Research Article

Factors Affecting the Success of Enterprise Resource Planning Systems in Thailand

Graham Kenneth Winley* and Supavadee Nontakao

Faculty of Science and Technology, Assumption University, Thailand
**Corresponding author. Email address: gkwinley@scitech.au.edu*

Received June 6, 2014; Accepted October 22, 2014

Abstract

This exploratory study compares factors which according to previous studies affect the success of the development, implementation, adoption, and use of Enterprise Resource Planning systems (ERP) in organizations. Six factors organized in two categories (*Characteristics of Users and the System* and *Organizational Issues and System Development Approaches*) were decomposed into 73 associated indicators. Data related to the indicators was collected by questionnaire from a sample of 211 stakeholders with experience with ERP used in organizations in Thailand. Although the results confirmed many findings reported in previous studies important differences were found between male and female stakeholders as well as between those working in IT and non IT positions. In addition, compared to previous studies less emphasis than expected was given to the importance of characteristics of the organization, characteristics of users, change management activities, and aspects of system development and implementation. The findings are of particular importance to ERP project leaders/members, users, and vendors in Thailand.

***Key Words*:** Characteristics of organizations, the system, and users, usage; Change management; Systems development and implementation

Introduction

This study examined factors which affect the success of the development, implementation, adoption, and use of ERP in organizations. ERP address structured problems with benefits derived mainly from their integration and tracking of transactions and activities across the organization's supply chain involving processes used to manage the supply of materials/services and the production and distribution of products and services typically involving the management of orders, inventory, finances, and human resources (Avison and Fitzgerald, 2003; Leon, 2010). While ERP systems provide integrated data and data analysis tools to support operational level decision making organizations have had less success in using them for decision making involving unstructured problems (White, 1999; Roberts-Witt; 1999; Adam, 2001; McAfee, 2003).

Eierman et al. (1995) proposed three categories of factors for studying the success of ERP and similar to the study by Ittiphaisitpan (2011) two of these were used in this study: *Characteristics of Users and the System*; and *Organizational Issues and System Development Approaches*. The third category used by Eierman et al. (1995) was *Technical Issues* concerned with the construction of the software such as: mathematical modeling; data analysis techniques; computer algorithms; software building and testing; and data access and storage technologies. Factors in this category were not examined because, as noted in several studies, they are not the main concerns in determining the success of the development, implementation, adoption, and

Table 1 Categories and factors examined in the study

Category	Factors	Number of Indicators
Characteristics of Users and the System	Characteristics of the System	12
	Characteristics of Users	19
	System Usage	3
Organizational Issues and System Development Approaches	Characteristics of Organizations	5
	Change Management Activities	9
	Systems Development and Implementation	25
	Total Number of Indicators	73

use of ERP while the factors in the two selected categories play a much more important role (Setzekorn et al., 2002; Avison and Fitzgerald, 2003; Duplaga and Astani, 2003; Ittiphaisitpan, 2011).

Table 1 lists the factors associated with the two categories. These were derived mainly from Eierman et al. (1995) supported by other studies (Adams et al., 1992; DeLone and McLean, 1992; Goodhue and Thompson, 1995; Falkowski et al., 1998; Aladwani, 2001; Ahituv et al., 2002; Abdinnour-Helm et al., 2003; McAfee, 2003; Umble et al., 2003; Ittiphaisitpan, 2011; Duangekanong, 2014). These factors were decomposed into 73 indicators based on the findings from previous studies which are identified in the section below on Related Literature.

The study was motivated by the following concerns: **(a)** ERP are difficult and expensive to implement and it is important to understand their important characteristics and the perspectives of different stakeholders (Ittiphaisitpan, 2011). In particular, the increased adoption of ERP has lead to a situation where there are large numbers of users and IT professionals with considerable ERP experience and it is important to know their viewpoints about important success factors for ERP (Appelrath and Ritter, 2000; Gupta, 2000; Shanks and Parr, 2000; Ahituv et al., 2002; Kumar et al., 2002); **(b)** the functionality of ERP has developed rapidly and a perception that ERP play a role in decision support has emerged especially among users (Ittiphaisitpan, 2011). This has implications for the importance of factors related to characteristics of the users as well as the system and these need to be understood (Adam, 2001; Mora et., 2003; Leon, 2010); and **(c)** although several studies have examined success factors for ERP in organizations in technologically developed nations there have been very few studies conducted in developing nations (Bingi et al., 1999; Buckhout et al., 1999; Holland and Light, 1999; Maneesh et al., 1999; Sumner, 1999; Wee, 2000; Nah et al., 2001; Duplaga and Astani, 2003; Sarker and Lee, 2003; Umble et al., 2003; Finney and Corbett, 2007). In Thailand, despite national ICT policies aimed at improved supply chain management and a competitive market with at least 45 ERP vendors (Association of Thai ICT Industry Database), there are very few studies that have addressed the importance of factors which affect the success of the development, implementation, adoption, and use of ERP especially from a perspective that includes the views of different groups of stakeholders (Ittiphaisitpan, 2011; Duangekanong, 2014).

Against this background, previous studies used to identify the indicators for the factors in Table 1 are presented in the next section. The research design and methodology are described in the third section. The results of data preparation and data analyses are presented in the fourth section. The findings of the study are discussed in the fifth section with overall conclusions in the last section.

Related Literature

The focus was on studies published since 1980

that related to the role of ERP in organizations and the factors associated with the two categories in Table 1. Earlier studies of fundamental importance were also included. Based on the findings in these studies each factor in Table 1 was decomposed into a set of indicators. The sets of factors and indicators used in Ittiphaisitpan (2011) were used as a starting point.

Characteristics of Users and the System

Explanations of ERP adoption have been influenced by the technology acceptance model (TAM) derived from models in social psychology which assume that intention operates prior to every behavior (Davis, 1989). In the TAM the degree to which a user believes that ERP enhances their work performance (perceived usefulness) and the degree to which a user believes that ERP are easy to use (perceived ease of use) determine the user's attitude toward the system and their intention to use the system. In Table 2 the 12 indicators for the factor ***Characteristics of the System*** are associated with these TAM constructs (Kieras and Polson, 1985; Polson, 1987; Robertson, 1989; Venkatesh and Davis, 2000; Ramayah and Lo, 2007). The three indicators for the factor ***System Usage*** (frequency of use, duration of use, and percentage of work done using the system) have been used frequently as predictors of system success (DeLone, 1988; DeLone and McLean, 1992).

The factor **Characteristics of Users** was decomposed into 19 indicators. Computer based systems should be flexible and adaptable to the different cognitive styles of users (Aldag and Power, 1986; Lu and Yeh, 1998). Cognitive style has been analyzed using different classification schemas. For example, according to adaptive-innovation theory (Kirton, 1976) a person's cognitive style in problem solving or decision making can range from adaptive to innovative. The effectiveness of adopting decision rules comes from a reduction in inconsistencies in unaided decision making due to the impact of irrelevant information. However, as problems become more complex insight and intuition may be used more effectively with the aid of a computerized system but users need to perceive that the system is easy to use (Daft and Lengel, 1986; Raymond et al., 1998; Kleinmuntz, 1990).

Experienced decision makers have a deeper understanding of problem characteristics and solution qualities than those with less experience and they use more direct and effective approaches (Mackey and Elam, 1992). Fenichel (1981) found that decision making performance was affected by both searching experience and experience with a technology. In addition, decision performance is influenced by age, education, and previous work experience (Benbasat and Dexter, 1982, Ramamurthy et al., 1992). Older decision makers seem to perform better than their younger counterparts even though they may take more time to make decisions (Taylor, 1975). According to Swink (1995) those with a more analytically oriented background will make better decisions than others. Older and less educated users, particularly males, have been observed to display less positive attitudes toward computers (Lucas, 1978). Powell et al. (1995) suggested that male and female managers differ with respect to their cognitive abilities, problem solving motivation, risk attitudes, confidence, and their decision styles.

Table 2 lists the factors and indicators with references in the category *Characteristics of Users and the System*.

