80**	.25
Eigenvalue		5.78	2.05
% of Variance		52.57	18.59
Cumulative %		52.57	71.16

User Related Variables – Korea

Variable	Item	Component				
		1	2	3	4	5
Output	report1	**.86**	.06	.28	.14	.17
	report2	**.82**	.13	.27	.14	.10
	output1	**.75**	.36	.10	.10	.03
	output2	**.54**	**.61**	.11	.06	.13
Job Relevance	job1	.22	.19	**.78**	-.13	.02
	job2	.23	.32	**.73**	-.14	.07
Image	image1	.12	.07	.12	.15	**.88**
	image2	.10	.10	.15	.01	**.89**
Result Demonstrability	result1	.12	.11	**.64**	.34	.17
	result2	.17	-.01	**.68**	.33	.23
Compatibility	compa1	.13	.12	.15	**.89**	.07
	compa2	.13	.11	-.02	**.86**	.07
Reliability	reliabl1	.37	**.70**	.19	.12	-.02
	reliabl2	.11	**.78**	.25	.21	-.02
	reliabl3	.05	**.87**	.06	-.01	.19
Eigenvalue		2.62	2.56	2.35	1.92	1.75
% of Variance		17.49	17.05	15.67	12.81	11.67
Cumulative %		17.49	34.54	50.21	63.02	74.69

Project Related Variables – Korea

Variable	Item	Component	
		1	2
Internal Support	interna1	.14	**.88**
	interna2	.29	**.79**
	interna4	**.67**	**.51**
Function	softwar1	**.79**	.32
	softwar2	**.83**	.19
	sysfun1	**.80**	.36
	sysfun2	**.76**	.25
Consultant Support	consul1	**.87**	.16
	consul2	**.89**	.16
Eigenvalue		4.61	2.02
% of Variance		51.25	22.43
Cumulative %		51.25	73.68

Intermediate Variables – Korea

Variable	Item	Component			
		1	2	3	4
Subjective Norm	sn1	.14	**.66**	.36	.25
	sn2	.05	**.81**	.20	.16
	sn3	.26	**.84**	.06	.10
	sn4	.07	**.86**	.00	-.04
Perceived Usefulness	pu1	**.86**	.19	.24	.10
	pu2	**.88**	.12	.24	.19
	pu3	**.92**	.09	.17	.17
	pu4	**.79**	.15	.26	.36
Perceived Ease of Use	eou1	.33	.16	**.83**	.14
	eou2	.28	.19	**.84**	.17
	eou3	.22	.11	**.91**	.07
Intention to Use / Use	use1	**.66**	.12	.28	.34
	use2	.29	.12	.08	**.89**
	use3	.33	.16	.21	**.84**
Eigenvalue		3.95	2.77	2.74	1.96
% of Variance		28.18	19.76	19.54	13.97
Cumulative %		28.18	47.94	67.48	81.45

Success Indicators – Korea

Variable	Item	Component	
		1	2
ERP Benefits	satis1	**.82**	.34
	satis2	**.78**	.38
	satis3	**.76**	.43
	indimpa1	**.85**	.00
	indimpa2	**.84**	.14
	orgimpa1	**.73**	.40
	orgimpa2	**.67**	.40
Project Success - Progress	prosucc1	.11	**.90**
	prosucc2	.22	**.90**
Project Success - Quality	prosucc3	**.55**	**.67**
	prosucc4	**.60**	**.59**
Eigenvalue		4.97	3.20
% of Variance		45.20	29.07
Cumulative %		45.20	74.27

Appendix D-4: Correlation Matrix – the U.S. & Korea

Correlation Matrix of All Scaled Variables - the U.S.

	output	job	image	result	compatib	reliable	internal	function	consult	sn	pu	eou	use	erp_bene	progress	quality
output	1															
job	.28**	1														
image	-.03	.05	1													
result	.49**	.50**	-.12	1												
compatib	.35**	.17*	.07	.39**	1											
reliable	.47**	.27**	-.01	.42**	.38**	1										
internal	.51**	.29**	.01	.43**	.22*	.47**	1									
function	.73**	.40**	-.09	.62**	.45**	.65**	.62**	1								
consult	.45**	.06	.08	.26**	.13	.43**	.48**	.43**	1							
sn	.49**	.45**	.03	.50**	.27**	.45**	.62**	.64**	.31**	1						
pu	.63**	.51**	-.01	.57**	.42**	.51**	.52**	.75**	.33**	.71**	1					
eou	.63**	.33**	-.15	.53**	.40**	.59**	.45**	.73**	.46**	.48**	.67**	1				
use	.45**	.63**	-.11	.66**	.31**	.50**	.51**	.69**	.34**	.69**	.79**	.66**	1			
erp_bene	.72**	.38**	-.06	.56**	.49**	.68**	.51**	.80**	.44**	.62**	.81**	.75**	.69**	1		
progress	.35**	.02	.04	.10	.05	.13	.44**	.21*	.34**	.31**	.22*	.22*	.17	.26**	1	
quality	.65**	.37**	-.14	.51**	.43**	.55**	.48**	.81**	.45**	.57**	.69**	.70**	.65**	.79**	.36**	1

*: Correlation is significant at the .05 level (2-tailed)
**: Correlation is significant at the .01 level (2-tailed)

Correlation Matrix of All Scaled Variables -Korea

	output	job	image	result	compatib	reliable	internal	function	consult	sn	pu	eou	use	erp_bene	progress	quality
output	1															
job	.51**	1														
image	.29**	.22*	1													
result	.42**	.38**	.31**	1												
compatib	.32**	.15	.24**	.32**	1											
reliable	.55**	.40**	.19*	.31**	.26**	1										
internal	.42**	.37**	.32**	.47**	.23*	.42**	1									
function	.66**	.48**	.33**	.36**	.32**	.60**	.59**	1								
consult	.51**	.27**	.27**	.21*	.23*	.45**	.56**	.76**	1							
sn	.24**	.32**	.41**	.18	.16	.16	.48**	.45**	.43**	1						
pu	.57**	.44**	.29**	.49**	.30**	.54**	.47**	.69**	.53**	.38**	1					
eou	.51**	.41**	.30**	.36**	.46**	.51**	.48**	.70**	.50**	.39**	.57**	1				
use	.50**	.60**	.21**	.50**	.38**	.44**	.37**	.52**	.35**	.38**	.69**	.51**	1			
erp_bene	.66**	.47**	.35**	.41**	.38**	.57**	.57**	.78**	.65**	.45**	.80**	.70**	.66**	1		
progress	.35**	.18	.20	.26**	.24*	.44**	.61**	.58**	.54**	.38**	.43**	.53**	.32**	.52**	1	
quality	.67**	.43**	.37**	.37**	.35**	.61**	.58**	.83**	.67**	.40**	.69**	.69**	.60**	.78**	.60**	1

*: Correlation is significant at the .05 level (2-tailed)
**: Correlation is significant at the .01 level (2-tailed)

APPENDIX E: RESULTS OF T TESTS

E-1: Country

E-2: Experience

E-3: Use Hours

Appendix E-1: Country

Country		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
output	Equal variances assumed	6.53	.01	-.54	267	.59	-.07	.13	-.34	.19
	Equal variances not assumed			-.54	261.26	.59	-.07	.13	-.33	.19
job	Equal variances assumed	.02	.90	-4.32	266	.00	-.65	.15	-.95	-.35
	Equal variances not assumed			-4.32	262.80	.00	-.65	.15	-.95	-.35
image	Equal variances assumed	2.78	.10	3.52	267	.00	.60	.17	.27	.94
	Equal variances not assumed			3.55	263.31	.00	.60	.17	.27	.94
result	Equal variances assumed	8.39	.00	-3.91	268	.00	-.54	.14	-.81	-.27
	Equal variances not assumed			-3.95	263.47	.00	-.54	.14	-.81	-.27
compatib	Equal variances assumed	5.50	.02	-2.52	265	.01	-.45	.18	-.81	-.10
	Equal variances not assumed			-2.54	264.02	.01	-.45	.18	-.80	-.10
reliable	Equal variances assumed	7.62	.01	-4.11	266	.00	-.60	.15	-.88	-.31
	Equal variances not assumed			-4.15	263.89	.00	-.60	.14	-.88	-.31
internal	Equal variances assumed	2.72	.10	-.27	248	.79	-.04	.15	-.33	.25
	Equal variances not assumed			-.27	243.77	.79	-.04	.14	-.32	.25
function	Equal variances assumed	7.02	.01	-3.02	249	.00	-.46	.15	-.75	-.16
	Equal variances not assumed			-3.03	240.07	.00	-.46	.15	-.75	-.16
consult	Equal variances assumed	2.89	.09	-.54	223	.59	-.09	.16	-.40	.23
	Equal variances not assumed			-.55	218.18	.59	-.09	.16	-.40	.23
sn	Equal variances assumed	3.24	.07	-4.36	247	.00	-.61	.14	-.89	-.34
	Equal variances not assumed			-4.37	244.11	.00	-.61	.14	-.89	-.34
pu	Equal variances assumed	9.26	.00	-1.17	249	.24	-.19	.16	-.51	.13
	Equal variances not assumed			-1.17	238.19	.24	-.19	.16	-.51	.13
eou	Equal variances assumed	7.93	.01	-2.66	248	.01	-.44	.17	-.76	-.11
	Equal variances not assumed			-2.67	237.12	.01	-.44	.16	-.76	-.12
use	Equal variances assumed	2.36	.13	-1.53	249	.13	-.23	.15	-.52	.07
	Equal variances not assumed			-1.53	246.23	.13	-.23	.15	-.52	.07
erp_bene	Equal variances assumed	5.97	.02	-3.25	245	.00	-.44	.14	-.71	-.17
	Equal variances not assumed			-3.26	237.20	.00	-.44	.14	-.71	-.18
progress	Equal variances assumed	13.30	.00	1.86	197	.07	.37	.20	-.02	.77
	Equal variances not assumed			1.88	181.42	.06	.37	.20	-.02	.76
quality	Equal variances assumed	3.39	.07	-3.34	235	.00	-.58	.17	-.92	-.24
	Equal variances not assumed			-3.35	230.99	.00	-.58	.17	-.92	-.24

Detailed Results – Country

	Country	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
report1	Equal variances assumed	1.53	.22	-.45	254	.65	-.07	.16	-.39	.24
	Equal variances not assumed			-.46	250.47	.65	-.07	.16	-.39	.24
report2	Equal variances assumed	5.53	.02	1.50	242	.13	.26	.17	-.08	.61
	Equal variances not assumed			1.50	221.94	.14	.26	.18	-.08	.61
output1	Equal variances assumed	11.09	.00	-1.04	264	.30	-.15	.14	-.43	.13
	Equal variances not assumed			-1.05	253.85	.29	-.15	.14	-.43	.13
output2	Equal variances assumed	11.36	.00	-2.41	255	.02	-.42	.17	-.76	-.08
	Equal variances not assumed			-2.42	243.93	.02	-.42	.17	-.76	-.08
job1	Equal variances assumed	1.42	.23	-3.48	266	.00	-.54	.16	-.85	-.24
	Equal variances not assumed			-3.47	260.21	.00	-.54	.16	-.85	-.23
job2	Equal variances assumed	.02	.88	-4.86	262	.00	-.77	.16	-1.09	-.46
	Equal variances not assumed			-4.85	258.10	.00	-.77	.16	-1.09	-.46
image1	Equal variances assumed	.22	.64	4.64	267	.00	.86	.18	.49	1.22
	Equal variances not assumed			4.67	266.58	.00	.86	.18	.50	1.22
image2	Equal variances assumed	4.29	.04	1.98	263	.05	.36	.18	.00	.72
	Equal variances not assumed			2.00	260.44	.05	.36	.18	.01	.71
result1	Equal variances assumed	7.52	.01	-3.60	268	.00	-.56	.15	-.86	-.25
	Equal variances not assumed			-3.63	263.12	.00	-.56	.15	-.86	-.25
result2	Equal variances assumed	4.44	.04	-3.88	267	.00	-.55	.14	-.83	-.27
	Equal variances not assumed			-3.90	265.94	.00	-.55	.14	-.83	-.27
compa1	Equal variances assumed	5.89	.02	-2.32	264	.02	-.44	.19	-.82	-.07
	Equal variances not assumed			-2.34	263.57	.02	-.44	.19	-.81	-.07
compa2	Equal variances assumed	2.88	.09	-2.43	263	.02	-.46	.19	-.83	-.09
	Equal variances not assumed			-2.46	262.72	.02	-.46	.19	-.83	-.09
reliabl1	Equal variances assumed	5.90	.02	-4.68	266	.00	-.71	.15	-1.01	-.41
	Equal variances not assumed			-4.74	261.92	.00	-.71	.15	-1.01	-.42
reliabl2	Equal variances assumed	2.18	.14	-2.68	264	.01	-.50	.19	-.86	-.13
	Equal variances not assumed			-2.70	263.51	.01	-.50	.18	-.86	-.13
reliabl3	Equal variances assumed	7.32	.01	-3.33	264	.00	-.58	.17	-.92	-.23
	Equal variances not assumed			-3.36	262.25	.00	-.58	.17	-.91	-.24

