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Measuring ERP Success: Integrated Model of User Satisfaction and Technology Acceptance; An Empirical Study in Japan

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Abstract. This study applied Wixon and Todd [34]'s integrated model of user satisfaction and technology acceptance on ERP Implementation. The survey data from 266 ERP users were analyzed using structural equation modeling. The integrated model empirically provides the conceptual understanding of the difference between object-based beliefs and attitudes and behavioral beliefs and attitudes toward use.

Keywords: Integrated Model, User Satisfaction, Technology Acceptance, SEM

1. Introduction

A significant proportion of ERP implementation projects do not succeed [3, 8, 16], and a number of potential explanations for ERP implementation failures have been found in the literature [8, 22, 27, 32]. ERP implementation would not achieve the expected benefits without the potential users' acceptance [6] and user satisfaction. After reviewing literature regarding issues on ERP implementation, Bagchi, et al. [1] identified many studies that have considered an organizational unit of analysis, but they could not find any that has looked at ERP adoption from the user's or individual's perspective. In this paper, we empirically examine the ERP systems' acceptance and satisfaction by Japanese corporations through Davis's [12] Technological Acceptance Model (TAM) and Delone and McLean (D&M) success model [13] to examine user participation and involvement in ERP adoption.

2. Literature Review

2.1. ERP Implementation

According to Davenport [11], Deloitte Consulting [15], Markus & Tanis [26] and Ross & Vitale [28], business benefits from ERP use are multidimensional, ranging from operational improvements through decision-making enhancement to support for strategic goals. Sarker and Lee [29] addressed three social enablers, *i.e.* strong and committed leadership, open and honest communication, and balanced and empowered team, in ERP implementation. Others mention ERP benefits in these areas, including both tangible and intangible benefits [7, 10, 18, 19, 20, 21, 30, 33]. Shang and Seddon [31] suggest that there are very strong precedents in the literature for attempting to classify the benefits of ERP in terms of operational, managerial and strategic dimensions. They also pointed out that a large number of previous studies mentioned that 'IT infrastructure benefits' and 'organizational benefits'. The benefit types are discussed in detail below in the examination of the sub-dimensions of each of the five main benefit dimensions [31].

2.2. An Integrated Model of User Satisfaction and Technology Acceptance

Wixom and Todd [34] suggested a model which integrated the technology acceptance model and user satisfaction model as two models represent complementary steps in a causal chain from key characteristics of system design to beliefs and expectations about outcomes that ultimately determine usage. After an empirical research with 465 data warehouse users, they demonstrated the potential to integrate concepts related to user satisfaction and technology acceptance into a single unified model.

2.3. The Technology Acceptance Model (TAM)

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The Technology Acceptance Model (TAM) is an information systems theory, developed by Davis [12], which models how users come to accept and use a technology. The model suggests a number of factors influence their decision about how and when they will use it when users are presented with a new technology.

TAM tests the users behavior toward IS, based on the following four factors; perceived usefulness (PU), perceived ease of use (PEU), attitude toward use (ATU) and behavioral intention of use (BIU). PU is ‘‘the degree to which a person believes that using a particular system would enhance his or her job performance”, and PEU is ‘‘the degree to which a person believes that using a particular system would be free of effort” [12]. ERP implementation would not achieve the expected benefits without the potential users’ acceptance [6]. Although many literatures use TAM to explain the IS acceptance has been identified (e.g., 24), there are very few studies regarding ERP system acceptance. TAM needs to identify the factors that influence the ERP systems [1] which are not defined by TAM [12]. Legris, et al. [23] conducted an extensive literature review on 80 empirical TAM studies published in six top IS journals, and concluded that TAM has proven to be a useful theoretical model in helping to understand and explain use behavior in IS implementation.

2.4. D&M IS Success Model

The ERP Success is considered as the extent of the improvement in business and performance value, generated in the organization by means of the ERP implementation [17, 25]. The ERP implementation evaluates the tangible business effects inherent to such adoption.

Delone and McLean (D&M) [13] exposed the relationship between user satisfaction and system success which has long been linked to usefulness, after an extensive literature review on 180 empirical studies. D&M classified dimensions of IS success into six categories; (1) *System Quality*, (2)*Information Quality,* (3) *Service Quality,* (4) *Perceived usefulness,* (5) *User Satisfaction, and* (6) *Net Benefits,* which has been considered a suitable foundation for further empirical and theoretical research, and has met with general acceptance [13]. Later, D&M have updated their original success model [14].

3. Research Model and Hypothesis

TAM postulated that ERP usage is determined by a behavioral intention to use a system, where the intention to use the system is jointly determined by a person’s attitude toward using the system and its perceived usefulness. The intention of the satisfaction perspective reflects an attitude on the outcome derived from using the system [9]. User Satisfaction was shown to increase for ERP when a decision support such as an ERP vender was provided to assist users in complex (*i.e.* multi-issue) negotiations.

In structural equation modeling, we consider the causalities among all variables, especially between the result and the latent variables. Latent variable enables us to find many compiled observed variables at the same time based on the notion of structure. This works for generating and verifying hypothesis to find factors and causalities.

Based on Wixom and Todd model, we introduced latent variables based on the properties of the questionnaire as follows; (1) Perceived Usefulness (PU), (2) Perceived Ease of Use (PEU), (3) Behavioral Intention to Use (BIU), and (4) Use Satisfaction (US), as shown in figure 1. *Perceived ease of use* and *perceived usefulness* leads to *behavioral intention to use*, then leads to *user satisfaction* respectively of the models. The *usefulness of each feature* is hypothesized to affect *behavioral intention to use* and *user satisfaction* (the subjective evaluation of the entire experience derived from using ERP).