Organizational Issues and System Development Approaches

Little (1970) observed that the development of technologies was not the main problem but instead it was having managers able to incorporate the appropriate use of technologies in their organization. Too many managers do not understand the relationship between technologies and the organization's mission, strategies, objectives, and their impact on operations. In organizations with a high level of maturity in using technology there is a much clearer understanding of these relationships. Jiang et al. (2000) reported that user resistance was one of the reasons for information systems failure and Davenport (1998) emphasized the organizational impact of an ERP which imposes its own logic on

Table 2 Characteristics of Users and the System: factors and indicators

Factors and Indicators	Reference
Characteristics of Users defined as characteristics that influence a user's system use, decision performance, and decision making time (Lu and Yeh, 1998).	
Ability to:	
Learn new skills and knowledge	Fishbein and Ajzen, 1975
Analyze quantitative information	Lu and Yeh, 1998
Analyze qualitative information	Benbasat and Dexter, 1982
Reason heuristically	Swink, 1995
Make judgments and decisions	Raymond et al., 1998
Adopt rules	Bagchi et al., 2003
Understand the context of a problem	Davis and Venkatesh, 2004
Deal with uncertainty	Amoako-Gyampah and Salam, 2004
Deal with ambiguity	Terzi and Cavalieri, 2004
Experience:	
In current work position	Jiang et al., 2000
In previous work positions	Bagchi et al., 2003
With computer based systems	Davis and Venkatesh, 2004
The user's:	
Age	Davis and Venkatesh, 2004
Gender	Terzi and Cavalieri, 2004
Level of education	Benbasat and Dexter, 1982
Type of education	Amoako-Gyampah and Salam, 2004
Communication skills	Fishbein and Ajzen, 1975
Interpersonal skills	Fishbein and Ajzen, 1975
Teamwork skills	Davis and Venkatesh, 2004
Characteristics of the System defined as psychological states reflecting the affective or evaluative feelings of the users concerning particular aspects of the system (Adams et al., 1992; McAfee, 2003; Umble et al., 2003).	
The usefulness of:	
System functions	Bagchi et al., 2003Barki and Hartwick, 1994
System output	Setzekorn et al., 2002
User documentation	Malhotra and Galletta, 1999
Help support	Mandal and Gunasekaran, 2003
The performance of the system.	Davis, 1989
Personal gains from using the system	Dishaw and Strong 1999
Ease of:	
Interaction with the system	Umble et al., 2003
Learning to use the system	Amoako-Gyampah, 2007
Time taken to learn the system	Wixom and Todd, 2005
The system's impact on:	
Increasing job security	Wixom and Todd, 2005
Improving the individual's work procedures	Venkatesh et al., 2003
Increasing the individual's job satisfaction	Wixom and Todd, 2005

Table 2 Characteristics of Users and the System: factors and indicators (cont.)

Factors and Indicators	Reference
System Usage defined as the duration and frequency of systems use and the proportion of the user's work done with the system (Goodhue and Thompson, 1995).	
System Usage:	
Frequency	Goodhue and Thompson, 1995
Duration	Davis, 1989
Percentage of work done with the system	DeLone and McLean, 1992

Note: As described in the Research Design and Methodology section underlined indicators were measured on different scales to the other indicators in the study questionnaire.

the organization's strategy and culture. The factor ***Characteristics of Organizations*** was decomposed into five indicators representing the organization's: mission and strategy; IT strategy; maturity in using IT; scope of activities; and financial position.

The factor ***Change Management Activities*** was decomposed into nine indicators related to building user acceptance of ERP and a positive employee attitude (Holland and Light, 1999; Ross and Vitale, 2000; Shanks and Parr, 2000; Kumar et al., 2002; Abdinnour-Helm et al., 2003). Wood and Caldas (2001) emphasized that in planning an ERP project it must be regarded as a change management initiative rather than an IT initiative. Finney and Corbett (2007) noted that in an ERP project change management is extremely important because, although many strategies may be proposed, strategies alone are not sufficient and important questions must be answered (*What tactics are required?, Are there different stakeholder views of tactics?, and How do influences like power, control, and resistance impact the selection of tactics?*).

Davenport and Short (1990) suggest that IT should be thought of in terms of how it supports new or redesigned business processes, and business processes and process improvements should be based on the capabilities provided by IT. This approach is referred to as industrial engineering, business process redesign, process reengineering, or process innovation and it is an enabler of organizational transformation (Davenport, 1993; Davidson, 1993; Hammer and Champy, 1993; Venkattaman, 1994). An ERP may be viewed as a process management tool and its implementation affects the whole enterprise and always requires work flow redesign (Davenport, 1998; Umble et al., 2003).

The factor ***Systems Development and Implementation*** was decomposed into 25 indicators. According to Eierman et al. (1995) operational systems such as ERP are usually developed using a traditional structured systems development life cycle approach rather than evolutionary, incremental, or small releases approaches which are better suited to developments where there are less structured requirements (Paulk, 2001). Bailey (1998) promoted the use of an iterative evolutionary method for the development of enterprise-wide information systems but success was very dependent on careful planning for resources such as time and finances. Customized frameworks involve the selection and use of compatible methods, techniques, and tools based on the characteristics of the project and this provides developers with increased flexibility compared to using a single methodology (Avison and Fitzgerald, 2003). Computer aided system engineering (CASE) tools provide support across a range of methods and techniques used in most approaches to systems development and they are useful for ERP projects (Umble et al., 2003).

An important part of building user acceptance of ERP involves securing the support of opinion leaders throughout the organization and team leaders need to negotiate between political turfs (Aladwani, 2001;

Skok and Legge, 2002). Prior to the start of the project a business plan is critical to outline the proposed strategic and tangible benefits, resources, costs, risks, and a timeline. This keeps a focus on the business benefits and a model of how the organization will operate after the implementation is essential (Falkowski et al., 1998; Holland and Light, 1999; Wee, 2000).

Vendor support is important for ERP and includes three dimensions (the vendor's service response time, qualified consultants with knowledge of the organization's business processes and IT, and the vendor's level of participation in the ERP project). ERP are not implemented as one time or phased projects like other information systems. An ERP is not just a project it is a "way of life" and the parameters of ERP are related with enterprise system security management. ERP are mission critical and rely on database backup and recovery procedures and they have a business process orientation which relies on role based security. Given the common practice of outsourcing of systems development the management of the relationships between the organization and vendors is very important for ERP as these systems are highly complex, wide in scope, and strategic to the organization (Ahituv et al., 2002). Organizations that are implementing ERP have to cope with a host of different stakeholders inside and outside the organization. Thus, organizations need to develop good relationships with stakeholders to enhance rapid communication and exchanges (Scott and Lane, 2000; Friedman and Miles, 2002). For ERP implementation top management support (i.e. the willingness of senior managers to provide the necessary resources and authority or power for project success) has been consistently identified as the most crucial success factor (Welti, 1999). Project managers must receive approval from top management and the project team should be cross-functional and include the best people in the organization (Laughlin, 1999; Wee, 2000). Successful ERP implementation calls for strong leadership, a clear plan, and a constant watch on the budget. Because many ERP implementations are oversold on the time required for implementation and on how quickly the benefits will appear project team members must agree before the project starts on the scope of the project, the goals, and expectations and these issues need to be monitored (Wagle, 1998; Mandal and Gunasekaran, 2003).

Table 3 lists the factors and indicators with references in *the Organizational Issues and System Development Approaches* category.

Research Design and Methodology

This quantitative field study was exploratory and cross-sectional in design. The unit of analysis was an individual with experience with ERP and related information systems used by organizations to manage supply chain processes and activities. Because of the substantial level of investment required for ERP the organizations were at least medium in size with at least 50 employees. Judgmental sampling was used with two directories as sampling frames (ICT Ministry Organizations Database and Association of Thai ICT Industry Database) from which it was estimated that there were at least 45 ERP vendors operating in Thailand and at least 45 appropriate ERP user organizations. Among these 90 organizations it was estimated that there were on average 10 individuals who had the expertise required to provide valid and reliable responses to the study questionnaire items. Consequently, with an estimated population size of 900 individuals and using a precision of 5 percent and a 95 percent confidence interval the minimum sample size for the study was determined as 277 (https://edis.ifas.ufl.edu/pd006). Hence, it was expected that an adequate sample of 270 participants could be obtained based on three participants from each of these 90 organizations.