Country		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
interna1	Equal variances assumed	3.56	.06	-2.59	238	.01	-.45	.17	-.79	-.11
	Equal variances not assumed			-2.61	232.83	.01	-.45	.17	-.79	-.11
interna2	Equal variances assumed	14.85	.00	-.20	244	.84	-.04	.19	-.41	.34
	Equal variances not assumed			-.20	226.94	.84	-.04	.19	-.41	.33
interna4	Equal variances assumed	11.57	.00	2.10	232	.04	.40	.19	.02	.78
	Equal variances not assumed			2.13	224.65	.03	.40	.19	.03	.77
softwar1	Equal variances assumed	3.78	.05	-3.32	243	.00	-.61	.18	-.98	-.25
	Equal variances not assumed			-3.32	234.88	.00	-.61	.18	-.98	-.25
softwar2	Equal variances assumed	6.01	.02	-3.21	242	.00	-.59	.19	-.96	-.23
	Equal variances not assumed			-3.23	233.18	.00	-.59	.18	-.96	-.23
sysfun1	Equal variances assumed	5.16	.02	-2.40	245	.02	-.39	.16	-.72	-.07
	Equal variances not assumed			-2.41	236.41	.02	-.39	.16	-.71	-.07
sysfun2	Equal variances assumed	8.04	.01	-1.72	245	.09	-.28	.16	-.60	.04
	Equal variances not assumed			-1.73	235.51	.09	-.28	.16	-.60	.04
consul1	Equal variances assumed	11.21	.00	1.66	221	.10	.30	.18	-.06	.65
	Equal variances not assumed			1.68	206.58	.10	.30	.18	-.05	.65
consul2	Equal variances assumed	7.88	.01	-2.71	220	.01	-.48	.18	-.83	-.13
	Equal variances not assumed			-2.75	204.24	.01	-.48	.17	-.82	-.14

	Country	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
sn1	Equal variances assumed	6.34	.01	-4.97	247	.00	-.80	.16	-1.12	-.49
	Equal variances not assumed			-5.00	238.70	.00	-.80	.16	-1.12	-.49
sn2	Equal variances assumed	2.16	.14	-.99	246	.32	-.17	.18	-.52	.17
	Equal variances not assumed			-.99	239.65	.32	-.17	.18	-.52	.17
sn3	Equal variances assumed	6.37	.01	-6.65	246	.00	-1.13	.17	-1.47	-.80
	Equal variances not assumed			-6.68	242.13	.00	-1.13	.17	-1.47	-.80
sn4	Equal variances assumed	.75	.39	-1.64	246	.10	-.30	.18	-.66	.06
	Equal variances not assumed			-1.64	245.02	.10	-.30	.18	-.66	.06
pu1	Equal variances assumed	6.84	.01	-.67	247	.51	-.11	.16	-.43	.21
	Equal variances not assumed			-.67	240.52	.50	-.11	.16	-.43	.21
pu2	Equal variances assumed	9.58	.00	-.46	246	.65	-.08	.17	-.42	.26
	Equal variances not assumed			-.46	236.88	.65	-.08	.17	-.41	.26
pu3	Equal variances assumed	8.05	.01	-.81	245	.42	-.14	.17	-.47	.20
	Equal variances not assumed			-.81	236.91	.42	-.14	.17	-.47	.20
pu4	Equal variances assumed	11.90	.00	-1.82	247	.07	-.31	.17	-.64	.03
	Equal variances not assumed			-1.82	230.41	.07	-.31	.17	-.64	.03
eou1	Equal variances assumed	4.33	.04	-2.78	246	.01	-.51	.18	-.86	-.15
	Equal variances not assumed			-2.79	242.73	.01	-.51	.18	-.86	-.15
eou2	Equal variances assumed	9.69	.00	-.96	247	.34	-.17	.18	-.52	.18
	Equal variances not assumed			-.97	237.97	.33	-.17	.17	-.51	.18
eou3	Equal variances assumed	13.21	.00	-3.83	248	.00	-.65	.17	-.98	-.32
	Equal variances not assumed			-3.84	233.85	.00	-.65	.17	-.98	-.32
use1	Equal variances assumed	2.44	.12	-2.08	244	.04	-.32	.15	-.62	-.02
	Equal variances not assumed			-2.09	238.58	.04	-.32	.15	-.62	-.02
use2	Equal variances assumed	.25	.62	-1.07	249	.29	-.18	.16	-.50	.15
	Equal variances not assumed			-1.07	248.97	.29	-.18	.16	-.50	.15
use3	Equal variances assumed	1.84	.18	-1.12	248	.27	-.21	.19	-.58	.16
	Equal variances not assumed			-1.12	246.43	.27	-.21	.19	-.58	.16

	Country	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
satis1	Equal variances assumed	8.82	.00	-3.25	244	.00	-.52	.16	-.84	-.20
	Equal variances not assumed			-3.27	226.11	.00	-.52	.16	-.83	-.21
satis2	Equal variances assumed	15.73	.00	-1.43	244	.15	-.24	.17	-.56	.09
	Equal variances not assumed			-1.44	217.54	.15	-.24	.16	-.56	.09
satis3	Equal variances assumed	5.20	.02	-3.43	243	.00	-.58	.17	-.92	-.25
	Equal variances not assumed			-3.45	231.34	.00	-.58	.17	-.91	-.25
indimpa1	Equal variances assumed	3.85	.05	-2.03	244	.04	-.36	.18	-.71	-.01
	Equal variances not assumed			-2.04	240.42	.04	-.36	.18	-.71	-.01
indimpa2	Equal variances assumed	.69	.41	-3.41	242	.00	-.53	.15	-.83	-.22
	Equal variances not assumed			-3.43	232.49	.00	-.53	.15	-.83	-.22
orgimpa1	Equal variances assumed	.19	.66	-1.70	218	.09	-.33	.19	-.71	.05
	Equal variances not assumed			-1.70	217.73	.09	-.33	.19	-.71	.05
orgimpa2	Equal variances assumed	3.56	.06	-2.17	211	.03	-.43	.20	-.81	-.04
	Equal variances not assumed			-2.17	204.77	.03	-.43	.20	-.81	-.04
prosucc1	Equal variances assumed	16.95	.00	1.92	195	.06	.40	.21	-.01	.81
	Equal variances not assumed			1.94	176.50	.06	.40	.21	-.01	.80
prosucc2	Equal variances assumed	13.29	.00	2.04	177	.04	.45	.22	.01	.88
	Equal variances not assumed			2.04	156.69	.04	.45	.22	.01	.88
prosucc3	Equal variances assumed	6.61	.01	-3.02	228	.00	-.57	.19	-.95	-.20
	Equal variances not assumed			-3.04	223.64	.00	-.57	.19	-.94	-.20
prosucc4	Equal variances assumed	2.01	.16	-3.13	230	.00	-.57	.18	-.93	-.21
	Equal variances not assumed			-3.14	225.54	.00	-.57	.18	-.93	-.21

Appendix E-2: Experience

Experience		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
output	Equal variances assumed	.63	.43	-2.38	231	.02	-.34	.14	-.62	-.06
	Equal variances not assumed			-2.39	217.40	.02	-.34	.14	-.61	-.06
job	Equal variances assumed	1.79	.18	-2.20	231	.03	-.36	.17	-.69	-.04
	Equal variances not assumed			-2.16	197.05	.03	-.36	.17	-.70	-.03
image	Equal variances assumed	.10	.75	.04	230	.97	.01	.18	-.35	.36
	Equal variances not assumed			.04	212.00	.97	.01	.18	-.35	.36
result	Equal variances assumed	.25	.62	-2.38	231	.02	-.34	.14	-.62	-.06
	Equal variances not assumed			-2.34	199.74	.02	-.34	.15	-.63	-.05
compatib	Equal variances assumed	.19	.67	.18	229	.86	.04	.20	-.36	.43
	Equal variances not assumed			.18	210.80	.86	.04	.20	-.36	.43
reliable	Equal variances assumed	.39	.53	-3.88	230	.00	-.61	.16	-.92	-.30
	Equal variances not assumed			-3.90	214.71	.00	-.61	.16	-.92	-.30
internal	Equal variances assumed	.01	.93	-3.15	224	.00	-.47	.15	-.76	-.17
	Equal variances not assumed			-3.13	200.43	.00	-.47	.15	-.76	-.17
function	Equal variances assumed	.44	.51	-3.33	225	.00	-.52	.15	-.82	-.21
	Equal variances not assumed			-3.33	207.07	.00	-.52	.15	-.82	-.21
consult	Equal variances assumed	1.42	.24	-2.96	201	.00	-.52	.18	-.87	-.17
	Equal variances not assumed			-2.99	179.61	.00	-.52	.17	-.86	-.18
sn	Equal variances assumed	.95	.33	-1.88	229	.06	-.29	.15	-.59	.01
	Equal variances not assumed			-1.85	196.29	.07	-.29	.16	-.60	.02
pu	Equal variances assumed	.02	.89	-2.17	230	.03	-.34	.16	-.66	-.03
	Equal variances not assumed			-2.15	202.85	.03	-.34	.16	-.66	-.03
eou	Equal variances assumed	.30	.59	-.96	230	.34	-.16	.17	-.49	.17
	Equal variances not assumed			-.97	216.19	.33	-.16	.17	-.49	.17
use	Equal variances assumed	6.20	.01	-3.17	231	.00	-.46	.15	-.75	-.18
	Equal variances not assumed			-3.08	187.93	.00	-.46	.15	-.76	-.17
erp_bene	Equal variances assumed	.12	.73	-2.12	230	.04	-.30	.14	-.57	-.02
	Equal variances not assumed			-2.10	204.44	.04	-.30	.14	-.58	-.02
progress	Equal variances assumed	1.51	.22	-.40	187	.69	-.09	.21	-.51	.34
	Equal variances not assumed			-.41	179.44	.68	-.09	.21	-.50	.33
quality	Equal variances assumed	2.04	.15	-2.93	223	.00	-.53	.18	-.89	-.17
	Equal variances not assumed			-2.97	210.97	.00	-.53	.18	-.88	-.18

