A Structural Equation Model of ERP Implementation Success in Thailand

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ABSTRACT

Enterprise Resource Planning (ERP) systems are globally implemented for improving the efficiency of business processes. ERP systems normally provide many advantages for firms, however, reports show few successful implementations. In many cases, problems are due to varied strategic perspectives on implementing ERP systems. These problems are an important reason to identify and understand important success factors as significant enablers to drive ERP in organizations in Thailand. Our research aims to build a model for ERP implementation success based on DeLone and McLean's information system success model. DeLone and Mclean's model uses four constructs; system quality, information quality, service quality and human quality as significant determining factors. Data was gathered from 306 respondents, to a questionnaire, who implemented an ERP system. Data analysis was done using a structural equation model (SEM). Results found that system quality and information quality have a direct effect on user satisfaction. Furthermore, human quality not only has a direct effect on user satisfaction but also affect the ERP implementation success.

Keywords: ERP Success Model, System Quality, Information Quality, Human Quality

1. INTRODUCTION

Information technology provides many advantages and benefits to businesses especially for managing data and process. Many firms use an enterprise resource planning system (ERP) to facilitate the flow of data and improving activities such as more efficient decisions making. Gartner's 2014 report showed an increase in market share of top ERP software vendors in recent years (Gartner, 2014). As of 2007, many firms in Thailand were accelerating ERP systems implementation to better integrate their various business functions (Ifinedo, 2008)

Although implementation of ERP has benefits, it is quite complex, difficult, and risky for success. Research showed that few ERP are successful and more than 50 percent of them face problems. Problems include ERP projects exceeding their budget, experiencing duration overruns and greater than 50 percent of their anticipated benefits (Panorama, 2016). Research on ERP suggests that inadequate IT/ERP resources and differences in culture, including lack of knowledge or knowing critical factors support, negatively affects the successful implementation of IS/ERP in Thailand (Huang and Palvia, 2001).

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This paper shows the development of an ERP success framework which is critical to the success of ERP implementation in organizations in Thailand. The model is adapted from DeLone and McLean's information system success model and includes constructs such as system quality, information quality, service quality, human quality, user satisfaction, and ERP implementation success.

2. LITERRATURE REVIEW

2.1 ERP implementation

ERP system is the integration of various functions using information technology. This integration can improve information sharing and collaboration across functional and corporate boundaries. The primary objective of an ERP project is to track its supply chain activities from inventory purchase to processing and final shipment to customers (Sumner, 2005).

Consulting companies in Thailand provide advice and support in choosing and implementing the appropriate information systems to firms of various sizes. However, only a few companies have found success in the ERP application systems. The disappointing results of ERP implementation are related to technical implementation, organizational implementation, and resource allocation. Technical implementation includes mistakes in choice of vendor and consultant, low IT measuring, and uncertainty in functional requirements. Organizational implementation issues include lack of commitment of top management, resistance to change from users, unclear understanding of cultural issues and user readiness. Resources allocation includes, insufficient resources of IT/ERP and lack of knowledge of ERP implementation or knowing the critical support factors severely affects IS success implementation in Thailand (Rotchanakitumnuai, 2010; Thukral, 2014).

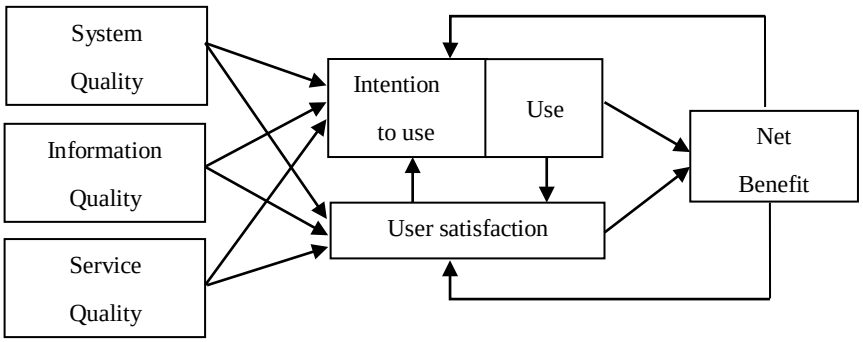

Figure 1: DeLone and Mclean's IS Success Model

2.2 DeLone and McLean's IS success model

The DeLone and McLean's IS success model is the standard of the information system success measurement and is based on extensive empirical analysis of literature. The DeLone and McLean's model consists of six dimensions which are; system quality, information quality, service quality, intention to use/use, user satisfaction and net benefit (DeLone & McLean, 2003; Bento, 2013). The relationship among the factors can be explained regarding a system as shown in Figure 1. The net benefits are positively and

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negatively related. DeLone and McLean's model is the widely accepted standard to measure information system success and adapted to the studied environment (Wei, 2009).