A questionnaire was used to collect data from the participants. The questionnaire design was checked by a focus group of six professionals with ERP experience. Their comments were incorporated in a Thai language version which was used in a pilot study with 10 individuals with ERP experience. No further modifications were required so the Thai

Table 3 *Organizational Issues and System Development Approaches*: factors and indicators

Factors and Indicators	Reference
Characteristics of Organizations defined as characteristics of the organization in which the computer based system is implemented (Umble and Umble, 2002).	
The organization's:	
Mission and strategy	Mandal and Gunasekaran, 2003
IT strategy	McAfee, 2003
Maturity in using IT	Glass, 1998
Scope of activities	Umble et al., 2003
Financial position	Umble and Umble, 2002
Change Management Activities defined as the preparation of a formal change management program (Nah, et al., 2001; Kuruppuarachchi et al., 2002).	
Managing changes to:	
Organizational roles and structures	Krovi, 1993
Communications	Bingi et al., 1999
Training and education	Santhanam et al., 2000
Performance management	Setzekorn et al., 2002
Management practices	Mandal and Gunasekaran, 2003
Determining the costs of:	
Existing processes	Guimaraes and Bond , 1996
New processes	Taylor, 1998
Modeling and designing processes	Umble et al., 2003
Redesigning and re-engineering processes.	Wu and Wang, 2006
Systems Development and Implementation defined by a planned approach based on compatible strategies, the methods, the techniques, and the tools used to implement a computer based system (Avison and Fitzgerald, 2003).	
Using:	
A traditional systems development life cycle	Lucas, 1978
An incremental/evolutionary	Gazmuri and Maturana, 2001
Small releases	Paulk, 2001
Customized frameworks for development	Avison and Fitzgerald, 2003
Modeling:	
Processes	Walsham, 1993
Data	Sabherwal and Robey, 1995
Using:	
Prototyping tools	Guimaraes and Bond , 1996
CASE tools	Ross and Vitale, 2000
Project management software and tools	Avison and Fitzgerald, 2003
Support from the:	
Organization's senior management	Setzekorn et al., 2002
IT department	Setzekorn et al., 2002
Vendors/suppliers	Mandal and Gunasekaran, 2003

Table 3 *Organizational Issues and System Development Approaches*: factors and indicators (cont.)

Factors and Indicators	Reference
Involvement of:	
Users	McAfee, 2003
Other stakeholders	Umble et al., 2003
An effective project:	
Manager	Mandal and Gunasekaran, 2003
Project team	Setzekorn et al., 2002
A clear definition of:	
Project goals	Ahituv et al., 2002
System requirements	Setzekorn et al., 2002
The delivery of system capabilities	Avison and Fitzgerald, 2003
Quality assurance of the system	Ross and Vitale, 2000
System security	Avison and Fitzgerald, 2003
Technical systems documentation	Paulk, 2001
Systems maintenance.	Umble et al., 2003
Completion time	Ross and Vitale, 2000
Adhering to the project budget.	Roberts-Witt, 1999

Note: As described in the Research Design and Methodology section underlined indicators were measured on different scales to the other indicators in the study questionnaire.

language version was then used in the full study. A summarized English language version is included in Appendix A1.

In order to strengthen the validity and reliability of the responses the participants were required to: **(a)** have at least 5 years work experience; **(b)** hold at least a bachelor degree qualification; and **(c)** have helped to develop/implement and/or have user experience with at least 10 of a selection of 16 systems representative of the modules typically implemented in ERP. Questions used to screen participants according to these limitations and to collect other personal information (gender, current professional position, and level of education) were included in Section 1 of the questionnaire. Section 2 included questions about the 73 indicators for the factors shown in Tables 2 and 3 above. Eight of the indicators (underlined in Tables 2 and 3) were measured in questions 1 – 8 and the other 65 were measured by asking respondents to indicate their level of importance for the success of an ERP using a 5-point Likert scale ranging from *unimportant* (1) to *very important* (5). All of the questions in section 2 were measured on scales where the midpoint was interpreted as a *neutral* point which indicated that a respondent did not have an opinion represented by points in either direction from this *neutral* value.

The limitations on the participants, an introduction to the purpose of the study/ questionnaire, and contact details were forwarded to each of the 90 organizations. After a deadline and a reminder to some organizations 220 responses were obtained. These were screened to remove a total of nine questionnaires (missing answers (1); respondents without at least 5 years work experience (3); respondents without at least a bachelor degree qualification (2); and respondents without the required experience with the specified systems (3)). Consequently, the final sample size was 211.

Data Analysis

Data entry was checked using a random selection of 21 (10 percent) of the questionnaires and no errors were found. There were no outliers among the

distributions of the responses to the questions about the indicators (Questionnaire Section 2, Q1- Q9).

Appendix Tables A1(a) and (b) show the results of analyzing information about the participants in the study (Questionnaire Section 1, Q1- Q6). From Table A1(a) it is seen that there are almost equal numbers of males and females. On average, their age is 38 years, they have 13 years of professional experience, and the majority holds a master degree qualification. There are almost equal numbers of IT and other professionals and in both of these categories the majorities hold positions above the entry level of officer. From Table A1(b) it is seen that across 16 information systems there were seven where most of the participants did not have experience in the development/use of the systems. This was expected because these 16 systems cover a wider range of applications than most individuals would experience in their workplaces. However, as required all of the participants had experience in the development/use of at least 10 of the 16 systems.

The information about the participants collected in Questionnaire Section 1, Q1- Q6 was cross tabulated with the gender of the respondents and with their current professional position classified as IT or not IT. Based on contingency coefficients (Siegal and Castellan, 1988) the only significant findings ($p < 0.05$) were: (a) among the 35 offices who were not in IT positions 94 percent were females; (b) among the 93 participants with only 5-10 years work experience 61 percent were females; and (c) 59 percent of those in IT positions held a master degree compared to only 36 percent of those not in IT positions and this result was reversed for those holding a bachelor degree.

Consequently, taking account of the characteristics of the 211 participants it was considered that they represented a broad cross-section of the stakeholders and that they had appropriate: experience with information systems; professional status and work experience; levels of education; and maturity to enable them to provide valid and reliable responses to the questionnaire.

Descriptive statistics (mean, standard deviation, skewness, and kurtosis) were computed for the distributions of the importance ratings for the 65 indicators in the Questionnaire Section 2, Q9 as shown in Appendix Table A2. All of the standard deviations were less than 1 which indicated that the means were appropriate measures of the average importance ratings. The measures of skewness and kurtosis were within acceptable limits of 3 and 7, respectively, which validated the use of t-tests used to test for statistically significant differences ($p < 0.05$) between the means and **(a)** the *neutral* value of 3 on the measurement scales and **(b)** the value 4 on the scales. The means for all of the 65 indicators were greater than the *neutral* value of 3 and only a user's *ability to learn new skills and knowledge* had an importance rating which was not significantly greater than 3. Although five indicators had mean values greater than 4 none were significantly greater than 4.

Based on the mean values of the importance ratings the indicators were ranked in order of importance from 1 (*most important*) to 65 (*least important*). These ranks were classified as high (H), medium (M), or low (L) according to whether the rank was in the top, middle, or bottom third of the distribution of the ranks, respectively. The results are displayed in Appendix Table A2. The distributions of the factors/indicators according to their type of rank (H, M, or L) and characteristics of these distributions are shown in Table 4.

In Table 4 if the indicators for each factor were distributed uniformly across the three types of ranks then it would be expected that one third of the indicators would be of each type. If the indicators for each factor were uniformly distributed within each type of rank then it would be expected that one fifth of the indicators would be of that type. In Table 4 in order to highlight noticeable differences from these expected proportions the percentages in plain (italic) bold type are more than 10 percent greater (less) than the expected proportions.

Kendall's rank order correlation coefficient (Siegal and Castellan, 1988) was used to examine the level of agreement among the rankings of indicators by: (a) male and female respondents; and (b) respondents in IT positions and those not in IT

Table 4 The distribution of indicators by type of rank

Factors	Ranking of the Indicators		
	High	Medium	Low
Characteristics of the System	***The usefulness of :*** System functions System output The performance of the system ***Ease of:*** Interaction with the system Learning to use the system ***The system's impact on:*** Increasing the individual's job security Improving the individual's work procedures	***The usefulness of:*** User documentation Help support Personal gains from using the system The system's impact on increasing the individual's job satisfaction	Nil
Characteristics of Users	Teamwork skills	Nil	***Ability to:*** Learn new skills and knowledge Analyze quantitative information Analyze qualitative information Reason heuristically Make judgments and decisions Adopt rules Understand the context of a problem Deal with uncertainty Deal with ambiguity Experience in current position Previous work experience Experience with computer based systems Level of education Type of education Communication skills Interpersonal skills
Characteristics of Organizations	Financial position	IT strategy Scope of activities	Mission and strategy Maturity in using IT

Table 4 The distribution of indicators by type of rank (cont.)