Detailed Results – Experience

Experience		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
report1	Equal variances assumed	.00	.97	-1.68	218	.09	-.29	.17	-.63	.05
	Equal variances not assumed			-1.69	200.19	.09	-.29	.17	-.63	.05
report2	Equal variances assumed	.80	.37	-1.60	207	.11	-.31	.19	-.68	.07
	Equal variances not assumed			-1.62	192.33	.11	-.31	.19	-.68	.07
output1	Equal variances assumed	3.26	.07	-2.17	229	.03	-.33	.15	-.63	-.03
	Equal variances not assumed			-2.19	218.95	.03	-.33	.15	-.62	-.03
output2	Equal variances assumed	.36	.55	-2.33	222	.02	-.43	.19	-.80	-.07
	Equal variances not assumed			-2.35	210.83	.02	-.43	.19	-.80	-.07
job1	Equal variances assumed	3.63	.06	-2.21	231	.03	-.38	.17	-.73	-.04
	Equal variances not assumed			-2.16	193.67	.03	-.38	.18	-.74	-.03
job2	Equal variances assumed	3.00	.09	-1.88	227	.06	-.33	.17	-.67	.02
	Equal variances not assumed			-1.85	195.32	.07	-.33	.18	-.68	.02
image1	Equal variances assumed	.08	.77	.14	230	.89	.03	.20	-.36	.42
	Equal variances not assumed			.14	210.32	.89	.03	.20	-.36	.42
image2	Equal variances assumed	.12	.73	.02	228	.99	.00	.19	-.37	.38
	Equal variances not assumed			.02	212.30	.99	.00	.19	-.37	.38
result1	Equal variances assumed	.12	.73	-1.53	231	.13	-.25	.16	-.56	.07
	Equal variances not assumed			-1.52	208.40	.13	-.25	.16	-.56	.07
result2	Equal variances assumed	.28	.60	-2.87	231	.01	-.43	.15	-.73	-.14
	Equal variances not assumed			-2.82	198.90	.01	-.43	.15	-.74	-.13
compa1	Equal variances assumed	.02	.89	-.47	228	.64	-.10	.21	-.52	.32
	Equal variances not assumed			-.47	209.94	.64	-.10	.21	-.52	.32
compa2	Equal variances assumed	.45	.51	1.07	227	.29	.22	.21	-.19	.64
	Equal variances not assumed			1.08	214.37	.28	.22	.21	-.19	.63
reliabl1	Equal variances assumed	1.36	.25	-2.96	230	.00	-.50	.17	-.83	-.17
	Equal variances not assumed			-2.99	218.38	.00	-.50	.17	-.83	-.17
reliabl2	Equal variances assumed	2.65	.11	-3.35	229	.00	-.67	.20	-1.06	-.27
	Equal variances not assumed			-3.29	193.49	.00	-.67	.20	-1.07	-.27
reliabl3	Equal variances assumed	1.37	.24	-3.54	228	.00	-.66	.19	-1.03	-.29
	Equal variances not assumed			-3.57	212.82	.00	-.66	.18	-1.02	-.29

	Experience	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
interna1	Equal variances assumed	.09	.77	-2.83	214	.01	-.52	.18	-.88	-.16
	Equal variances not assumed			-2.82	193.21	.01	-.52	.18	-.89	-.16
interna2	Equal variances assumed	.25	.62	-2.94	221	.00	-.55	.19	-.92	-.18
	Equal variances not assumed			-2.91	192.16	.00	-.55	.19	-.93	-.18
interna4	Equal variances assumed	3.06	.08	-1.40	209	.16	-.28	.20	-.68	.11
	Equal variances not assumed			-1.43	203.26	.15	-.28	.20	-.67	.11
softwar1	Equal variances assumed	.02	.90	-2.51	220	.01	-.48	.19	-.86	-.10
	Equal variances not assumed			-2.50	199.14	.01	-.48	.19	-.86	-.10
softwar2	Equal variances assumed	.11	.74	-4.08	220	.00	-.75	.18	-1.11	-.39
	Equal variances not assumed			-4.06	198.25	.00	-.75	.18	-1.11	-.39
sysfun1	Equal variances assumed	1.77	.19	-2.39	220	.02	-.41	.17	-.75	-.07
	Equal variances not assumed			-2.43	207.53	.02	-.41	.17	-.74	-.08
sysfun2	Equal variances assumed	1.26	.26	-2.28	221	.02	-.39	.17	-.72	-.05
	Equal variances not assumed			-2.29	204.14	.02	-.39	.17	-.72	-.05
consul1	Equal variances assumed	5.51	.02	-3.05	198	.00	-.60	.20	-.99	-.21
	Equal variances not assumed			-3.10	181.19	.00	-.60	.19	-.99	-.22
consul2	Equal variances assumed	.12	.73	-2.12	198	.04	-.41	.19	-.80	-.03
	Equal variances not assumed			-2.14	174.66	.03	-.41	.19	-.79	-.03

	Experience	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
sn1	Equal variances assumed	.92	.34	-2.87	229	.01	-.50	.17	-.84	-.16
	Equal variances not assumed			-2.82	196.04	.01	-.50	.18	-.85	-.15
sn2	Equal variances assumed	.34	.56	-.23	228	.82	-.04	.18	-.40	.32
	Equal variances not assumed			-.23	205.94	.82	-.04	.18	-.41	.32
sn3	Equal variances assumed	.54	.47	-1.78	228	.08	-.34	.19	-.72	.04
	Equal variances not assumed			-1.76	199.50	.08	-.34	.19	-.72	.04
sn4	Equal variances assumed	.77	.38	-1.22	228	.22	-.24	.19	-.62	.14
	Equal variances not assumed			-1.21	200.03	.23	-.24	.20	-.62	.15
pu1	Equal variances assumed	.03	.86	-1.88	228	.06	-.30	.16	-.62	.01
	Equal variances not assumed			-1.86	202.95	.06	-.30	.16	-.62	.02
pu2	Equal variances assumed	.35	.56	-2.11	228	.04	-.36	.17	-.71	-.02
	Equal variances not assumed			-2.10	201.12	.04	-.36	.17	-.71	-.02
pu3	Equal variances assumed	.13	.72	-1.94	228	.05	-.33	.17	-.66	.01
	Equal variances not assumed			-1.91	197.25	.06	-.33	.17	-.67	.01
pu4	Equal variances assumed	.01	.92	-1.80	229	.07	-.30	.17	-.63	.03
	Equal variances not assumed			-1.78	201.83	.08	-.30	.17	-.64	.03
eou1	Equal variances assumed	.73	.40	-1.28	228	.20	-.24	.19	-.61	.13
	Equal variances not assumed			-1.28	209.89	.20	-.24	.19	-.61	.13
eou2	Equal variances assumed	.01	.91	-.27	229	.79	-.05	.18	-.40	.30
	Equal variances not assumed			-.27	213.66	.79	-.05	.18	-.40	.30
eou3	Equal variances assumed	.30	.59	-1.12	230	.27	-.20	.18	-.55	.15
	Equal variances not assumed			-1.12	216.16	.26	-.20	.18	-.55	.15
use1	Equal variances assumed	2.84	.09	-2.50	226	.01	-.38	.15	-.68	-.08
	Equal variances not assumed			-2.45	191.04	.02	-.38	.16	-.69	-.07
use2	Equal variances assumed	12.33	.00	-3.92	231	.00	-.63	.16	-.95	-.31
	Equal variances not assumed			-3.78	179.81	.00	-.63	.17	-.96	-.30
use3	Equal variances assumed	1.08	.30	-2.09	230	.04	-.39	.19	-.76	-.02
	Equal variances not assumed			-2.06	196.66	.04	-.39	.19	-.77	-.02

Experience		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
satis1	Equal variances assumed	1.34	.25	-1.24	229	.22	-.21	.17	-.54	.12
	Equal variances not assumed			-1.26	218.67	.21	-.21	.17	-.53	.12
satis2	Equal variances assumed	.05	.83	-2.25	229	.03	-.38	.17	-.72	-.05
	Equal variances not assumed			-2.26	213.92	.03	-.38	.17	-.71	-.05
satis3	Equal variances assumed	.03	.86	-1.97	228	.05	-.35	.18	-.69	.00
	Equal variances not assumed			-1.97	210.30	.05	-.35	.18	-.69	.00
indimpa1	Equal variances assumed	.41	.52	-1.07	229	.29	-.20	.18	-.56	.17
	Equal variances not assumed			-1.07	213.44	.29	-.20	.18	-.56	.17
indimpa2	Equal variances assumed	3.63	.06	-2.65	227	.01	-.42	.16	-.73	-.11
	Equal variances not assumed			-2.60	194.29	.01	-.42	.16	-.73	-.10
orgimpa1	Equal variances assumed	2.47	.12	-2.49	204	.01	-.50	.20	-.90	-.10
	Equal variances not assumed			-2.44	172.39	.02	-.50	.21	-.91	-.10
orgimpa2	Equal variances assumed	.01	.91	.10	197	.93	.02	.21	-.39	.43
	Equal variances not assumed			.09	180.42	.93	.02	.21	-.39	.43
prosucc1	Equal variances assumed	1.10	.30	-.30	186	.77	-.07	.22	-.51	.38
	Equal variances not assumed			-.30	177.26	.77	-.07	.22	-.50	.37
prosucc2	Equal variances assumed	1.77	.19	-.63	170	.53	-.15	.24	-.61	.32
	Equal variances not assumed			-.66	164.89	.51	-.15	.23	-.60	.30
prosucc3	Equal variances assumed	1.46	.23	-2.69	216	.01	-.54	.20	-.93	-.14
	Equal variances not assumed			-2.73	202.75	.01	-.54	.20	-.93	-.15
prosucc4	Equal variances assumed	.41	.52	-2.60	218	.01	-.50	.19	-.87	-.12
	Equal variances not assumed			-2.63	200.82	.01	-.50	.19	-.87	-.12

Appendix E-3: Use Hours

Use Hours		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
output	Equal variances assumed	.04	.85	-1.65	173	.10	-.25	.15	-.56	.05
	Equal variances not assumed			-1.66	158.92	.10	-.25	.15	-.56	.05
job	Equal variances assumed	15.59	.00	-4.87	173	.00	-.88	.18	-1.23	-.52
	Equal variances not assumed			-5.16	172.06	.00	-.88	.17	-1.21	-.54
image	Equal variances assumed	12.61	.00	-.06	172	.95	-.01	.21	-.43	.41
	Equal variances not assumed			-.06	124.52	.96	-.01	.22	-.46	.43
result	Equal variances assumed	.00	.99	-1.99	173	.05	-.34	.17	-.67	.00
	Equal variances not assumed			-1.99	155.52	.05	-.34	.17	-.67	.00
compatib	Equal variances assumed	2.12	.15	-1.56	171	.12	-.36	.23	-.81	.09
	Equal variances not assumed			-1.53	143.06	.13	-.36	.23	-.82	.10
reliable	Equal variances assumed	.37	.54	.26	172	.80	.05	.19	-.33	.43
	Equal variances not assumed			.26	156.55	.80	.05	.19	-.33	.43
internal	Equal variances assumed	.09	.77	-.49	171	.63	-.08	.17	-.41	.25
	Equal variances not assumed			-.49	154.81	.63	-.08	.17	-.41	.25
function	Equal variances assumed	.03	.87	-1.14	170	.26	-.20	.17	-.54	.15
	Equal variances not assumed			-1.13	153.61	.26	-.20	.18	-.55	.15
consult	Equal variances assumed	.00	.98	-.59	157	.56	-.11	.19	-.49	.27
	Equal variances not assumed			-.58	142.50	.56	-.11	.19	-.50	.27
sn	Equal variances assumed	.00	.98	-2.07	172	.04	-.37	.18	-.71	-.02
	Equal variances not assumed			-2.05	154.11	.04	-.37	.18	-.72	-.01
pu	Equal variances assumed	.07	.80	-2.78	173	.01	-.47	.17	-.81	-.14
	Equal variances not assumed			-2.75	150.85	.01	-.47	.17	-.81	-.13
eou	Equal variances assumed	.01	.95	-3.83	173	.00	-.69	.18	-1.05	-.33
	Equal variances not assumed			-3.85	160.42	.00	-.69	.18	-1.04	-.34
use	Equal variances assumed	4.06	.05	-5.02	173	.00	-.78	.16	-1.09	-.47
	Equal variances not assumed			-5.16	170.14	.00	-.78	.15	-1.08	-.48
erp_bene	Equal variances assumed	.00	.97	-2.26	171	.03	-.35	.16	-.66	-.05
	Equal variances not assumed			-2.24	150.08	.03	-.35	.16	-.67	-.04
progress	Equal variances assumed	4.76	.03	-1.16	140	.25	-.27	.23	-.73	.19
	Equal variances not assumed			-1.13	115.08	.26	-.27	.24	-.74	.20
quality	Equal variances assumed	.45	.50	-3.24	168	.00	-.64	.20	-1.03	-.25
	Equal variances not assumed			-3.27	160.10	.00	-.64	.20	-1.03	-.25