2.3 A conceptual framework for ERP implementation success and hypotheses

This research presents an ERP implementation success model related to ERP implementation critical factors in Thailand. Six dimensions considered are as follows:

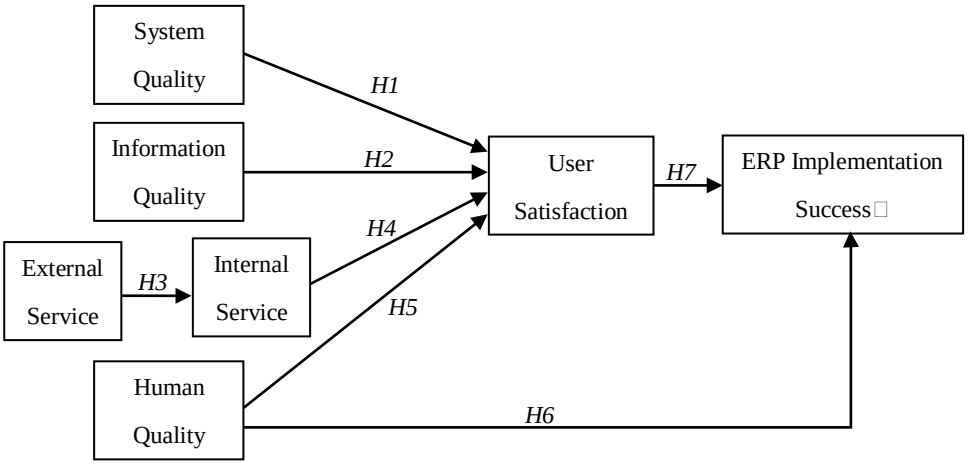

Figure 2: A purposed model of ERP implementation success in Thailand

2.3.1 System quality

System quality is a desirable characteristic of an information system. Research shows that system quality is significantly related to user satisfaction (Gable, 2003; Ifinedo, 2006; Rajesri, 2014). Quality is measured via, ease of use, integration, functionality, flexibility and accuracy. Typically, for ERP implementation success assessment of the system capability and the firm's information systems requirement are required for confidence in objectives or problems that need to be solved. These are elements of ERP implementation success that can improve end users satisfaction. Therefore, we offer the following hypothesis:

H1: The system quality dimension positively influences user satisfaction.

2.3.2 Information quality

Information quality is a desirable characteristic in the system outputs or management reports. Five dimensions of information quality are; relevance, completeness, understandability, accuracy and timeliness. For information, quality is often not distinguished as a unique construct but is measured as a component of user satisfaction (Peter, 2008). However, quality of information is a factor of data quality in that poor data quality results in poor information quality (Gorla, 2010). Therefore, we offer the following hypothesis:

H2: The information quality dimension positively influences user satisfaction.

2.3.3 Service quality

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Service quality is the quality of the support that system users receive from the IS department and IT support personnel (Ifinedo, 2008). Many services for ERP implementation are mentioned in research and can be divided as follows:

2.3.3.1 External service is support received from vendor and consultant. External parties have expert knowledge and experience on ERP implementation and tend to bring success to organizations by providing professional services. A more comprehensive ERP success model should incorporate the vendor's and consultant's quality dimension. Quality is measured using reliability, responsiveness, experience and assurance. Some studies showed that external service significantly affects internal service (Nah, 2001; Tsai, 2009). Therefore, we offer the hypothesis:

H3: The external service dimension positively influences internal service quality.

2.3.3.2 Internal service is service that the user receives from the IT support department of the organization. Service includes monitoring, evaluation ERP system performance and request feedback that are critical factors in the success of any ERP system. The quality of service has enabled the development of SERVQUAL whose five dimensions are reliability, tangibles, responsiveness, assurance, empathy (Parasuraman, 1988). Several studies have examined the relationship between service quality and user satisfaction and showed that there is a significant effect (Peter, 2008). Therefore, we offer the hypothesis:

H4: The internal service dimension positively influences user satisfaction.

2.3.4 Human quality

One intangible asset in an organization is the human resources which involve the capabilities, knowledge, skills, behavior, attitudes, and talents of employees. Human resources contributed significantly to the building of shareholder value (Nair, 2005). The recognition of the importance and value speople bring to the success equation helps with both personal success and organizational success (Swanson, 2001).