Factors	Ranking of the Indicators		
	High	Medium	Low
Change Management Activities	Nil	***Managing changes to:*** Organization roles and structures Training and education Performance management Management practices ***Determining the costs of:*** Existing processes New processes Modeling and designing processes Redesigning and re-engineering processes	Managing changes to communications
Systems Development and Implementation	Using a traditional systems development life cycle Modeling processes Support from the organization's senior management Support from the IT department Involvement of users Involvement of other stakeholders Project management software and tools An effective project manager An effective project team A clear definition of project goals Quality assurance of the system System security Technical systems documentation	Using customized frameworks for development Modeling data Support from the vendors/ suppliers The delivery of system capabilities Systems maintenance Adhering to the project budget	An incremental/evolutionary methodology A small releases methodology Prototyping tools CASE tools

Table 4 The distribution of indicators by type of rank (cont.)

Distributions of Indicators Across/Within Types of Ranks						
Factors (Number of Indicators)	Distribution Across the Types of Rank (Percentage)			Distribution Within Each Type of Rank (Percentage)		
	High	Medium	Low	High	Medium	Low
Characteristics of the System (11)	***64***	*36*	***0***	***32***	*20*	***0***
Characteristics of Users (17)	***6***	***0***	***94***	***4.5***	***0***	***70***
Characteristics of Organizations (5)	***20***	*40*	*40*	***4.5***	*10*	***9***
Change Management Activities (9)	***0***	***89***	***11***	***0***	***40***	***4***
Systems Development and Implementation (23)	***57***	*26*	***17***	***59***	*30*	*17*

positions. In both cases the level of agreement was statistically significant ($p < 0.05$).

Results of the analyses of the responses to the questions related to the other eight indicators (Questionnaire Section 2, Q1 – Q8) are shown in Appendix Table A3. For these eight indicators t-tests were used to examine differences between the means and the *neutral* value of 3 on the measurement scales as well as differences in the level of success in using ERP associated with the age and gender of the users. In addition, for these eight indicators as well as the other 65 indicators (Questionnaire Section 2, Q9) t-tests were used to examine differences between the means for: (a) male and female respondents; and (b) respondents in IT positions and those not in IT positions. The results of all of these t-tests where there were significant differences ($p < 0.05$) are described in Table 5.

Discussion

None of the 65 indicators that were rated in terms of their level of importance for the success of the development, implementation, adoption, and use of ERP were found to be unimportant to any extent and this confirmed the findings in previous studies from which they were derived. In addition, ERP were found to be used frequently for tasks of short duration that accounted for about 65 percent of a user's work load. Users needed a short period of time to learn how to use an ERP and, although males and females used ERP successfully, females were considered to have more success than males. Individuals less than 35 years of age were considered to be more successful in using ERP than older users. These findings are compatible with a situation in organizations in Thailand where younger individuals, mainly females in junior officer positions, working on repetitive tasks of fairly short duration are using ERP more often and more successfully than older male employees working in more senior positions with different types of tasks. The requirements for an ERP were considered to be easy to determine probably because of the structured nature of the requirements which are closely related to transaction processing. In agreement with the findings in many studies the time needed to complete an ERP implementation was considered to be normally underestimated which reflects the wide scope and complexity of ERP implementations.

Among the indicators there were some where male and female respondents had different opinions. Previous studies have identified communication and interpersonal skills as being important for ERP users and the female participants in this study considered these skills to be more important than the males. Female participants gave greater importance than males to the role of ERP in improving their work performance and increasing their job security. Compared to the males the females gave greater emphasis to the importance of the performance and quality assurance of ERP, the time needed to learn about ERP, and the time taken to complete tasks using ERP. Also, females emphasized more than males the need for effective ERP project teams and the use of project management software tools. It is likely that in organizations in Thailand females have

Table 5 Summary of the results of t-tests

Factor/Indicator	Results of T-tests
Characteristics of the System	
The *performance of the system*	Females considered the performance of the system to be significantly more important for the success of ERP than males.
The amount of *time taken to learn the system*	The amount of time it takes users to learn the system is significantly less than a *neutral* level. Males consider the amount of time it takes users to learn the system is significantly less than females. Respondents not in IT positions considered the amount of time taken to learn the system was significantly less than respondents in IT positions.
The system's impact on *increasing job security*	Females considered the system's impact on increasing job security to be significantly more important for the success of ERP than males.
The system's impact on *improving the individual's work procedures*	Females considered the system's impact on improving the individual's work procedures to be significantly more important for the success of ERP than males.
Characteristics of Users	
The *age* of ERP users and their success in using ERP	Users of age less than 35 years have significantly more than a *neutral* level of success in using ERP. Users of age less than 35 years have significantly more success in using ERP than users of age 35 years or more.
The *gender* of ERP users and their success in using ERP	Males and females both have significantly more than a *neutral* level of success in using ERP. Females have significantly more success in using ERP than males.
The user's ability to *make judgments and decisions*	Respondents not in IT positions considered that the user's ability to make judgments and decisions was significantly more important than respondents in IT positions.
The user's *communication skills*	Females considered communication skills to be significantly more important for the success of ERP than males. Respondents not in IT positions considered that communications skills were significantly more important for the success of ERP than respondents in IT positions.
The user's *interpersonal skills*	Females considered interpersonal skills to be significantly more important for the success of ERP than males.
System Usage	
The *frequency* of ERP usage	The frequency of use is significantly greater than a *neutral* level.

Table 5 Summary of the results of t-tests (cont.)

Factor/Indicator	Results of T-tests
System Usage (cont.)	
The *duration* of ERP usage	The amount of time it takes users to complete tasks with ERP is significantly less than a *neutral* level of duration.
	Males consider the amount of time it takes users to complete tasks with ERP to be significantly less than females.
The *percentage of work done* with the system	The percentage of work done with the system is significantly greater than 50 percent (65 percent approximately).
Systems Development and Implementation	
Using *project management software and tools*	Females considered using project management software and tools to be significantly more important for the success of ERP than males.
An effective project team	Females considered an effective project team to be significantly more important for the success of ERP than males.
The amount of *difficulty in determining system requirements*	The amount of difficulty in determining system requirements is significantly less than a *neutral* level.
Quality assurance of the system	Females considered quality assurance of the system to be significantly more important for the success of ERP than males.
The level of *success in estimating the completion time* of an ERP implementation	There is a significant tendency to underestimate the completion time for the development and implementation of the system.

come to these understandings based on their greater exposure to ERP because, as noted above, females are using ERP more often and more successfully than males. These differences due to gender were observed less often in studies conducted in technologically developed nations.

There were very few differences between the opinions of respondents who worked in IT positions and those who worked in other positions. Compared to the IT professionals those not in IT positions considered the amount of time needed to learn the system was significantly less and that the user's communication skills and their ability to make judgments and decisions were significantly more important. These findings reflect the IT professional's more detailed knowledge about the technical complexity of the system and its functions and the non IT professional's more practical understanding of the required user centered skills. These findings are compatible with those from studies conducted in technologically developed nations.

None of the indicators were rated as unimportant for the success of ERP but the ranking of the indicators provided insights into noticeable differences in their relative importance:

(a) The vast majority of the indicators (91 percent) that were ranked high were associated with only two of the factors *Systems Development and Implementation* (59 percent) and *Characteristics of the System* (32 percent) and for both factors most of

their indicators (57 percent and 64 percent, respectively) were ranked high. In particular, none of the indicators associated with the factor *Change Management Activities* were ranked high. Based on findings from studies in technologically developed nations it was expected that change management activities would have been ranked highly. This is of concern for organizations in Thailand since it is well recognized that successful ERP implementation requires a thorough review of existing business processes and often the need to reengineer these processes.

(b) In contrast, 70 percent of the indicators that were ranked low were associated with *Characteristics of Users* and these accounted for 94 percent of the indicators for this factor. *Characteristics of Users* are normally found to be more important in studies conducted in technologically developed nations. In particular, none of the indicators associated with the factor *Characteristics of the System* were ranked low, which is usually the case in studies conducted in technologically developed nations.