Detailed Results – Use Hours

Use Hours		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
report1	Equal variances assumed	.36	.55	-1.27	168	.21	-.23	.19	-.60	.13
	Equal variances not assumed			-1.27	156.09	.21	-.23	.18	-.60	.13
report2	Equal variances assumed	.37	.54	-1.58	161	.12	-.32	.20	-.72	.08
	Equal variances not assumed			-1.59	149.18	.11	-.32	.20	-.72	.08
output1	Equal variances assumed	.15	.70	-.75	171	.45	-.13	.18	-.49	.22
	Equal variances not assumed			-.76	161.53	.45	-.13	.18	-.48	.21
output2	Equal variances assumed	2.30	.13	-1.32	165	.19	-.29	.22	-.72	.14
	Equal variances not assumed			-1.35	157.57	.18	-.29	.21	-.71	.13
job1	Equal variances assumed	19.76	.00	-4.91	173	.00	-.93	.19	-1.30	-.56
	Equal variances not assumed			-5.19	172.34	.00	-.93	.18	-1.28	-.58
job2	Equal variances assumed	7.34	.01	-4.08	170	.00	-.81	.20	-1.21	-.42
	Equal variances not assumed			-4.23	166.70	.00	-.81	.19	-1.19	-.43
image1	Equal variances assumed	10.64	.00	.54	172	.59	.13	.24	-.34	.60
	Equal variances not assumed			.52	127.41	.61	.13	.25	-.36	.62
image2	Equal variances assumed	10.81	.00	-.68	170	.50	-.15	.22	-.59	.29
	Equal variances not assumed			-.65	129.56	.52	-.15	.23	-.61	.31
result1	Equal variances assumed	.86	.35	-1.04	173	.30	-.20	.19	-.58	.18
	Equal variances not assumed			-1.03	148.71	.31	-.20	.20	-.59	.19
result2	Equal variances assumed	1.46	.23	-3.02	172	.00	-.52	.17	-.86	-.18
	Equal variances not assumed			-3.08	164.46	.00	-.52	.17	-.86	-.19
compa1	Equal variances assumed	.94	.33	-1.78	170	.08	-.44	.25	-.93	.05
	Equal variances not assumed			-1.75	143.91	.08	-.44	.25	-.93	.06
compa2	Equal variances assumed	5.18	.02	-1.39	169	.17	-.33	.24	-.80	.14
	Equal variances not assumed			-1.35	137.82	.18	-.33	.24	-.81	.15
reliabl1	Equal variances assumed	.01	.94	-.66	172	.51	-.13	.20	-.52	.26
	Equal variances not assumed			-.66	155.90	.51	-.13	.20	-.53	.26
reliabl2	Equal variances assumed	1.06	.30	.84	171	.40	.21	.25	-.28	.69
	Equal variances not assumed			.82	145.16	.41	.21	.25	-.29	.70
reliabl3	Equal variances assumed	.36	.55	.42	169	.67	.10	.23	-.35	.55
	Equal variances not assumed			.42	150.11	.68	.10	.23	-.36	.55

	Use Hours	Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
interna1	Equal variances assumed	6.00	.02	-.77	166	.44	-.15	.20	-.54	.24
	Equal variances not assumed			-.78	165.44	.43	-.15	.19	-.53	.23
interna2	Equal variances assumed	1.75	.19	-.34	170	.73	-.07	.22	-.50	.35
	Equal variances not assumed			-.33	144.28	.74	-.07	.22	-.51	.36
interna4	Equal variances assumed	.92	.34	.08	164	.94	.02	.22	-.43	.46
	Equal variances not assumed			.08	147.09	.94	.02	.23	-.43	.47
softwar1	Equal variances assumed	.48	.49	-1.40	168	.16	-.30	.22	-.73	.12
	Equal variances not assumed			-1.41	161.70	.16	-.30	.22	-.73	.12
softwar2	Equal variances assumed	.24	.63	-1.61	166	.11	-.35	.22	-.78	.08
	Equal variances not assumed			-1.58	145.91	.12	-.35	.22	-.79	.09
sysfun1	Equal variances assumed	.16	.69	-.05	169	.96	-.01	.19	-.38	.37
	Equal variances not assumed			-.04	149.03	.97	-.01	.19	-.39	.37
sysfun2	Equal variances assumed	.11	.74	-1.02	168	.31	-.20	.19	-.57	.18
	Equal variances not assumed			-1.02	157.19	.31	-.20	.19	-.57	.18
consul1	Equal variances assumed	.53	.47	-.15	156	.88	-.03	.22	-.47	.40
	Equal variances not assumed			-.15	137.83	.88	-.03	.22	-.48	.41
consul2	Equal variances assumed	.01	.91	-1.03	156	.31	-.22	.21	-.63	.20
	Equal variances not assumed			-1.02	143.17	.31	-.22	.21	-.64	.21

Use Hours		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
sn1	Equal variances assumed	.64	.43	-2.50	172	.01	-.51	.20	-.91	-.11
	Equal variances not assumed			-2.52	162.28	.01	-.51	.20	-.91	-.11
sn2	Equal variances assumed	1.22	.27	-1.66	171	.10	-.35	.21	-.77	.07
	Equal variances not assumed			-1.63	147.39	.11	-.35	.22	-.78	.08
sn3	Equal variances assumed	.01	.93	-1.47	171	.14	-.33	.22	-.77	.11
	Equal variances not assumed			-1.48	160.61	.14	-.33	.22	-.77	.11
sn4	Equal variances assumed	3.84	.05	-1.44	171	.15	-.32	.22	-.76	.12
	Equal variances not assumed			-1.40	140.14	.16	-.32	.23	-.78	.13
pu1	Equal variances assumed	.26	.61	-2.42	171	.02	-.42	.17	-.76	-.08
	Equal variances not assumed			-2.37	146.24	.02	-.42	.18	-.77	-.07
pu2	Equal variances assumed	.40	.53	-2.45	172	.02	-.45	.19	-.82	-.09
	Equal variances not assumed			-2.42	148.76	.02	-.45	.19	-.83	-.08
pu3	Equal variances assumed	.46	.50	-2.57	170	.01	-.47	.18	-.83	-.11
	Equal variances not assumed			-2.53	148.27	.01	-.47	.19	-.84	-.10
pu4	Equal variances assumed	.59	.44	-3.05	172	.00	-.56	.18	-.93	-.20
	Equal variances not assumed			-3.09	164.25	.00	-.56	.18	-.92	-.20
eou1	Equal variances assumed	.01	.91	-3.08	172	.00	-.64	.21	-1.04	-.23
	Equal variances not assumed			-3.10	161.54	.00	-.64	.21	-1.04	-.23
eou2	Equal variances assumed	.01	.92	-3.96	172	.00	-.76	.19	-1.15	-.38
	Equal variances not assumed			-3.98	160.52	.00	-.76	.19	-1.14	-.39
eou3	Equal variances assumed	.39	.53	-3.59	173	.00	-.66	.18	-1.03	-.30
	Equal variances not assumed			-3.54	149.38	.00	-.66	.19	-1.03	-.29
use1	Equal variances assumed	3.37	.07	-3.69	168	.00	-.62	.17	-.95	-.29
	Equal variances not assumed			-3.75	161.37	.00	-.62	.16	-.94	-.29
use2	Equal variances assumed	9.07	.00	-3.18	173	.00	-.56	.18	-.90	-.21
	Equal variances not assumed			-3.32	172.90	.00	-.56	.17	-.89	-.23
use3	Equal variances assumed	9.92	.00	-5.91	172	.00	-1.12	.19	-1.50	-.75
	Equal variances not assumed			-6.14	171.75	.00	-1.12	.18	-1.48	-.76

Use Hours		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper
satis1	Equal variances assumed	1.33	.25	-1.78	170	.08	-.33	.18	-.69	.03
	Equal variances not assumed			-1.82	164.88	.07	-.33	.18	-.68	.03
satis2	Equal variances assumed	.01	.93	-1.87	170	.06	-.36	.19	-.74	.02
	Equal variances not assumed			-1.85	147.49	.07	-.36	.19	-.75	.02
satis3	Equal variances assumed	.07	.79	-2.53	169	.01	-.51	.20	-.90	-.11
	Equal variances not assumed			-2.52	153.22	.01	-.51	.20	-.91	-.11
indimpa1	Equal variances assumed	.01	.95	-1.61	170	.11	-.34	.21	-.75	.08
	Equal variances not assumed			-1.59	149.42	.11	-.34	.21	-.75	.08
indimpa2	Equal variances assumed	.26	.61	-1.73	169	.09	-.30	.17	-.64	.04
	Equal variances not assumed			-1.70	143.50	.09	-.30	.18	-.65	.05
orgimpa1	Equal variances assumed	.04	.84	-1.03	157	.31	-.23	.23	-.69	.22
	Equal variances not assumed			-1.02	142.43	.31	-.23	.23	-.69	.22
orgimpa2	Equal variances assumed	.15	.70	-.96	151	.34	-.22	.23	-.68	.24
	Equal variances not assumed			-.95	133.06	.34	-.22	.23	-.69	.24
prosucc1	Equal variances assumed	3.90	.05	-.39	139	.70	-.10	.25	-.58	.39
	Equal variances not assumed			-.38	113.54	.71	-.10	.25	-.60	.40
prosucc2	Equal variances assumed	1.61	.21	-1.99	126	.05	-.51	.25	-1.01	.00
	Equal variances not assumed			-1.95	105.47	.05	-.51	.26	-1.02	.01
prosucc3	Equal variances assumed	.23	.63	-2.50	161	.01	-.56	.22	-1.00	-.12
	Equal variances not assumed			-2.48	147.57	.01	-.56	.23	-1.01	-.11
prosucc4	Equal variances assumed	1.21	.27	-3.27	166	.00	-.68	.21	-1.08	-.27
	Equal variances not assumed			-3.31	161.96	.00	-.68	.20	-1.08	-.27

APPENDIX F: REGRESSION ANALYSIS WITH DUMMY VARIABLE – COUNTRY

Summary of Regression Analysis – with Dummy Variable: Country

Dependent Variable	Predictors	R	R^2	Adjusted R^2	Std. Error of the Estimate
pu	output, job, image, result, compatib, reliable, internal, function, consult, sn, eou, country	.80	.64	.62	.76
use	sn, pu, eou, country	.78	.60	.60	.75
erp_bene	use, progress, quality, country	.84	.70	.70	.61
progress	internal, function, consult, country	.53	.28	.27	1.22
quality	internal, function, consult, country	.83	.69	.69	.78

Result of Regression on Perceived Usefulness – with Dummy Variable: Country

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.22	.39		-.57	.57		
output	.15	.07	.13	2.17	**.03**	.48	2.10
job	.11	.05	.11	2.13	**.04**	.66	1.51
image	.01	.04	.01	.19	.85	.88	1.14
result	.10	.06	.09	1.60	.11	.58	1.73
compatib	.05	.04	.06	1.20	.23	.74	1.36
reliable	.06	.06	.06	.94	.35	.49	2.04
internal	.05	.07	.05	.77	.44	.47	2.13
function	.29	.08	.29	3.50	**.00**	.26	3.83
consult	-.08	.06	-.07	-1.31	.19	.57	1.74
sn	.24	.06	.23	3.89	**.00**	.52	1.93
eou	.13	.06	.14	2.15	**.03**	.43	2.33
country	.26	.12	.11	2.13	**.03**	.72	1.40