The critical factors for ERP implementation surveyed in the literature include human. Human resource is an uncontrollable or forecastable resource but fundamental to the success of an organization. Therefore, improving readiness and clear understanding of human resource is useful to firms (Hussein, 2007; Rotchanakitumnuai, 2010). From reviewing existing research about ERP implementation in Thailand, we found the critical factors mentioned as follow:

2.3.4.1 Top management support is the involvement and participation of top level management of the organization in information technology activities. Earlier research found that top management support plays a significant role by showing commitment, providing sufficient resources and motivation for successful implementation. Senior managers have to support all phases of the implementation process and should justify goals and objectives by sharing plans and vision of the organization with employees. Therefore, top management support has a significant influence on information system success (Nah, 2001; Wong, 2005; Hussein, 2007; Rotchanakitumnuai, 2010).

2.3.4.2 Managerial IT knowledge refers to senior management experience and knowledge concerning information technology. The purpose of ERP projects is knowledge sharing across organizational boundaries and requires explicit and tactic

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(observations and experiences) knowledge for sharing among users to use the ERP system efficiently. Studies show that managerial IT knowledge was an important factor in promoting high levels of IT use within business units (Hussein, 2007; Rotchanakitumnuai, 2010). Therefore, proposes that managerial IT knowledge is one of the factors necessary to influence Information system success.

2.3.4.3 Management Style is the way in which management tends to influence, coordinate, and direct people's activities towards objectives. Lu & Wang (1997) have categorized management styles into people-oriented and task-oriented which are both significantly and positively correlated. People-oriented managers emphasize interpersonal relationships and are concerned with mutual trust, friendship, respect, and warmth. Task-oriented managers tend to focus more on the task aspect of jobs and deals with defining and organizing tasks for goal attainment (Hussein, 2007).

2.3.4.4 Organization culture describes an organization's environment and incorporates its assumptions, beliefs, and members shared values and guidelines for workers to interact with a formal structure (Christensen, 1999). The effective implementation of an ERP system requires change management strategies and an understanding of organizational structure which impacts culture. Changes and reorganization influence organizational culture and principles by increasing self-confidence, empowerment, promoting creativity and employees' enthusiasm. (Ngai, 2008)

However, the human quality is necessary to influence user satisfaction (Bento, 2013) and is a significant predictor of ERP success (Mohamed, 2006). Therefore, our model offers these hypotheses:

H5: The human quality positively influences the user satisfaction.

H6: The human quality positively influences the ERP implementation success.

2.3.5 User satisfaction

User satisfaction is the feeling of pleasure or displeasure of users with the system's implementation. Also, user satisfaction has a positive impact on performance and job satisfaction including supporting the increase productivity and effectiveness of the ERP system (Peter, 2008; Bento, 2013). Therefore, we offer this hypothesis:

H7: The user satisfaction dimension positively influences the ERP implementation success.

2.3.6 ERP implementation success

The impact of factors that influences the implementation of an ERP system is a net benefit. The benefits dimension influences organizations in Thailand by a reduction in cycle time, reduce failure of process and redundancy of data including improving decision-making.

3. DATA ANALYSIS AND FINDINGS

3.1 Data collection

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This research used questionnaires as the data collection method. The questionnaires were mailed to a random sample of 350 organizations in Thailand with prior experience in implementing ERP systems. A total of 306 responses were obtained; for a decent responses rate of 87.42%.

3.2 Reliability and validity analysis

A structural equation model (SEM) was used in statistical analysis. Data from the survey were utilized for a confirmatory factor analysis (CFA) on the measurement scales to test the model hypotheses.

A CFA using complete standardize solution in AMOS 22 showed that all 29 items loaded on their corresponding factors which provided strong empirical evidence of construct independence and validity of the construct. Furthermore, most reliability measures greater than the recommended level of 0.7, indicating adequate internal consistency. See Table 1.

Table 1: Factor loading, Reliability, and Validity

Inventory	Loading	CR	AVE	α
System Quality (SYSQ)		0.74	0.51	0.701
Ease of use	0.491			
Integration	0.467			
Functionality	0.748			
Flexibility	0.834			
Accuracy	0.604			
Information Quality (INFQ)		0.89	0.51	0.731
Relevance	0.459			
Understandability	0.652			
Completeness	0.646			
Accuracy	0.650			
Timeliness	0.624			
External Service (EXTS)		0.95	0.70	0.876
Reliability	0.796			
Experience	0.738			
Assurance	0.796			
Responsiveness	0.794			
Internal Service (INTS)		0.96	0.75	0.901
Tangibles	0.446			
Reliability	0.817			
Assurance	0.790			
Empathy	0.867			
Responsiveness	0.810			
Human Quality (HUMQ)		0.83	0.51	0.779
Top management Support	0.705			
Managerial IT Knowledge	0.571			
Management Style	0.602			
Organization Culture	0.783			
User Satisfaction (USAT)		0.88	0.59	0.706
Efficiency	0.501			
Suitability	0.567			
Supporting	0.584			
ERP Implementation Success (ERPS)		0.88	0.63	0.764
Reduction in cycle time	0.659			
Reduce Failure	0.627			
Improve decision-making	0.716			