(c) The indicators ranked medium were associated mainly with the factor *Change Management Activities* (40 percent) and these accounted for 89 percent of the indicators for this factor. In particular, none of the indicators for *Characteristics of Users* were ranked medium.

(d) There was significant agreement about the ranking of the indicators between male and female respondents and between those working in IT positions and those working in other positions.

In terms of specific indicators a number of those ranked high were in line with results from previous studies and were concerned with: the support and involvement of a wide range of stakeholders; the importance of sound project management practices; using a traditional systems life cycle approach to development; and the need for attention to system security, technical systems documentation, and modeling organizational processes. In addition, indicators related to TAM constructs (perceived usefulness and perceived ease of use) were among the most important and concerned the usefulness of system functions and outputs, performance of the system, the ease of learning and using the system, and its positive impact on an individual's work performance and job security.

Among the indicators that were ranked low it was surprising to find such a large proportion (70 percent) related to *Characteristics of the Users* concerned with an individual's work experience, their level and type of education, a wide range of problem solving skills, and interpersonal and communication skills. The only user characteristic that was not ranked low was *teamwork skills* and its high ranking was as expected since the ability to work with others using ERP has been identified as being important in previous studies. All of the other user characteristics were reported in previous studies as essential for individuals who operated successfully with technologies where there was an emphasis on unstructured problem solving as a part of decision making. Consequently, the low ranking of these indicators in relation to ERP suggests that, in accordance with McAfee (2003) and Adam (2001), decision support especially involving unstructured problems is not a very important role for ERP in organizations in Thailand and elsewhere even though ERP provide integrated data and data analysis tools to support operational level decision making.

The indicators ranked medium addressed most of the issues concerned with *Change Management Activities* and it was surprising that these indicators were not ranked higher since changes to management practices and business processes and the associated costs have been indentified in numerous studies as being very important in relation to ERP. Also, there were other indicators that from previous studies were expected to be among the most important but they were only ranked medium. These included: adherence to the ERP project budget; systems maintenance and vendor support; and user documentation and help. There was less emphasis than expected on the importance of understanding the organization's IT strategy and its scope of activities, which were only ranked medium, and an

understanding of organization's mission and strategy and maturity in using IT, which were ranked low.

Conclusion

In relation to the concerns which motivated this study as expressed in the Introduction section it was found that:

(a) In general, ERP were considered to be relatively easy to learn and use successfully. ERP are used frequently for tasks of short duration which account for approximately 65 percent of a user's work load. Females under 35 years of age who work in organizations in junior officer positions are the most frequent users. The requirements for these systems are relatively easy to determine due to the structured nature of their functionality but despite this the time taken develop and implement ERP is normally underestimated probably because of their wide scope and complexity.

The involvement and support of stakeholders was very important for the success of ERP. However, there were important differences among stakeholders between males and females and between those in IT positions and those not in IT positions.

Females assigned greater importance than males to: communication and interpersonal skills; the role of ERP in improving their work performance and increasing their job security, the performance and quality assurance of ERP; and the amount of time needed to learn about ERP and to complete tasks using ERP; the need for effective ERP project teams and the use of project management software tools. It is likely that these emphases by females are due to their greater exposure to ERP because compared to males females used ERP more often and with more success.

There were fewer differences between stakeholders who worked in IT positions and those who worked in other positions. Compared to those in IT positions others considered that the amount of time needed to learn ERP was significantly less and a user's communication skills and ability to make judgments and decisions were significantly more important. These findings reflect the IT professional's more detailed technical knowledge about the system and its functions and the non IT professional's more practical understanding of the importance of user centered skills.

(b) The findings suggested that ERP were not used for unstructured problem solving in the manner that Decision Support Systems (DSS) are used. User characteristics required for the successful use of DSS were not emphasized. However, there was sufficient emphasis on these skills to support the findings in other studies that ERP provide integrated data and analysis tools to support operational level decision making.

(c) The findings of the study addressed ERP concerns that have not been addressed in previous ERP studies in organizations in Thailand. Among the findings there were many that were in accordance with the findings of other studies conducted in other contexts. However, as noted in the Discussion section there were findings that were new or unexpected and attention is drawn to these as issues that ERP project leaders/members, users, and vendors in Thailand should recognize in practice. Differences were found between IT and non IT stakeholders as well as between male and female stakeholders. There was less emphasis than expected on most *Characteristics of Users* and *Change Management Activities* as well as indicators related to understanding the organization's mission, strategy, IT strategy, maturity in using IT, and its scope of activities. In addition, adherence to the ERP project budget, systems maintenance and vendor support; and user documentation and help were not emphasized to the extent that was expected on previous studies.

Because this study was mainly exploratory in nature the external validity of the findings can only be tested by repeating the study in Thailand and this is recommended strongly. In addition, further research may examine the importance of factors in relation to particular phases of an ERP systems development life cycle (e.g. development, implementation, maintenance, adoption, and use).

References

Abdinnour-Helm, S., Lengnick-Hall, M. L., and Lengnick-Hall, C. A. (2003) Pre-implementation attitudes and organizational readiness for implementing an enterprise resource planning system. *European Journal of Operational Research* 146: 258-263.

Adam, F. (2001) ERP and its impact on decision making. *Journal of Decision Systems* 10(1).

Adams, D., Ryan, N., and Peter, T. (1992) Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS Quarterly* 16(2): 227-247.

Ahituv, N., Neumann, S., and Zviran, M. (2002) A system development methodology for ERP systems. *Journal of Computer Information Systems* 42(3): 56-67.

Aladwani, A. M. (2001) Change management strategies for successful ERP implementation. *Business Process Management Journal* 7(3): 266-275.

Aldag, R. J. and Power, D. J. (1986) An empirical assessment of computer-assisted decision analysis. *Decision Science* 17(4): 572-588.

Amoako-Gyampah, K. (2007) Perceived usefulness, user involvement and behavioral intention: and empirical study of ERP implementation. *Computer in Human Behavior* 23: 1232-1248.

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

Appelrath, H. and Ritter, J. (2000) *SAP R/3 implementation: Method and tools*, Springer, Germany.

Avison, D. and Fitzgerald G. (2003) *Information systems development methodologies techniques and tools* (3rd edition), McGraw-Hill, New York.

Bagchi, S., Kanungo, S., and Dasgupta, S. (2003) Modeling use of enterprise resource planning systems: A path analytic study. *European Journal of Information Systems* 12(2): 142-158.

Bailey, A. (1998) Un-oh. It's a computer systems project. *IEEE Engineering Management Review* Winter: 21-25.

Barki, H. and Hartwick, J. (1994) Measuring user participation, user involvement, and user attitude. *MIS Quarterly*, 18(1): 59-81.

Benbasat, I. and Dexter, A. S. (1982) Individual Differences in the Use of Decision Support Aids. *Journal of Accounting Research* 20(1): 1-11.

Bingi, P., Sharma, M. K., and Godla, J. K. (1999) Critical issue affecting an ERP implementation. *Information Systems Management* 16(3): 7-14.

Buckhout, S., Frey, E., and Nemec, J. (1999) Making ERP succeed: Turning fear into promise. *IEEE Engineering Management Review*: 116-123.

Daft, R. L. and Lengel, R. H. (1986) Organization requirements, media richness and structural design. *Management Science* 32(5): 554-571.

Davenport, T. H. (1993) *Process innovation*, Harvard Business School Press, Boston.

Davenport, T. H. (1998) Putting the enterprise into the enterprise system. *Harvard Business Review* 76(4): 121-132.

Davenport, T. H. and Short, J. E. (1990) The new industrial engineering: Information technology and business process redesign. *Sloan Management Review* 31(4): 11-21.

Davidson, W. H. (1993) Beyond re-engineering: the three phases of business information. *IBM Systems Journal* 32(1): 65-79.

Davis, F. D. (1989) Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 13(3): 19-340.

Davis, F. D. and Venkatesh, V. (2004) Toward pre-prototype user acceptance testing of new information systems: Implications for software project management. *IEEE Transactions on Engineering Management* 51(1): 31-46.

DeLone, W. H. (1988) Determinants of success for computer usage in small business. *MIS Quarterly* (12): 1, 51-61.