Result of Regression on Use – with Dummy Variable: Country

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.31	.25		5.28	.00		
sn	.18	.05	.17	3.35	**.00**	.61	1.64
pu	.51	.05	.54	9.29	**.00**	.49	2.05
eou	.16	.05	.18	3.39	**.00**	.57	1.74
country	.05	.10	.02	.54	.59	.90	1.11

Result of Regression on ERP Benefits – with Dummy Variable: Country

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.71	.24		2.94	.00		
use	.31	.05	.33	6.58	**.00**	.63	1.60
progress	.02	.04	.02	.46	.64	.79	1.27
quality	.47	.04	.58	10.67	**.00**	.52	1.92
country	-.10	.09	-.04	-1.07	.29	.89	1.12

Result of Regression on Progress – with Dummy Variable: Country

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.55	.46		1.21	.23		
internal	.48	.10	.39	4.89	**.00**	.61	1.64
function	-.02	.10	-.02	-.22	.83	.55	1.81
consult	.25	.09	.22	2.82	**.01**	.65	1.53
country	.42	.18	.15	2.31	**.02**	.96	1.05

Result of Regression on Quality – with Dummy Variable: Country

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.21	.28		.75	.46		
internal	.00	.06	.00	-.07	.94	.59	1.69
function	.87	.06	.76	14.31	**.00**	.53	1.89
consult	.12	.06	.10	2.08	**.04**	.63	1.60
country	-.21	.11	-.08	-1.90	.06	.95	1.05

APPENDIX G: RESULTS OF STRUCTURAL EQUATION MODELING

G-1: Original Model

G-2: Best Fit Model

Appendix G-1: Original Model

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	110	292.19	42	.00	6.96
Saturated model	152	.00	0		
Independence model	16	2533.89	136	.00	18.63

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.89	.63	.90	.66	.90
Saturated model	1.00		1.00		1.00
Independence model	.00	.00	.00	.00	.00

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.31	.27	.28
Saturated model	.00	.00	.00
Independence model	1.00	.00	.00

NCP

Model	NCP	LO 90	HI 90
Default model	250.19	199.71	308.16
Saturated model	.00	.00	.00
Independence model	2397.89	2238.15	2564.98

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	1.04	.89	.71	1.10
Saturated model	.00	.00	.00	.00
Independence model	9.05	8.56	7.99	9.16

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.15	.13	.16	.00
Independence model	.25	.24	.26	.00

AIC

Model	AIC	BCC	BIC	CAIC
Default model	512.19	526.41		
Saturated model	304.00	323.65		
Independence model	2565.89	2567.96		

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.83	1.65	2.04	1.88
Saturated model	1.09	1.09	1.09	1.16
Independence model	9.16	8.59	9.76	9.17

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	56	64
Independence model	19	20

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
pu	<---	job	.08	.05	1.64	.10	
pu	<---	image	.05	.04	1.44	.15	
pu	<---	result	.12	.06	2.22	.03	
pu	<---	compatib	.02	.04	.58	.56	
pu	<---	output	.18	.06	2.88	.00	
pu	<---	reliable	.01	.05	.21	.84	
pu	<---	eou	.16	.06	2.78	.01	
pu	<---	sn	.16	.06	2.75	.01	
pu	<---	internal	.03	.06	.53	.59	
pu	<---	function	.30	.08	3.86	***	
pu	<---	consult	-.03	.05	-.56	.58	
use	<---	sn	.19	.05	3.99	***	
use	<---	pu	.50	.05	9.68	***	
use	<---	eou	.16	.05	3.42	***	
progress	<---	internal	.44	.10	4.60	***	
progress	<---	function	-.01	.09	-.11	.92	
progress	<---	consult	.27	.08	3.17	.00	
quality	<---	internal	.01	.06	.12	.90	
quality	<---	function	.83	.06	14.66	***	
quality	<---	consult	.13	.05	2.37	.02	
erp_bene	<---	progress	.01	.03	.35	.72	
erp_bene	<---	quality	.46	.03	13.44	***	
erp_bene	<---	use	.31	.04	7.95	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
pu	<---	job	.08
pu	<---	image	.06
pu	<---	result	.11
pu	<---	compatib	.03
pu	<---	output	.16
pu	<---	reliable	.01
pu	<---	eou	.17
pu	<---	sn	.15
pu	<---	internal	.03
pu	<---	function	.29
pu	<---	consult	-.03
use	<---	sn	.19
use	<---	pu	.53
use	<---	eou	.18
progress	<---	internal	.36
progress	<---	function	-.01
progress	<---	consult	.23
quality	<---	internal	.01
quality	<---	function	.73
quality	<---	consult	.11
erp_bene	<---	progress	.02
erp_bene	<---	quality	.58
erp_bene	<---	use	.34

Means: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
output	5.09	.07	76.78	***	
job	5.62	.08	72.94	***	
image	4.14	.09	48.34	***	
reliable	4.70	.07	63.45	***	
result	5.15	.07	73.44	***	
compatib	4.03	.09	45.12	***	
sn	4.69	.07	65.07	***	
eou	4.35	.08	54.29	***	
consult	4.54	.08	56.64	***	
internal	5.00	.07	70.30	***	
function	4.87	.07	65.55	***	

Intercepts: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
pu	-.03	.33	-.08	.94	
use	1.30	.22	5.92	***	
progress	.80	.43	1.84	.07	
quality	.18	.26	.67	.50	
erp_bene	.74	.21	3.54	***	

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
output	<-->	job	.54	.09	5.93	***	
job	<-->	image	.11	.11	.96	.34	
image	<-->	result	-.04	.10	-.36	.72	
result	<-->	compatib	.68	.11	6.06	***	
compatib	<-->	reliable	.68	.12	5.75	***	
job	<-->	result	.72	.10	7.24	***	
image	<-->	compatib	.19	.13	1.48	.14	
result	<-->	reliable	.62	.09	6.54	***	
output	<-->	result	.62	.09	7.18	***	
job	<-->	compatib	.40	.12	3.44	***	
image	<-->	reliable	.02	.11	.14	.89	
job	<-->	reliable	.60	.10	5.87	***	
output	<-->	image	.13	.10	1.39	.16	
output	<-->	compatib	.56	.10	5.39	***	
output	<-->	reliable	.69	.09	7.49	***	
internal	<-->	function	.83	.10	8.23	***	
function	<-->	consult	.77	.11	7.07	***	
internal	<-->	consult	.69	.10	6.76	***	
output	<-->	sn	.51	.09	5.93	***	
job	<-->	sn	.69	.10	6.79	***	
image	<-->	sn	.21	.10	1.99	.05	
result	<-->	sn	.58	.09	6.38	***	
compatib	<-->	sn	.50	.11	4.49	***	
reliable	<-->	sn	.59	.10	6.17	***	
sn	<-->	internal	.77	.10	7.97	***	
sn	<-->	function	.84	.10	8.20	***	
sn	<-->	consult	.40	.10	4.09	***	
output	<-->	eou	.83	.10	8.19	***	
job	<-->	eou	.66	.11	6.00	***	
image	<-->	eou	.02	.12	.20	.85	
result	<-->	eou	.76	.10	7.26	***	
compatib	<-->	eou	.85	.13	6.56	***	
reliable	<-->	eou	.91	.11	8.07	***	
eou	<-->	internal	.70	.10	6.79	***	
eou	<-->	function	1.16	.12	9.56	***	
eou	<-->	consult	.71	.11	6.21	***	
eou	<-->	sn	.72	.11	6.87	***	
reliable	<-->	internal	.64	.10	6.71	***	
reliable	<-->	function	.97	.11	8.90	***	
reliable	<-->	consult	.57	.11	5.42	***	
compatib	<-->	internal	.40	.11	3.72	***	
compatib	<-->	function	.73	.12	6.16	***	
compatib	<-->	consult	.23	.12	1.94	.05	
result	<-->	internal	.60	.09	6.66	***	
result	<-->	function	.77	.10	7.81	***	
result	<-->	consult	.35	.10	3.69	***	
image	<-->	internal	.19	.10	1.88	.06	
image	<-->	function	.09	.11	.79	.43	
image	<-->	consult	.20	.12	1.72	.09	
job	<-->	internal	.49	.10	5.15	***	
job	<-->	function	.72	.11	6.90	***	
job	<-->	consult	.22	.10	2.15	.03	
output	<-->	internal	.62	.09	7.12	***	
output	<-->	function	.93	.10	9.34	***	
output	<-->	consult	.60	.10	6.24	***	

Correlations: (Group number 1 - Default model)

			Estimate
output	<-->	job	.38
job	<-->	image	.06
image	<-->	result	-.02
result	<-->	compatib	.39
compatib	<-->	reliable	.37
job	<-->	result	.48
image	<-->	compatib	.09
result	<-->	reliable	.43
output	<-->	result	.48
job	<-->	compatib	.21
image	<-->	reliable	.01
job	<-->	reliable	.38
output	<-->	image	.08
output	<-->	compatib	.34
output	<-->	reliable	.51
internal	<-->	function	.59
function	<-->	consult	.50
internal	<-->	consult	.48
output	<-->	sn	.39
job	<-->	sn	.46
image	<-->	sn	.12
result	<-->	sn	.42
compatib	<-->	sn	.29
reliable	<-->	sn	.41
sn	<-->	internal	.57
sn	<-->	function	.58
sn	<-->	consult	.27
output	<-->	eou	.58
job	<-->	eou	.39
image	<-->	eou	.01
result	<-->	eou	.49
compatib	<-->	eou	.44
reliable	<-->	eou	.57
eou	<-->	internal	.46
eou	<-->	function	.72
eou	<-->	consult	.43
eou	<-->	sn	.47
reliable	<-->	internal	.45
reliable	<-->	function	.64
reliable	<-->	consult	.37
compatib	<-->	internal	.24
compatib	<-->	function	.40
compatib	<-->	consult	.13
result	<-->	internal	.45
result	<-->	function	.54
result	<-->	consult	.24
image	<-->	internal	.12
image	<-->	function	.05
image	<-->	consult	.11
job	<-->	internal	.33
job	<-->	function	.46
job	<-->	consult	.14
output	<-->	internal	.48
output	<-->	function	.69
output	<-->	consult	.43

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
output	1.22	.10	11.76	***	
job	1.64	.14	11.73	***	
image	2.04	.17	11.77	***	
result	1.37	.12	11.79	***	
compatib	2.19	.19	11.71	***	
reliable	1.52	.13	11.74	***	
eou	1.72	.15	11.46	***	
sn	1.38	.12	11.41	***	
internal	1.34	.12	11.42	***	
function	1.50	.13	11.57	***	
consult	1.58	.15	10.90	***	
e1	.61	.05	11.34	***	
e2	.55	.05	11.35	***	
e4	1.56	.15	10.14	***	
e5	.69	.06	11.01	***	
e3	.40	.04	11.16	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
pu	.62
quality	.64
progress	.25
use	.61
erp_bene	.66

Matrices (Group number 1 - Default model)