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Findings show a Cronbach's Alpha greater than 0.70, composite reliability (CR) greater than 0.60, and average variance extracted (AVE) greater than 0.50 are accepted to measure reliability and validity as shown in Table 1.

3.3 Results of measurement models

After the assessment of reliability and validity, the overall fit and the explanatory power of the model were examined together with the relative strengths of the individual path. Results were used as input into the AMOS computer program, and maximum likelihood estimation (MLE) was obtained for all model parameters as shown in Figure 3.

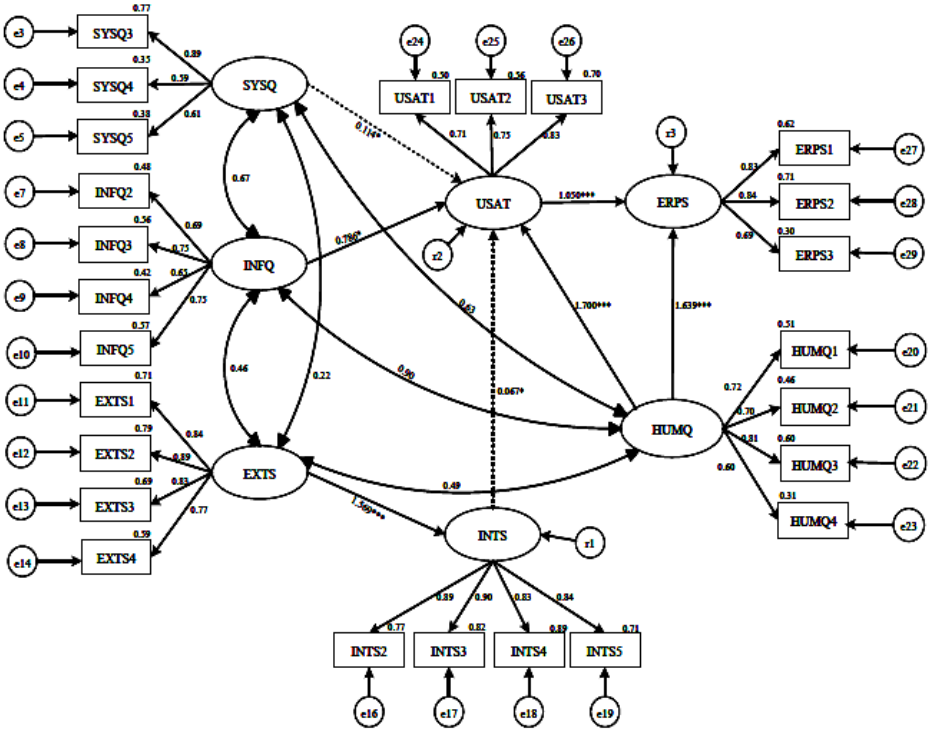

Figure 3: The measurement model of ERP implementation success in Thailand

The common model fit in measures were used to assess the model's overall goodness of fit; relative chi-square (x^2/df), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), comparative fit index (CFI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR) in the following Table 2.

Table 2: The Fitness Indexes for Measurement Model

Fit Indices	Threshold	Output
x^2/df	≤ 2	2.293
CFI	≥ 0.95	0.949
GFI	≥ 0.95	0.891
AGFI	≥ 0.90	0.841
RMSEA	≤ 0.08	0.065
SRMR	$\leq .05$	0.032

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From the result, RMSEA and SRMR are greater than the threshold value, so we considered modifying the model to obtain a better-fitting model. Thus the modification indices to generate the expected reduction in the overall model fit chi-square for each possible path that can be added to the model as shown in Figure 4.