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

Duangekanong, S. (2014) Factors influencing the success of an ERP system: A study in the context of an agricultural enterprise in Thailand.

Silpakorn University Science and Technology Journal 8(1): 18-45.

Dishaw M. T. and Strong, D. M. (1999) Extending the technology acceptance model with task-technology fit constructs. *Information and Management* 36: 9-21.

Duplaga, E. and Astani, M. (2003) Implementing ERP in manufacturing. *Information Systems Management* 20(3): 68-75.

Eierman, M. A., Niederman, F., and Adams, C. (1995) DSS theory: A model of constructs and relationships. *Decision Support Systems* 14(1): 1-26.

Falkowski, G., Pedigo, P., Smith, B., and Swanson, D. (1998) A recipe for ERP success. *Beyond Computing*: 44-45.

Fenichel, C. H. (1981) Online searching: Measures that discriminate among ssers with different types of experiences. *Journal of the American Society for Information Science* 32(1): 23-32.

Finney, S. and Corbett, M. (2007) ERP implementation a compilation and analysis of critical success factors. *Business Process Management Journal* 13(3): 329-347.

Fishbein, M. and Ajzen, I. (1975) *Belief, attitude, intention and behavior: An introduction to theory and research,* Addison-Wesley, Reading, MA.

Friedman, A. L. and Miles, S. (2002) Developing stakeholder theory. *Journal of Management Studies* 39(1): 1-21.

Gazmuri, P. and Maturana, S. (2001) Developing and implementing a production planning DSS for CTI using structured modeling. *Interfaces* 31(4): 22-36.

Glass, R. L. (1998) Enterprise resource planning: Breakthrough and/or term problem? *Database* 29(2): 14-15.

Goodhue, D. L. and Thompson, R. L. (1995) Task-technology fit and individual performance. *MIS Quarterly* 19(2): 213-236.

Guimaraes, T. and Bond, W. (1996) Empirically assessing the impact of BPR on manufacturing firms. *International Journal of Operations & Production Management* 16(8): 5-28.

Gupta, A. (2000) Enterprise resource planning: The emerging organizational value systems. *Industrial Management & Data Systems* 100(1).

Hammer, M. and Champy, J. (1993) *Reengineering the corporation: A manifesto for business revolution*, Harper Business, New York.

Holland, C. and Light, B. (1999) A critical success factors model for ERP implementation. *IEEE Software* 16: 30-35.

Ittiphaisitpan, R. (2011) An investigation of the implementation of decision support and enterprise resource planning systems in organization in Thailand. *Journal Information Technology Management* XXII(4): 13-46.

Jiang, J., Muhanna, W., and Klein, G. (2000) User resistance and strategies for promoting acceptance across system types. *Information & Management* 37(1): 25-36.

Kieras, D.E. and Polson, P.G. (1985) An Approach to the Formal Analysis of User Complexity. *International Journal of Man-Machine Studies* 22: 365-394.

Kirton, M.J. (1976) Adaptors and innovators: A description and a measure. *Journal of Applied Psychology* 61: 622-629.

Kleinmuntz, D.N. (1990) Decomposition and the control of error in decision-analytic models. In *Insights in decision making: A tribute to Hillel J. Einhorn* (Hogarth, R.M., ed), pp. 107-126. University of Chicago Press, Chicago.

Krovi, R. (1993) Identifying the causes of resistance to IS implementation: A change in theory perspective. *Information and Management* 25: 327-335.

Kumar, V., Maheshwari, B., and Kumar, U. (2002) ERP systems implementation: Best practices in Canadian government organizations. *Government Information Quarterly* 19: 147-172.

Kuruppuarachchi, P., Mandal, P., and Smith, R. (2002) IT project implementation strategies for effective changes: A critical review. *Logistics Information Management* 15(2): 126-137.

Laughlin, S.P. (1999) An ERP game plan. *Journal of Business Strategy* 20(1).

Leon, A. (2010) *ERP demystified* (2nd Edition), Tata

McGraw Hill, New Delhi.

Little, J.D.C. (1970) Models and managers: The concept of a decision calculus. *Management Science* 16(8): 466-485.

Lu, H.P. and Yeh, D.C. (1998) Enterprise's perceptions on business process re-engineering: A path analytic model. *OMEGA International Journal of Management Science* 26(1): 17-27.

Lucas, H.C. (1978) Empirical evidence for a descriptive model of implementation. *MIS Quarterly* 2(2): 27-41.

Mackey, J.M. and Elam, J.J. (1992) A comparative study of how experts and novices use a decision aid to solve problems in complex knowledge domains. *Information Systems Research* 3(2): 150-172.

Malhotra, Y. and Galletta, D.F. (1999) Extending the technology acceptance model to account for social influence: Theoretical bases and empirical validation, In *Proceedings of the 32nd Hawaii International Conference on Systems Sciences*, pp. 1-14.

Mandal, P. and Gunasekaran, A. (2003) Issues in implementing ERP: A case study. *European Journal of Operational Research* 146: 274-283.

Maneesh, K., Bingi, P.S., and Godla, J.K. (1999) Critical issues affecting an ERP implementation. *Information Systems Management* 16(3): 7-14.

McAfee, A. (2003) When too much IT knowledge is a dangerous thing. *MIT Sloan Management Review* 44(2): 83-89.

Mora, M., Forgionne, G., Gelman, O., Gervantes, O., Cervantes, O., Weitzenfeld, A., and Raczynski, S. (2003) Implementation of DMSS: A systemic approach. In *Innovations in Decision Support Systems* (Tonfoni, G., and Jain, L. eds.), pp. 17-84. Advance Knowledge International, Magill University.

Nah, F.F., Lau, J., and Kuang, J. (2001) Critical factors for successful implementation of enterprise systems. *Business Process Management Journal* 7(3): 285-293.

Paulk, M. (2001) Extreme programming from a CMM perspective. *IEEE Software* Nov./Dec.: 19-26.

Polson, P.G. (1987) A quantitative theory of human-computer interaction, In *Interfacing thought: Cognitive aspects of human-computer interaction* (Carroll, J.M. ed.), pp.184-235, MIT Press Cambridge, MA.

Powell, P.L., Connell, N.A.D., and Holt, J. (1995) Gender and DSS design: The research implications. *Decision Support Systems* 14: 27-58.

Ramamurthy, K., William R., and Premkumar, G. (1992) User characteristics DSS effectiveness linkage: An empirical sssessment. *Man-Machine Studies* 36: 469-505.

Ramayah, T. and Lo, M-C. (2007) Impact of shared beliefs on perceived usefulness and ease of use in the implementation of an enterprise resource planning system. *Management Research News* 30(6): 420-431.

Raymond, L., Rivard, D., and Blili, S. (1998) Impact of task uncertainty, end-user involvement, and competence on the success of end-user computing. *Information & Management* 33(3): 137-153.

Roberson, L. (1989) Assessing personal work goals in the organizational setting: development and evaluation of the work concerns inventory. *Organization Behavior and Human Decision Processes* 44: 345-367.

Roberts-Witt, S. L. (1999) Power to the enterprise. *Knowledge Management* March.

Ross, J. W. and Vitale, H. R. (2000) The ERP revolution: Surviving vs. thriving. *Information Systems Frontiers* 2(2): 233-241.

Saade, R. and Bahli, B. (2005) The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: An extension of the technology acceptance model. *Information & Management* 42(2): 317-327.

Sabherwal, R. and Robey, D. (1995) Reconciling variance and process strategies for studying information system development. *Information Systems Research* 6(4): 303-327.

Sarker, S. and Lee, A.S. (2003) Using a case study to test the role of three key social enables in ERP implementation. *Information and Management* 40.

Scott, S.G. and Lane, V. (2000) A stakeholder approach to organizational identity. *The Academy of Management Review* 25(1): 43-62.

Setzekorn, K., Sugumaran, V., and Patnayakuni, N. (2002) A comparison of implementation resistance factors for DMSS vs. other information systems. *Information Resources Management Journal* 15(4): 48-63.

Shanks, G. and Parr, A. (2000) A model of ERP project implementation. *Journal of Information Technology* 15: 289-303.

Siegal, S. and Castellan, N.J. (1988) Nonparametric Statistics for the Behavioural Sciences, McGraw-Hill, New York.