Implied Covariances (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use	erp_bene
consult	1.58															
function	.77	1.50														
internal	.69	.83	1.34													
sn	.40	.84	.77	1.38												
eou	.71	1.16	.70	.72	1.72											
reliable	.57	.97	.64	.59	.91	1.52										
compatib	.23	.73	.40	.50	.85	.68	2.19									
result	.35	.77	.60	.58	.76	.62	.68	1.37								
image	.20	.09	.19	.21	.02	.02	.19	-.04	2.04							
job	.22	.72	.49	.69	.66	.60	.40	.72	.11	1.64						
output	.60	.93	.62	.51	.83	.69	.56	.62	.13	.54	1.22					
pu	.58	1.12	.76	.84	1.06	.81	.73	.81	.20	.78	.86	1.61				
quality	.84	1.35	.79	.75	1.05	.88	.64	.69	.10	.63	.85	1.01	1.92			
progress	.72	.56	.77	.44	.49	.43	.23	.35	.14	.27	.42	.48	.56	2.09		
use	.48	.91	.64	.80	.94	.67	.59	.64	.14	.63	.66	1.14	.82	.40	1.42	
erp_bene	.54	.90	.56	.60	.78	.61	.48	.51	.09	.48	.60	.82	1.13	.40	.82	1.18

Implied Correlations (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use	erp_bene
consult	1															
function	.50	1														
internal	.48	.59	1													
sn	.27	.58	.57	1												
eou	.43	.72	.46	.47	1											
reliable	.37	.64	.45	.41	.57	1										
compatib	.13	.40	.24	.29	.44	.37	1									
result	.24	.54	.45	.42	.49	.43	.39	1								
image	.11	.05	.12	.12	.01	.01	.09	-.02	1							
job	.14	.46	.33	.46	.39	.38	.21	.48	.06	1						
output	.43	.69	.48	.39	.58	.51	.34	.48	.08	.38	1					
pu	.36	.72	.52	.57	.64	.52	.39	.55	.11	.48	.62	1				
quality	.48	.79	.49	.46	.58	.51	.31	.42	.05	.36	.55	.57	1			
progress	.40	.32	.46	.26	.26	.24	.11	.21	.07	.15	.27	.26	.28	1		
use	.32	.62	.46	.57	.60	.45	.34	.46	.08	.41	.50	.75	.49	.23	1	
erp_bene	.40	.68	.45	.47	.55	.46	.30	.41	.06	.35	.50	.59	.76	.26	.63	1

Implied Means (Group number 1 - Default model)

consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use	erp_bene
4.54	4.87	5.00	4.69	4.35	4.70	4.03	5.15	4.14	5.62	5.09	5.25	4.82	4.16	5.52	4.69

Total Effects (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use
pu	-.03	.30	.03	.16	.16	.01	.02	.12	.05	.08	.18	.00	.00	.00	.00
quality	.13	.83	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
progress	.27	-.01	.44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
use	-.01	.15	.02	.27	.24	.01	.01	.06	.03	.04	.09	.50	.00	.00	.00
erp_bene	.06	.43	.01	.08	.07	.00	.00	.02	.01	.01	.03	.15	.46	.01	.31

Standardized Total Effects (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use
pu	-.03	.29	.03	.15	.17	.01	.03	.11	.06	.08	.16	.00	.00	.00	.00
quality	.11	.73	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
progress	.23	-.01	.36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
use	-.02	.15	.02	.27	.26	.01	.01	.06	.03	.04	.09	.53	.00	.00	.00
erp_bene	.06	.48	.01	.09	.09	.00	.01	.02	.01	.01	.03	.18	.58	.02	.34

Direct Effects (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use
pu	-.03	.30	.03	.16	.16	.01	.02	.12	.05	.08	.18	.00	.00	.00	.00
quality	.13	.83	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
progress	.27	-.01	.44	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
use	.00	.00	.00	.19	.16	.00	.00	.00	.00	.00	.00	.50	.00	.00	.00
erp_bene	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.46	.01	.31

Standardized Direct Effects (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use
pu	-.03	.29	.03	.15	.17	.01	.03	.11	.06	.08	.16	.00	.00	.00	.00
quality	.11	.73	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
progress	.23	-.01	.36	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
use	.00	.00	.00	.19	.18	.00	.00	.00	.00	.00	.00	.53	.00	.00	.00
erp_bene	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.58	.02	.34

Indirect Effects (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use
pu	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
quality	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
progress	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
use	-.01	.15	.02	.08	.08	.01	.01	.06	.03	.04	.09	.00	.00	.00	.00
erp_bene	.06	.43	.01	.08	.07	.00	.00	.02	.01	.01	.03	.15	.00	.00	.00

Standardized Indirect Effects (Group number 1 - Default model)

	consult	function	internal	sn	eou	reliable	compatib	result	image	job	output	pu	quality	progress	use
pu	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
quality	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
progress	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
use	-.02	.15	.02	.08	.09	.01	.01	.06	.03	.04	.09	.00	.00	.00	.00
erp_bene	.06	.48	.01	.09	.09	.00	.01	.02	.01	.01	.03	.18	.00	.00	.00

Appendix G-2: Best Fit Model

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	107	114.25	45	.00	2.54
Saturated model	152	.00	0		
Independence model	16	2533.89	136	.00	18.63

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.96	.86	.97	.91	.97
Saturated model	1.00		1.00		1.00
Independence model	.00	.00	.00	.00	.00

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.33	.32	.32
Saturated model	.00	.00	.00
Independence model	1.00	.00	.00

NCP

Model	NCP	LO 90	HI 90
Default model	69.25	41.50	104.67
Saturated model	.00	.00	.00
Independence model	2397.89	2238.15	2564.98

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.41	.25	.15	.37
Saturated model	.00	.00	.00	.00
Independence model	9.05	8.56	7.99	9.16

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.07	.06	.09	.01
Independence model	.25	.24	.26	.00

AIC

Model	AIC	BCC	BIC	CAIC
Default model	328.25	342.08		
Saturated model	304.00	323.65		
Independence model	2565.89	2567.96		

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.17	1.07	1.30	1.22
Saturated model	1.09	1.09	1.09	1.16
Independence model	9.16	8.59	9.76	9.17

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	152	172
Independence model	19	20

Estimates (Group number 1 - Default model)

Scalar Estimates (Group number 1 - Default model)

Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
pu	<---	job	.13	.04	3.38	***	
pu	<---	result	.16	.04	3.55	***	
pu	<---	function	.25	.06	4.10	***	
progress	<---	internal	.44	.09	5.16	***	
progress	<---	consult	.26	.08	3.31	***	
pu	<---	eou	.18	.06	3.30	***	
pu	<---	output	.16	.05	3.25	.00	
pu	<---	sn	.18	.05	3.33	***	
use	<---	sn	.00	.05	-.09	.93	
use	<---	eou	.05	.05	.98	.33	
quality	<---	function	1.08	.08	14.24	***	
use	<---	pu	.86	.09	9.25	***	
quality	<---	consult	.12	.09	1.44	.15	
quality	<---	progress	-.25	.17	-1.49	.14	
erp_bene	<---	quality	.20	.04	5.51	***	
erp_bene	<---	use	.81	.07	12.44	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
pu	<---	job	.13
pu	<---	result	.14
pu	<---	function	.24
progress	<---	internal	.35
progress	<---	consult	.23
pu	<---	eou	.19
pu	<---	output	.14
pu	<---	sn	.16
use	<---	sn	.00
use	<---	eou	.06
quality	<---	function	.95
use	<---	pu	.91
quality	<---	consult	.11
quality	<---	progress	-.26
erp_bene	<---	quality	.25
erp_bene	<---	use	.87

Means: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
output	5.09	.07	76.78	***	
job	5.61	.08	72.92	***	
result	5.15	.07	73.44	***	
sn	4.69	.07	65.18	***	
eou	4.35	.08	54.26	***	
consult	4.54	.08	56.65	***	
internal	5.00	.07	70.34	***	
function	4.87	.07	65.56	***	
image	4.15	.09	48.34	***	
reliable	4.70	.07	63.45	***	
compatib	4.03	.09	45.11	***	

Intercepts: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
pu	.07	.28	.26	.79	
progress	.80	.41	1.94	.05	
use	.82	.27	3.01	.00	
quality	.04	.40	.11	.91	
erp_bene	-.77	.29	-2.63	.01	

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
output	<-->	job	.54	.09	5.92	***	
job	<-->	result	.72	.10	7.22	***	
output	<-->	result	.61	.09	7.15	***	
internal	<-->	function	.83	.10	8.23	***	
function	<-->	consult	.77	.11	7.05	***	
internal	<-->	consult	.69	.10	6.74	***	
output	<-->	sn	.50	.09	5.91	***	
job	<-->	sn	.68	.10	6.76	***	
result	<-->	sn	.58	.09	6.37	***	
job	<-->	eou	.66	.11	6.00	***	
result	<-->	eou	.75	.10	7.23	***	
internal	<-->	eou	.70	.10	6.74	***	
function	<-->	eou	1.16	.12	9.62	***	
sn	<-->	eou	.71	.10	6.83	***	
result	<-->	internal	.60	.09	6.65	***	
result	<-->	function	.77	.10	7.89	***	
result	<-->	consult	.35	.10	3.65	***	
job	<-->	internal	.49	.10	5.12	***	
job	<-->	function	.74	.10	7.13	***	
job	<-->	consult	.22	.10	2.08	.04	
output	<-->	internal	.61	.09	7.08	***	
output	<-->	function	.92	.10	9.34	***	
output	<-->	consult	.59	.10	6.16	***	
output	<-->	eou	.83	.10	8.19	***	
consult	<-->	eou	.70	.11	6.12	***	
function	<-->	sn	.83	.10	8.19	***	
consult	<-->	sn	.40	.10	4.06	***	
internal	<-->	sn	.77	.10	7.96	***	
e5	<-->	e4	.74	.28	2.64	.01	
e2	<-->	e1	-.29	.07	-4.42	***	
e5	<-->	function	-.22	.05	-4.65	***	
image	<-->	job	.11	.11	.98	.33	
image	<-->	result	-.04	.10	-.39	.70	
compatib	<-->	result	.68	.11	6.03	***	
compatib	<-->	reliable	.67	.12	5.75	***	
image	<-->	compatib	.19	.13	1.50	.13	
reliable	<-->	result	.61	.09	6.52	***	
compatib	<-->	job	.40	.12	3.44	***	
image	<-->	reliable	.02	.11	.17	.87	
reliable	<-->	job	.60	.10	5.88	***	
image	<-->	output	.14	.10	1.42	.16	
compatib	<-->	output	.56	.10	5.39	***	
reliable	<-->	output	.69	.09	7.48	***	
image	<-->	sn	.21	.10	1.98	.05	
compatib	<-->	sn	.49	.11	4.44	***	
image	<-->	eou	.03	.12	.24	.81	
compatib	<-->	eou	.85	.13	6.56	***	
reliable	<-->	eou	.91	.11	8.07	***	
reliable	<-->	internal	.64	.10	6.67	***	
reliable	<-->	function	.97	.11	8.97	***	
reliable	<-->	consult	.56	.10	5.35	***	
compatib	<-->	internal	.40	.11	3.67	***	
compatib	<-->	function	.75	.12	6.40	***	
compatib	<-->	consult	.22	.12	1.84	.07	
image	<-->	internal	.19	.10	1.86	.06	
image	<-->	function	.08	.10	.79	.43	
image	<-->	consult	.20	.12	1.73	.08	
e3	<-->	e2	-.44	.06	-7.80	***	
reliable	<-->	sn	.59	.10	6.14	***	

Correlations: (Group number 1 - Default model)