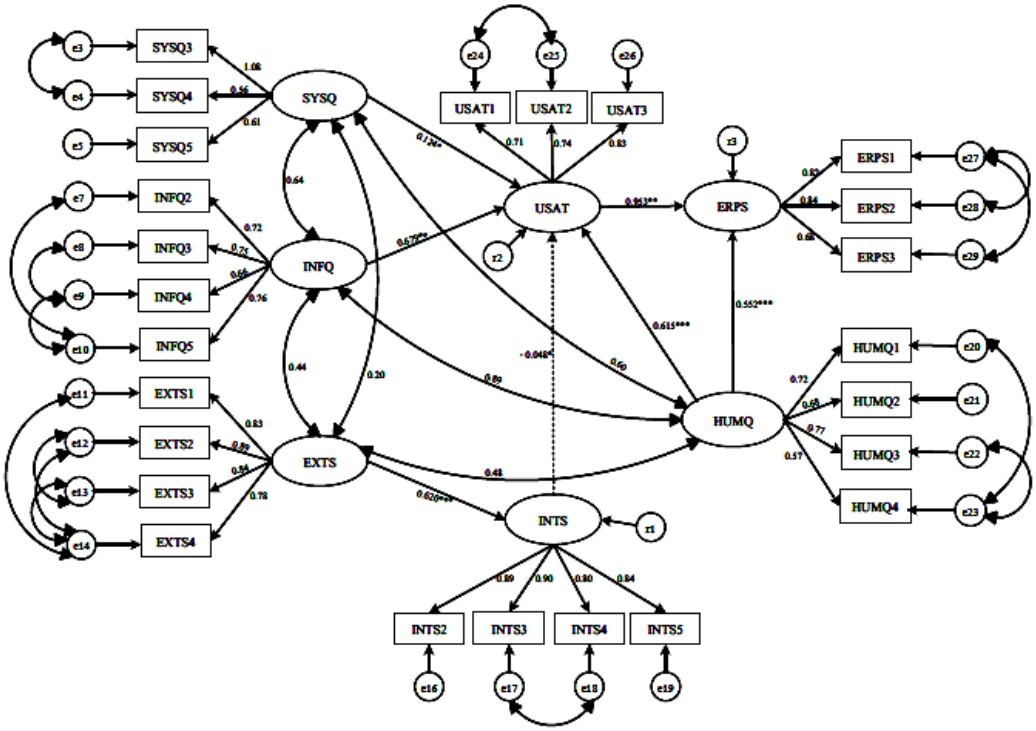

Figure 4: The measurement modified model of ERP implementation success in Thailand.

The model was adjusted by adding the correlation between covariance between the errors of observed variables until the p-value is higher than 0.05. All reflective indicators were standardized to be consistent with recommendations for dealing with interaction as shown in Table 3 (Hair et al., 2010; Kline, 1998).

Table 3: Results of initial model

Fit Indices	Threshold	Output
χ^2/df	≤ 2	1.853
CFI	≥ 0.95	0.968
GFI	≥ 0.95	0.914
AGFI	≥ 0.90	0.867
RMSEA	≤ 0.08	0.053
SRMR	$\leq .05$	0.033

This research has seven hypotheses each assuming P-value less than 0.05. All assumptions were supported except H4 as shown in Table 4. Table Four shows that the model developed is consistent with empirical data.

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Table 4: Hypotheses testing

Hypothesis	P-value	Result
H1: SYSQ → USAT	0.049	Supported
H2: INFQ → USAT	0.003	Supported
H3: EXTS → INTS	0.001	Supported
H4: INTS → USAT	0.452	Not supported
H5: HUMQ → USAT	0.001	Supported
H6: HUMQ → ERPS	0.002	Supported
H7: USAT → ERPS	0.029	Supported

***p-value < 0.05

4. DISCUSSIONS AND CONCLUSIONS

This research develops a structural equation model for ERP implementation success in Thailand consisting of six factors using DeLone and Mclean's information system success model. From this finding, the results indicate that the system quality, information quality, and human quality (except internal service) have a direct impact on the user satisfaction. Our model also shows that when implementing an ERP system in an organization in Thailand, priority should be given to the selection process and functions are supported. Organizations should focus on improving the human quality element because humans are the main resource behind ERP's success. Support through sufficient resources and sharing of knowledge including a clear understanding of the purpose and operation of the system is needed. Companies should adjust their behavior so that quality can be linked together in different areas. Overall results will be seen in a reduction of mistakes that may occur in the processes and work to achieve organizational goals.

For internal service, no impact on user satisfaction was recorded because of data collection. Most organizations surveyed are small-medium enterprises which have implemented enterprise resource planning system less than five years. During the first five-year organizations are still adapting to the new technology. It is possible that users are not confident with the in-house IT Support expertise. Results are consistent with Choe (1996) who said that in the early stages of new technology use, users must learn and adapt to the new functionality.

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