Skok, W. and Legge, M. (2002) Evaluating enterprise resource planning (ERP) systems using an interpretive approach. *Knowledge and Process Management* 9(2): 72-80.

Sumner, M. (1999) Critical success factors in enterprise wide information management systems projects. In *Proceedings of the Americans Conference on Information Systems (AMCIS)*, pp. 232-234.

Swink, M. (1995) The influences of user characteristics on performance in a logistics DSS application. *Decision Sciences* 26(4): 503-529.

Taylor, J. C. (1998) Participative design linking BPR and SAP with an STS approach. *Journal of Organizational Change Management* 11(3): 233-245.

Taylor, R. N. (1975) Age and experience as determinants of managerial information processing and decision making performance. *Academy of Management Journal* 18(1): 74-81.

Terzi, S. and Cavalieri, S. (2004) Simulation in the supply chain context: a survey. *Computers in Industry* 53(1): 3-16.

Umble, E.J. and Umble, M.M. (2002) Avoiding ERP implementation failure. *Industrial Management* (Jan-Feb).

Umble, E., Haft, R., and Umble, M. (2003) Enterprise resource planning: Implementing procedures and critical success factors. *European Journal of Operations Research* 146: 241-257.

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

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

Venkattaman, N. (1994) IT-enabled business transformation from automation to business scope redefinition. *Sloan Management Review Winter*: 73-88.

Wagle, D. (1998) The case for ERP systems. *The Mckinsey Quarterly* 2: 130-138.

Walsham, G. (1993) *Interpreting information systems in organizations*, Wiley, UK.

Wee, S. (2000) Juggling toward ERP success: Keep key success factors high. *ERP News* February.

Welti, N. (1999) Successful SAP R/3 implementation: practical management of ERP projects, Addison-Wesley, Harlow.

White, C. (1999) ERP come alive. *Intelligent Enterprise* January 26.

Wixom, B. H. and Todd, P. A. (2005) A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research* 16(1): 85-102.

Wood, T. and Caldas, M.P. (2001) Reductionism and complex thinking during ERP implementations. *Business Process Management Journal* 7.

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

APPENDIX

A1 Questionnaire

The questionnaire has been abbreviated and includes the measuring scales used for the variables.

Section One: *Personal Information*

1. Age (years): ☐ 26 or less ☐ 27-33 **(1)** ☐ 34-40 **(2)** ☐ 41-47 **(3)** ☐ 48-54 **(4)** ☐ 55-61 **(5)** ☐ 62 or more **(6)**
2. Gender: ☐ Male **(1)** ☐ Female **(2)**
3. Professional experience (years): ☐ Less than 5 **(1)** ☐ 5-10 **(2)** ☐ 11-20 **(3)** ☐ 21-30 **(4)** ☐ Over 30 **(5)**
4. Current professional position

CIO	System Engineer	Middle manager
IT manager	IT consultant	Supervisor
IT strategist	IT officer	Consultant
IT project manager	Senior executive	Officer
Systems Analyst/Designer	Senior manager	Other (Please specify): ……

5. Highest level of formal education: ☐ High School (or equivalent) **(1)** ☐ Bachelor's degree **(2)** ☐ Master degree **(3)** ☐ Doctoral degree **(4)**

6. Please indicate the types of experiences you have had with these types of information systems. In each case respondents chose one or both of the responses: ***Helped to Develop/Implement*** and/or ***Experience in Using***

System			
Demand forecasting	Financial systems	Data warehouse	Transportation scheduling
Order management	Inventory planning	Supply Chain Management	Sales and marketing
Human resources	Strategic planning	Capacity planning	Business intelligence
Distribution/Warehouse management	Shop floor tracking	Manufacturing scheduling	Customer relationship management

Section Two: *Characteristics of ERP Systems*

ERP *systems are used to keep track of routine transactions and elementary activities of an organization and that order management, inventory movement, financial management, and human resource management systems are all good examples.*

1. Please indicate the amount of difficulty in determining a clear definition of system requirements.

Very Easy to Determine 1	2	3	4	Very Difficult to Determine 5

2. Please indicate the level of success achieved in estimating the completion time for the development and implementation of the system.

Always Underestimated 1	2	Estimated Correctly 3	4	Always Overestimated 5

3. Please indicate the amount of time taken by users to learn how to use the system.

Very Little Time 1	2	3	4	A Lot of Time 5

4. Please indicate the frequency of system usage.

Infrequently 1	2	3	4	Frequently 5

5. Please indicate the duration of time users take to complete tasks using the system.

Very Little Time 1	2	3	4	A Lot of Time 5

6. Please indicate the percentage of a user's workload that is done using the system.

0 - 20 Percent 1	21 - 40 Percent 2	41 - 60 Percent 3	61 - 80 Percent 4	81 - 100 Percent 5

7. Please indicate the amount of success that older and younger users have in using the system.

User	Very Little Success 1	2	3	4	A Lot of Success 5
35 years or older					
Younger than 35 years					

8. Please indicate the amount of success that male and female users have in using the system.

User	Very Little Success 1	2	3	4	A Lot of Success 5
Males					
Females					

9. The respondents indicated the level of importance of each of 65 characteristics for the success of an ERP system on a 5-point Likert scale ranging from *Unimportant* (1) to *Very Important* (5). The 65 characteristics are listed in Table A2 below.

Table A1(a) Characteristics of the respondents (Questionnaire Section 1, Q1 – Q5)

Gender	Frequency	Percent	**Experience (Years)**	Frequency	Percent	Cumulative Percent	**Level of Education**	Frequency	Percent	Cumulative Percent	**Age (Years)**	Frequency	Percent	Cumulative Percent
Male	111	52.6	5 - 10	93	44.1	44.1	Bachelor Degree	97	46.0	46.0	27 - 33	28	13.3	13.3
Female	100	47.4	11 - 20	101	47.9	91.9	Master Degree	110	52.1	98.1	34 - 40	55	26.1	39.3
Total	*211*	*100*	21 - 30	11	2.9	97.2	Doctoral Degree	4	1.9	100	41 - 47	68	32.2	71.6
			Over 30	6	2.8	100	*Total*	*211*	*100*	-	48 - 54	48	22.7	94.3
			Total	*211*	*100*	-					55 - 61	12	5.7	100
			Mean 13 years, *Standard Deviation* 3 years				*Mode* Master Degree				*Total*	*211*	*100*	-
											Mean 38 years, *Standard Deviation* 5 years			

Current Position	Frequency	Percent	**Current Position**	Frequency	Percent
IT Officer	29	13.7	Officer	35	16.6
IT Consultant	6	2.8	Consultant	13	6.2
Systems Engineer	14	6.6	Supervisor	15	7.1
Systems Analyst/Designer	22	10.4	Middle Manager	15	7.1
IT Project Manager	14	6.6	Senior Manager	14	6.6
IT Strategist	1	0.5	Senior Executive	9	4.3
IT Manager	12	5.7	Other (Self employed)	6	2.8
CIO	6	2.8			

Table A1(b) Percentage of respondents with different types of experience with different systems (Questionnaire Section 1, Q6)

Type of Experience	Type of System			
	Human Resource Management	**Order Management**	**Forecasting**	**Distribution Management**
Not Develop and Not Use	47.6	50.4	56.4	52.6
Develop Only	22.0	19.1	14.7	18.1
Use Only	24.2	25.4	25.9	21.6
Develop and Use	6.2	5.1	2.6	2.4
	Shop Floor Management	**Financial Management**	**Inventory**	**Strategic Planning**
Not Develop and Not Use	50.9	48.1	42.8	29.4
Develop Only	23.8	23.3	23.2	14.3
Use Only	21.5	23.8	22.7	14.4
Develop and Use	3.8	4.3	7.3	41.9
	Scheduling	**Database Management**	**Supply Chain Management**	**Capacity Planning**
Not Develop and Not Use	47.5	42.1	21.4	59.2
Develop Only	21.5	20.2	35.0	19.9
Use Only	27.1	32.0	35.7	24.6
Develop and Use	2.9	5.6	7.9	2.3
	Customer Relationship Management	**Sales and Marketing**	**Logistics**	**Business Intelligence**
Not Develop and Not Use	51.8	43.5	61.2	34.0
Develop Only	18.0	25.7	16.0	31.0
Use Only	25.0	28.5	21.6	32.4
Develop and Use	5.2	3.3	1..0	3.0