			Estimate
output	<-->	job	.38
job	<-->	result	.48
output	<-->	result	.48
internal	<-->	function	.59
function	<-->	consult	.50
internal	<-->	consult	.48
output	<-->	sn	.39
job	<-->	sn	.46
result	<-->	sn	.42
job	<-->	eou	.39
result	<-->	eou	.49
internal	<-->	eou	.46
function	<-->	eou	.72
sn	<-->	eou	.47
result	<-->	internal	.45
result	<-->	function	.54
result	<-->	consult	.24
job	<-->	internal	.33
job	<-->	function	.47
job	<-->	consult	.13
output	<-->	internal	.48
output	<-->	function	.68
output	<-->	consult	.42
output	<-->	eou	.58
consult	<-->	eou	.42
function	<-->	sn	.58
consult	<-->	sn	.27
internal	<-->	sn	.57
e5	<-->	e4	.59
e2	<-->	e1	-.46
e5	<-->	function	-.18
image	<-->	job	.06
image	<-->	result	-.02
compatib	<-->	result	.39
compatib	<-->	reliable	.37
image	<-->	compatib	.09
reliable	<-->	result	.43
compatib	<-->	job	.21
image	<-->	reliable	.01
reliable	<-->	job	.38
image	<-->	output	.09
compatib	<-->	output	.34
reliable	<-->	output	.50
image	<-->	sn	.12
compatib	<-->	sn	.29
image	<-->	eou	.01
compatib	<-->	eou	.44
reliable	<-->	eou	.57
reliable	<-->	internal	.45
reliable	<-->	function	.64
reliable	<-->	consult	.36
compatib	<-->	internal	.23
compatib	<-->	function	.42
compatib	<-->	consult	.12
image	<-->	internal	.12
image	<-->	function	.05
image	<-->	consult	.11
e3	<-->	e2	-.69
reliable	<-->	sn	.41

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
output	1.22	.10	11.76	***	
job	1.64	.14	11.73	***	
result	1.37	.12	11.79	***	
internal	1.34	.12	11.42	***	
function	1.50	.13	11.56	***	
consult	1.58	.15	10.90	***	
sn	1.37	.12	11.40	***	
eou	1.72	.15	11.46	***	
e4	1.56	.15	10.15	***	
e1	.63	.06	11.35	***	
e2	.66	.07	8.88	***	
e5	1.02	.28	3.63	***	
e3	.62	.08	7.82	***	
image	2.04	.17	11.77	***	
compatib	2.19	.19	11.71	***	
reliable	1.51	.13	11.74	***	

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
progress	.25
pu	.61
quality	.47
use	.54
erp_bene	.50

Matrices (Group number 1 - Default model)

Implied Covariances (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use	erp_bene	reliable	compatib	image
eou	1.72															
sn	.71	1.37														
consult	.70	.40	1.58													
function	1.16	.83	.77	1.50												
internal	.70	.77	.69	.83	1.34											
result	.75	.58	.35	.77	.60	1.37										
job	.66	.68	.22	.74	.49	.72	1.64									
output	.83	.50	.59	.92	.61	.61	.54	1.22								
progress	.49	.44	.71	.56	.77	.36	.27	.42	2.08							
pu	1.06	.84	.57	1.09	.72	.83	.83	.83	.46	1.61						
quality	1.22	.83	.85	1.35	.79	.78	.76	.96	.91	1.08	1.93					
use	.99	.75	.52	.99	.65	.75	.74	.75	.42	1.13	.98	1.42				
erp_bene	1.05	.77	.59	1.07	.69	.77	.76	.80	.52	1.14	1.18	.91	1.25			
reliable	.91	.59	.56	.97	.64	.61	.60	.69	.42	.79	1.01	.72	.79	1.51		
compatib	.85	.49	.22	.75	.40	.68	.40	.56	.23	.68	.78	.62	.66	.67	2.19	
image	.03	.21	.20	.08	.19	-.04	.11	.14	.14	.09	.08	.08	.08	.02	.19	2.04

Implied Correlations (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use	erp_bene	reliable	compatib	image
eou	1															
sn	.47	1														
consult	.42	.27	1													
function	.72	.58	.50	1												
internal	.46	.57	.48	.59	1											
result	.49	.42	.24	.54	.45	1										
job	.39	.46	.13	.47	.33	.48	1									
output	.58	.39	.42	.68	.48	.48	.38	1								
progress	.26	.26	.39	.32	.46	.21	.15	.27	1							
pu	.64	.56	.35	.70	.49	.56	.51	.59	.25	1						
quality	.67	.51	.48	.80	.49	.48	.43	.63	.46	.61	1					
use	.64	.53	.34	.68	.47	.54	.49	.57	.24	.75	.59	1				
erp_bene	.72	.59	.42	.79	.53	.59	.53	.65	.33	.80	.76	.69	1			
reliable	.57	.41	.36	.64	.45	.43	.38	.50	.24	.51	.59	.49	.57	1		
compatib	.44	.29	.12	.42	.23	.39	.21	.34	.11	.36	.38	.35	.40	.37	1	
image	.01	.12	.11	.05	.12	-.02	.06	.09	.07	.05	.04	.05	.05	.01	.09	1

Implied Means (Group number 1 - Default model)

eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use	erp_bene	reliable	compatib	image
4.35	4.69	4.54	4.87	5.00	5.15	5.61	5.09	4.17	5.25	4.82	5.51	4.68	4.70	4.03	4.15

Total Effects (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use
progress	.00	.00	.26	.00	.44	.00	.00	.00	.00	.00	.00	.00
pu	.18	.18	.00	.25	.00	.16	.13	.16	.00	.00	.00	.00
quality	.00	.00	.06	1.08	-.11	.00	.00	.00	-.25	.00	.00	.00
use	.21	.15	.00	.21	.00	.13	.11	.14	.00	.86	.00	.00
erp_bene	.17	.12	.01	.39	-.02	.11	.09	.11	-.05	.70	.20	.81

Standardized Total Effects (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use
progress	.00	.00	.23	.00	.35	.00	.00	.00	.00	.00	.00	.00
pu	.19	.16	.00	.24	.00	.14	.13	.14	.00	.00	.00	.00
quality	.00	.00	.05	.95	-.09	.00	.00	.00	-.26	.00	.00	.00
use	.23	.15	.00	.22	.00	.13	.12	.13	.00	.91	.00	.00
erp_bene	.20	.13	.01	.43	-.02	.11	.10	.11	-.07	.79	.25	.87

Direct Effects (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use
progress	.00	.00	.26	.00	.44	.00	.00	.00	.00	.00	.00	.00
pu	.18	.18	.00	.25	.00	.16	.13	.16	.00	.00	.00	.00
quality	.00	.00	.12	1.08	.00	.00	.00	.00	-.25	.00	.00	.00
use	.05	.00	.00	.00	.00	.00	.00	.00	.00	.86	.00	.00
erp_bene	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.20	.81

Standardized Direct Effects (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use
progress	.00	.00	.23	.00	.35	.00	.00	.00	.00	.00	.00	.00
pu	.19	.16	.00	.24	.00	.14	.13	.14	.00	.00	.00	.00
quality	.00	.00	.11	.95	.00	.00	.00	.00	-.26	.00	.00	.00
use	.06	.00	.00	.00	.00	.00	.00	.00	.00	.91	.00	.00
erp_bene	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.25	.87

Indirect Effects (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use
progress	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
pu	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
quality	.00	.00	-.07	.00	-.11	.00	.00	.00	.00	.00	.00	.00
use	.16	.15	.00	.21	.00	.13	.11	.14	.00	.00	.00	.00
erp_bene	.17	.12	.01	.39	-.02	.11	.09	.11	-.05	.70	.00	.00

Standardized Indirect Effects (Group number 1 - Default model)

	eou	sn	consult	function	internal	result	job	output	progress	pu	quality	use
progress	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
pu	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
quality	.00	.00	-.06	.00	-.09	.00	.00	.00	.00	.00	.00	.00
use	.17	.15	.00	.22	.00	.13	.12	.13	.00	.00	.00	.00
erp_bene	.20	.13	.01	.43	-.02	.11	.10	.11	-.07	.79	.00	.00

REFERENCES

Agarwal, R., and Prasad, J. (1997). "The Role of Innovation Characteristics and Perceived Voluntariness in the Acceptance of Information Technologies." *Decision Sciences, the Decision Sciences Institute*, 28(3), 557-582.

Ajzen, I. (1991). "The Theory of Planned Behavior." *Organizational Behavior and Human Decision Processes, Elsevier*, 50(2), 179-211.

Akkermans, H., and Helden, K. V. (2002). "Vicious and Virtuous Cycles in ERP Implementation: A Case Study of Interrelations between Critical Success Factors." *European Journal of Information Systems, Operational Research Society Ltd.*, 11, 35-46.

Alter, S. (1992). *Information Systems: A Management Perspective*, Addison-Wesley, Reading, MA.

Arbuckle, J. L. (2006). *Amos 7.0 User's Guide*, Amos Development Corporation, Spring House, PA.

Ashenfelter, O., Levine, P. B., and Zimmerman, D. J. (2003). *Statistics and Econometrics: Methods and Applications*, John Wiley & Sons, Inc., New York, NY.

Barker, T., and Frolick, M. N. (2003). "ERP Implementation Failure: A Case Study." *Information Systems Management, Auerbach*, 20(4), 43-49.

Barki, H., and Hartwick, J. (1994). "Measuring User Participation, User Involvement,and User Attitude." *MIS Quarterly, Society for Management Information Systems*, 18(1), 59-82.

Bedworth, D. D., and Bailey, J. E. (1987). *Integrated Production Control Systems: Management, Analysis, Design*, Wiley, New York.

Brennan, M., Hoek, J., and Astridge, C. (1991). "The Effects of Monetary Incentives on the Response Rate and Cost-Effectiveness of a Mail Survey." *Journal of the Market Research Society, Market Research Society*, 33(3), 229-241.

Burch, J. G. (1992). *Systems Analysis, Design, and Implementation*, Boyd and Fraser, Boston, MA.

Burch, J. G., and Grudnitski, G. (1989). *Information Systems Theory and Practice*, John Wiley and Sons, NY.

Chatterjee, S., and Hadi, A. S. (2006). *Regression Analysis by Example*, Wiley-Interscience, Hoboken, NJ.

Chin, W. W., and Todd, P. A. (1995). "On the Use, Usefulness, and Ease of Use of Structural Equation Modeling in MIS Research: A Note of Caution." *MIS Quarterly, Society for Management Information Systems*, 19(2), 237-246.

Crowley, A. (1999). "Training Treadmill: A Rigorous Plan of End-User Education is Critical to Whipping ERP Systems into Shape." PC Week, Ziff Davis Media, NY, January 4th 1999.

Davenport, T. H. (2000). *Mission Critical : Realizing the Promise of Enterprise Systems*, Harvard Business School Press, Boston, MA.

Davis, F. D. (1989). "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." *MIS Quarterly, Society for Management Information Systems*, 13(3), 318-340.

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. (1989). "User Acceptance of Computer Technology: A Comparison of Two Theoretical Models." *Management Science, INFORMS*, 35(8), 982-1003.

Davis, G. B., and Olson, M. H. (1985). *Management Information Systems: Conceptual Foundations, Structure, and Development*, McGraw-Hill, New York.

DeLone, W. H., and McLean, E. R. (1992). "Information Systems Success: The Quest for the Dependent Variable." *Information Systems Research, INFORMS*, 3(1), 60-95.

DeLone, W. H., and McLean, E. R. (2003). "The DeLone and McLean Model of Information Systems Success: A Ten-Year Update." *Journal of Management Information Systems, M.E. Sharpe, Inc.*, 19(4), 9-30.

Downes-LeGuin, T., Janowitz, P., Stone, R., and Khorram, S. (2002). "Use of Pre-incentives in an Internet Survey." *Journal of Online Research, IMRO*, 1-7.

Ein-Dor, P., and Segev, E. (1978). "Organizational Context and the Success of Management Information System." *Management Science, INFORMS*, 24(10), 1064-1077.

Elarbi, N. (2001). "ERP and Business Continuity." Sungard, Philadelphia, Pennsylvania.

Ewusi-Mensah, K. (1997). "Critical Issues in Abandoned Information Systems Development Projects." *Communications of the ACM, Association for Computing Machinery*, 40(9), 74-80.

Ferratt, T. W., Ahire, S., and De, P. (2006). "Achieving Success in Large Projects: Implications from a Study of ERP Implementations." *Interfaces, INFORMS*, 36(5), 458-469.

Fishbein, M., and Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*, Addison-Wesley Publishing Company., Reading, MA.

Gajraj, A. M., Faria, A. J., and Dickinson, J. R. (1990). "A Comparison of the Effect of Promised and Provided Lotteries, Monetary and Gift Incentives on Mail Survey Response Rate, Speed and Cost." *Journal of the Market Research Society, Market Research Society*, 32(1), 141-162.

Gargeya, V. B., and Brady, C. (2005). "Success and Failure Factors of Adopting SAP in ERP System Implementation." *Business Process Management Journal, Emerald Group Publishing*, 11(5), 501-516.

Gefen, D., and Ragowsky, A. (2005). "A Multi-Level Approach to Measuring the Benefits of an ERP System in Manufacturing Firms." *Information Systems Management, Auerbach*, 22(1), 18-25.

Gefen, D., Straub, D. W., and Boudreau, M.-C. (2000). "Structural Equation Modeling and Regression: Guidelines for Research Practice." *Communications of the AIS, Association for Information Systems*, 4(7), 1-79.

George, D., and Mallery, P. (2007). *SPSS for Windows Step by Step: A Simple Guide and Reference 14.0 Update*, Allyn & Bacon, Boston, MA.

Gerbing, D. W., and Anderson, J. C. (1988). "An Updated Paradigm for Scale Development Incorporating Unidimensionality and Its Assessment." *Journal of Marketing Research (JMR), American Marketing Association*, 25(2), 186-192.

Goodhue, D. L. (1995). "Understanding User Evaluations of Information Systems." *Management Science, INFORMS*, 41(12), 1827-1844.

Goodhue, D. L., and Thompson, R. L. (1995). "Task-Technology Fit and Individual Performance." *MIS Quarterly, Society for Management Information Systems*, 19(2), 213-236.

Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (1998). *Multivariate Data Analysis with Readings*, Prentice Hall, Englewood Cliffs, NJ.

Hamilton, S., and Chervany, N. L. (1981). "Evaluating Information System Effectiveness. Part I. Comparing Evaluation Approaches." *MIS Quarterly, Society for Management Information Systems*, 5(3), 55-69.

Hartwick, J., and Barki, H. (1994). "Explaining the Role of User Participation in Information System Use." *Management Science, INFORMS*, 40(4), 440-465.

Hartwick, J., and Barki, H. (2001). "Communication as a Dimension of User Participation." *IEEE Transactions on Professional Communication, IEEE*, 44(1), 21-36.

Intermec. (1999). "Aligning Your Data Collection and ERP Implementation Decisions." Intermec Technologies Corporation

Ives, B., Hamilton, S., and Davis, G. B. (1980). "A Framework for Research in Computer-Based Management Information Systems." *Management Science, INFORMS*, 26(9), 910-934.

Januschkowetz, A. (2001). "Use of Enterprise Resource Planning Systems for Life Cycle Assessment and Product Stewardship," Ph.D. Dissertation, Carnegie Mellon University, Pittsburgh, Pennsylvania.

Kaplan, A. F., and White, G. D. "Incentives in a Business Survey: A Study in Improving Response Rate." *Proceedings of the Survey Research Methods Section, American Statistical Association (2002).*

Kaplan, R. M., and Saccuzzo, D. P. (1993). *Psychological Testing: Principles, Applications and Issues*, Brooks/Cole Publishing, Pacific Grove, CA.

Karahanna, E., Straub, D. W., and Chervany, N. L. (1999). "Information Technology Adoption across Time: A Cross-Sectional Comparison of Pre-Adoption and Post-Adoption Beliefs." *MIS Quarterly, Society for Management Information Systems*, 23(2), 183-213.

Keil, M., Cule, P. E., Lyytinen, K., and Schmidt, R. C. (1998). "A Framework for Identifying Software Project Risks." *Communications of the ACM, Association for Computing Machinery*, 41(11), 76-83.

Keizer, G. (2006). "IRS Gives Away $318 Million Because Of Bungled Software Upgrade " InformationWeek, September 5, 2006.

Keller, E. (1994). "ERP Selection Process: Methodology and Vendor Comparison." Gartner Group.

Kelman, H. C. (1958). "Compliance, Identification, and Internalization: Three Processes of Attitude Change." *The Journal of Conflict Resolution, Sage Publications, Inc.*, 2(1), 51-60.

Kim, K. K. (1988). "Organizational Coordination and Performance in Hospital Accounting Information Systems: An Empirical Investigation." *The Accounting Review, American Accounting Association*, 63(3), 472-489.

Knorr, E. (2005). "Anatomy of an IT disaster: How the FBI blew it " InfoWorld, March 2005.

Koch, C. (2002). "ABC: An Introduction to ERP, Getting Started with Enterprise Resource Planning (ERP)." CIO, March 2002.

Kozak-Holland, M. (2007). "What Determines a Project Success or Failure." Lessons From History.

Lee, S., Arif, A. U., and Jang, H. (2004). "Quantified Benefit of Implementing Enterprise Resource Planning through Process Simulation." *Canadian Journal of Civil Engineering, NRC Canada*, 31, 263-271.

Legris, P., Ingham, J., and Collerette, P. (2003). "Why Do People Use Information Technology? A Critical Review of the Technology Acceptance Model." *Information & Management, Elsevier*, 40, 191–204.

Leonard-Barton, D., and Deschamps, I. (1988). "Managerial Influence in the Implementation of New Technology." *Management Science, INFORMS*, 34(10), 1252-1265.

Li, K. (2006). "Student Preferences for Survey Incentives (Report #366)." Student Affairs Research & Information, UC Davis

Lucas, H. C. (1975). "Performance and the Use of an Information System." *Management Science, INFORMS*, 21(8), 908-919.

Lucas, H. C. (2007). "Research Methods in Information Technology." Lecture in BMGT 808B, University of Maryland, Spring 2007.

Lucas, H. C., and Spitler, V. K. (1999). "Technology Use and Performance: A Field Study of Broker Workstations." *Decision Sciences, the Decision Sciences Institute*, 30(2), 291-311.

Mathieson, K. (1991). "Predicting User Intentions: Comparing the Technology Acceptance Model with the Theory of Planned Behavior." *Information Systems Research, INFORMS*, 2(3), 173-191.

Moore, G. C., and Benbasat, I. (1991). "Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation." *Information Systems Research, INFORMS*, 2(3), 192-222.

Murphy, K. E., and Simon, S. J. (2002). "Intangible Benefits Valuation in ERP Projects." *Information Systems Journal, Blackwell Science Ltd.*, 12(4), 301-320.

Nelson, R. R., and Cheney, P. H. (1987). "Training End users: An Exploratory Study." *MIS Quarterly, Society for Management Information Systems*, 11(4), 547-559.

O'Brien, J. A. (2004). *Management Information Systems: Managing Information Technology in the Business Enterprise*, McGraw-Hill/Irwin, Boston.

O'connor, J. T., and Dodd, S. C. (2000). "Achieving Integration on Capital Projects with Enterprise Resource Planning Systems." *Automation in Construction, Elsevier*, 9, 515-524.

O'Leary, D. E. (2000). *Enterprise Resource Planning Systems: Systems, Life Cycle, Electronic Commerce, and Risk*, Cambridge University Press, Cambridge ; New York.

Paolillo, J. G. P., and Lorenzi, P. (1984). "Monetary Incentives and Mail Questionnaire Response Rates." *Journal of Advertising, M.E. Sharpe, Inc.*, 13, 46-48.

Perry, W. E. (1992). "Quality Concerns in Software Development: The Challenge Is Consistency." *Information Systems Management, Auerbach*, 9(2), 48-52.

Pinto, J. K., and Slevin, D. P. (1987). "Critical Factors in Successful Project Implementation." *IEEE Transactions on Engineering Management, IEEE*, EM34(1), 22-27.

Rogers, E. M. (1983). *Diffusion of Innovations*, The Free Press, New York.

SAP. (1996). "SAP AG: Functions in Detail – PP: R/3_ System. Integrated Manufacturing." SAP AG, Walldorf, Germany

SAP. (1999). "SAP AG: R/3® System: The three-tier client/server architecture at the heart of the R/3 System." SAP AG, Walldorf, Germany.

SAP. (2004). "Strategies for Profitable Growth: Engineering, Construction and Operations Industry." SAP AG, Walldorf, Germany.

SAP. (2005). "SAP Annual Report 2004 - Investing in Success." SAP AG, Walldorf, Germany.

Schlag, P. V. (2006). "IT Business Analyst: Delivering Benefits to the Enterprise." *Certification Magazine, MediaTec Publishing, Inc. September 2006*, 8(9), 30-35.

Schultheis, R. A., Sumner, M., and Bock, D. B. (1992). *Management Information Systems: the Manager's View*, Irwin, Homewood, IL.

Shang, S., and Seddon, P. B. (2000). "A Comprehensive Framework for Classifying the Benefits of ERP Systems." *Proceedings of Americas Conference on Information Systems*.

Shenhar, A. J., Tishler, A., Dvir, D., Lipovetsky, S., and Lechler, T. (2002). "Refining the Search for Project Success Factors: A Multivariate, Typological Approach." *R&D Management, Blackwell Publishers Ltd.*, 32(2), 111-126.

Shi, J. J., and Halpin, D. W. (2003). "Enterprise Resource Planning for Construction Business Management." *Journal of Construction Engineering and Management, ASCE*, 129(2), 214-221.

Sirkin, R. M. (1999). *Statistics for the Social Sciences*, Sage Publications, Thousand Oaks, CA.

Srinivasan, A. (1985). "Alternative Measures of System Effectiveness: Associations and Implications." *MIS Quarterly, Society for Management Information Systems*, 9(3), 243-253.

Stein, T. (1998). "Dell Takes 'Best-Of-Breed' Approach In ERP Strategy." *InformationWeek, May 11th 1998*.

Stensrud, E., and Myrtveit, I. (2003). "Identifying High Performance ERP Projects." *IEEE Transactions on Software Engineering, IEEE*, 29(5), 398-416.

Teo, H. H., Wei, K. K., and Benbasat, I. (2003). "Predicting Intention to Adopt Interorganizational Linkages: An Institutional Perspective." *MIS Quarterly, Society for Management Information Systems*, 27(1), 19-49.

Thompson, R., Barclay, D. W., and Higgins, C. A. (1995). "The Partial Least Squares Approach to Causal Modeling: Personal Computer Adoption and Use as an Illustration." *Technology Studies: Special Issue on Research Methodology*, 2(2), 284-324.

Umble, E. J., and Umble, M. M. (2002). "Avoiding ERP Implementation Failure." *Industrial Management, Industrial Management Society*, 44(1), 25-33.

Varon, E. (2004). "No Easy IT Fix for the IRS." CIO, April 2004.

Venkatesh, V., and Davis, F. D. (2000). "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies." *Management Science, INFORMS*, 46(2), 186-204.

Vessey, I. (1991). "Cognitive Fit: A Theory-Based Analysis of the Graphs Versus." *Decision Sciences, the Decision Sciences Institute*, 22(2), 219-240.

Warriner, K., Goyden, J., Gjertsen, H., Hohner, P., and McSpurren, K. (1996). "Charities, No; Lotteries, No; Cash, Yes: Main Effects and Interactions in a Canadian Incentives Experiment." *Public Opinion Quarterly, University of Chicago Press*, 60, 542-562.

Wilder, C., and Davis, B. (1998). "False Starts, Strong Finishes." *InformationWeek, November 30th 1998*, 41-53.

Wilk, R. J. (1993). "The Use of Monetary Incentives to Increase Survey Response Rates." *Social Work Research & Abstracts, National Association of Social Workers*, 29(1), 33-34.

Worthen, B. (2002). "Nestle's ERP Odyssey." *CIO Magazine, May 15th 2002*.

www.oracle.com. (2005).

www.oracle.com. (2006).

www.oracle.com. (2007).

www.sap.com. (2007).