Table A2 Descriptive statistics for the level of importance of indicators (Questionnaire Section 2, Q9)

Factors and Indicators	Mean	Std. Dev.	Skewness	Kurtosis	Rank	Type of Rank
Characteristics of the System						
The usefulness of: System functions	4.06*	.935	-.729	-.359	3	H
System output	3.94*	.917	-.501	-.600	11	H
User documentation	3.69*	.962	-.252	-.872	36	M
Help support	3.64*	.907	-.161	-.537	39	M
The performance of the system	3.98*	.963	-.570	-.535	8.5	H
Personal gains from using the system	3.81*	.965	-.402	-.627	24.5	M
Ease of: Interaction with the system	4.04*	.942	-.734	-.003	4	H
Learning to use the system	3.92*	.954	-.571	-.240	12	H
The system's impact on: Increasing job security	3.90*	.989	-.494	-.668	13.5	H
Improving the individual's work procedures	3.90*	.978	-.591	-.311	13.5	H
Increasing the individual's job satisfaction	3.70*	.914	-.419	-.175	34.5	M
Characteristics of Users						
Ability to: Learn new skills and knowledge	3.13	.940	-.329	-.480	65	L
Analyze quantitative information	3.20*	.923	-.119	-.175	63	L
Analyze qualitative information	3.40*	.880	.118	-.440	51.5	L
Reason heuristically	3.22*	.791	.005	-.337	60.5	L
Make judgments and decisions	3.29*	.893	.145	-.318	56	L
Adopt rules	3.54*	.885	-.030	-.479	44	L
Understand the context of a problem	3.42*	.895	-.133	-.161	50	L
Deal with uncertainty	3.31*	.798	.312	-.255	54	L
Deal with ambiguity	3.25*	.851	.198	.201	58	L
Experience: In current work position	3.21*	.931	.112	-.292	62	L
In previous work positions	3.22*	.873	.009	.000	60.5	L
With computer based systems	3.30*	.877	.066	-.294	55	L

Factors and Indicators	Mean	Std. Dev.	Skewness	Kurtosis	Rank	Type of Rank
The User's: Level of education	3.28*	.878	-.135	-.299	57	L
Type of education	3.19*	.862	-.110	.086	64	L
Communication skills	3.51*	.820	-.213	-.585	46	L
Interpersonal skills	3.44*	.932	-.270	-.213	49	L
Teamwork skills	3.85*	.977	-.553	-.180	20.5	H
Characteristics of Organizations						
The organization's: Mission and strategy	3.54*	.969	-.288	-.141	44	L
IT strategy	3.72*	.907	-.146	-.816	31	M
Maturity in using IT	3.40*	.905	.020	-.179	51.5	L
Scope of activities	3.72*	.878	-.464	.309	31	M
Financial position	3.89*	.888	-.408	-.133	15	H
Change Management Activities						
Managing changes to: Organizational roles and structures	3.58*	.810	-.104	-.129	42	M
Communications	3.54*	.969	-.288	-.610	44	L
Training and education	3.78*	.950	-.459	-.313	26.5	M
Performance management	3.66*	.890	-.288	-.382	38	M
Management practices	3.75*	.918	-.225	-.796	29	M
Determining the costs of: Existing processes	3.71*	.935	-.248	-.437	33	M
New processes	3.59*	.821	-.313	-.265	40.5	M
Modeling and designing processes	3.70*	.870	-.134	-.677	34.5	M
Redesigning and re-engineering processes	3.77*	.942	-.298	-.635	28	M
Systems Development and Implementation						
Using: A traditional systems development life cycle	3.85*	.840	-.337	-.457	20.5	H
An incremental/evolutionary methodology	3.39*	.980	-.162	-.370	53	L
A small releases methodology	3.23*	.948	.003	-.531	59	L
Customized frameworks for development	3.59*	.911	-.498	-.011	40.5	M
Modeling: Processes	3.86*	.988	-.559	-.092	18	H
Data	3.72*	.956	-.589	.127	31	M
Using: Prototyping tools	3.48*	.920	-.425	.125	47	L
CASE tools	3.47*	.873	-.480	.362	48	L
Project management software and tools	3.99*	.879	-.436	-.683	6.5	H
Support from the: Organization's senior management	3.99*	.940	-.801	.751	6.5	H
IT department	3.86*	.901	-.817	1.038	18	H
Vendors/suppliers	3.81*	.976	-.664	.581	24.5	M
Involvement of: Users	3.84*	.950	-.854	.920	22	H
Other stakeholders	3.88*	.935	-.662	.582	16	H
An effective project: Manager	3.97*	.897	-.879	1.311	10	H
Project team	4.00*	.907	-.859	1.163	5	H
A clear definition of project goals	3.86*	.993	-.579	.189	18	H
The delivery of system capabilities	3.68*	.953	-.331	-.611	37	M
Quality assurance of the system	3.98*	.809	-.341	-.550	8.5	H
System security	4.10*	.853	-.583	-.238	1	H
Technical systems documentation	4.09*	.812	-.416	-.716	2	H
Systems maintenance	3.83*	.862	-.293	-.339	23	M
Adhering to the project budget	3.78*	.946	-.300	-.483	26.5	M

Notes: (a) * indicates that the mean is statistically significantly greater than 3 ($p < 0.05$); **(b)** Ranks are classified as high (H), medium (M), or low (L) if the rank was in the top, middle, or bottom third of the distribution of the ranks, respectively.

Table A3 Analysis of indicators of the success of ERP (Questionnaire Section 2, Q1 – Q8)

The amount of success that users have in using the system	**Age**				**Gender**			
	Age ≥ 35 years		Age < 35 years		Males		Females	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
1Very Little Success	8	3.8	3	1.4	0	0	0	0
2	40	19.0	18	8.5	7	3.3	4	1.9
3	102	48.3	63	29.9	107	50.7	81	38.4
4	49	23.2	86	40.8	83	39.3	97	46.0
5 A Lot of Success	12	5.7	41	19.4	14	6.6	29	13.7
Total	*211*	*100*	*211*	*100*	*211*	*100*	*211*	*100*
	Mean 3.09, *Std. Dev.* 0.905		*Mean* 3.69*, *Std. Dev.* 0.986		*Mean* 3.49*, *Std. Dev.* 0.696		*Mean* 3.75*, *Std. Dev.* 0.745	
	Mean (Age < 35) – *Mean* (Age ≥ 35) = 0.6 (p < 0.05)				*Mean* (Females) – *Mean* (Males) = 0.26 (p < 0.05)			

The frequency of system usage			The duration of system usage			Time taken to learn the system		The percentage of work done using the system		
How often the system is used	Frequency	Percent	Amount of time taken	Frequency	Percent	Frequency	Percent	Percentage	Frequency	Percent
1Infrequently	6	2.8	1Very Little	31	14.7	29	13.7	0 - 20	7	3.3
2	13	6.2	2	80	37.9	55	26.1	21 - 40	11	5.2
3	45	21.3	3	82	38.9	84	39.8	41 - 60	53	25.1
4	82	38.9	4	25	11.8	36	17.1	61 - 80	89	42.2
5 Frequently	65	30.8	5A Lot	3	1.4	7	3.3	81 -100	51	24.2
Total	*211*	*100*	*Total*	*211*	*100*	*211*	*100*	*Total*	*211*	*100*
Mean 4.02*, *Std. Dev.* 0.967			*Mean* 2.52**, *Std. Dev.* 0.986			*Mean* 2.85**, *Std. Dev.* 0.988		*Mean* 3.75* (65%) *Std. Dev.* 0.999		

The amount of difficulty in determining a clear definition of system requirements	Frequency	Percent	The level of success achieved in estimating the completion time for the development and implementation of the system.	Frequency	Percent
1 Very Easy	23	10.9	1 Always Underestimated	105	49.8
2	75	35.5	2	48	22.7
3	86	40.8	3 Estimated Correctly	49	23.2
4	22	10.4	4	8	3.8
5 Very Difficult	5	2.4	5 Always Overestimated	1	0.5
Total	*211*	*100*	*Total*	*2111*	*100*
Mean 2.62**, *Std. Dev.* 0.951			*Mean* 1.37**, *Std. Dev.* 0.827		

Note: * (**) indicates that the mean is statistically significantly greater (less) than the *neutral* value of 3 (p < 0.05)