Therefore, the following hypotheses are proposed:

D-1. Perceived Usefulness (PU)

H-1: Function

If users are offered the abundance of advanced feature, then they would perceive usefulness of ERP.

H-2: Standard

If ERP meet the industrial standard or international standard, then users perceive usefulness of ERP.

H-3: Reputation

If the ERP establishes reputations among rival companies or in-house, then users perceive usefulness of ERP.

D-2. Perceived ease of use (PEU)

H-4: Compatibility

If ERP meet the user companies' specific business styles or practices, i.e. compatible to Japanese market and their businesses, then users would perceive ease of use of ERP.

H-5: Support

This will examine the impact of external support on perceived ease of use. If ERP vender provide enough support on implementation, then users would perceive ease of use.

D-3. Behavioral Intention to Use (BIU)

H-6: Upgrading Version

Many ERP environments cost millions to implement, and the same again each year in additional projects, support and maintenance. ERP maintenance and upgrade are costly decisions. Thus, user willingness to upgrade version imply behavioral intention to use.

H-7: ERP Implementation

An actual ERP implementation decision, whether the company has already implemented, is going to implement, or never implemented ERP, are asked. Willingness to ERP implementation implies behavioral intention to use.

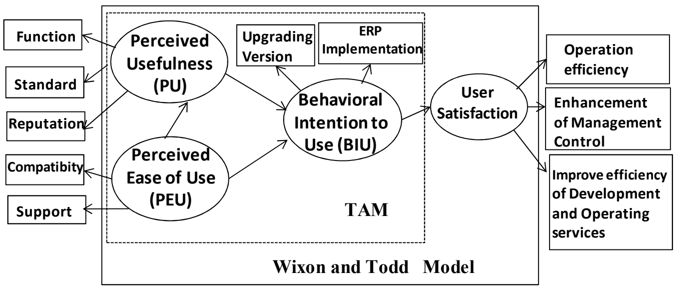


Fig. 1: Research Model.

D-4. User Satisfaction (US)

H-8: Operational Efficiency

Users' satisfaction gained by operational efficiency, such as shorten the closing date based on the standardization, improvement of a supply chain management (SCM) business, and internal controls, through the ERP implementation.

H-9: Enhancement of management control

Users' satisfaction gained by the enhancement of management control (*i.e.* real-time management information and understanding, rapid strategy utilizing business intelligence).

H-10: Improve Efficiency

Users' satisfaction gained by improving efficiency of development and operation services (*i.e.* shorter development periods, lower development and operating costs).

4. Surveys

Data were collected through a survey conducted by IT Leaders and ERP Forum Japan in May, 2011. They amassed 266 valid responses. The survey was conducted in the form of a web questionnaire, and respondents were solicited via an e-mail magazine to readers of IT Leaders. This data can conceivably be valuable since the respondents concerned are individuals with awareness of IT issues.

Most of the questionnaires are asked by 5 point scale. A list of sample characteristics is shown in Table I.

5. Results -The Structural Model Analysis

Testing the efficacy of the structural model was conducted by AMOS 20, and the major results of analysis are shown in Figure 2. The path diagram highlights the structural relationships. In this diagram, the measured variables are enclosed in boxes, latent variables are circled, and arrows connecting two variables represent relations, and open arrows represent errors. By means of various goodness-of-fit indexes, including the normed (NFI) indexes, the comparative fit index (CFI) [2], the incremental fit index (IFI) [4], and the root mean squared error of approximation (RMSEA) [5], the estimated matrix can be evaluated against the observed sample covariance matrix to determine whether the hypothesized model is an acceptable representation of the data. In general, incremental fit indexes (i.e., NFI, CFI, and IFI) above 0.90 signify good model fit. RMSEA values lower than .08 signify acceptable model fit, with values lower than .05 indicative of good model fit [5]. Based on these indexes, our result was regarded as acceptable. Table II presents the results of hypothesis. The modified structural model did improve the model fit significantly as shown in Figure 3; NFI=0.936, IFI=0.981, CFI=0.980, RMSEA=0.039, and AIC is lower than the original structural model. Multicollinearities between PU and BIU, and, between PEU and BIU, have also resolved.

6. Conclusions and Future Research

This study applied Wixon and Todd [34]'s integrated model of user satisfaction and technology acceptance on ERP Implementation. The survey data from 266 ERP users were analyzed using structural equation modeling. Overall the results are largely consistent with the hypothesized model, except “Upgrading Version” was not related to Behavioral Intention to Use at all. It implies that some companies keep using the old version due to associated high cost for upgrading.

In this study, the integrated model of user satisfaction and TAM model empirically provide the conceptual understanding of the difference between object-based beliefs and attitudes and behavioral beliefs and attitudes toward use as suggested by [34]. ERP survey will be conducted annually, and the authors are planning to continue studying the relationships proposed in the integrated model.

Table. 1 :Sample Characteristics

		Effective data	Percentage (%)
Industry Group	Manufacturing and Construction	136	51.13
	Distribution	32	12.03
	Service	45	16.92
	Information Services	48	18.05
	Others	5	1.88
Size by Sales	over one trillion yen	13	4.90
	100 billion ～ one trillion yen	55	20.60
	30 billion ～ 100 billion yen	43	16.10
	5 billion ～ 30 billion yen	89	33.40
	less than 5 billion yen	66	24.80
Size by Number of Employees	less than 299 people	66	24.81
	300-999	30	11.28
	1,000-4,999	22	8.27
	5,000-9,999	7	2.63
	over 10,000	9	3.38

		Effective data	Percentage (%)
Operation efficiency	Poor	31	11.7
	Deficient	91	34.2
	Good	134	50.4
	Excellent	10	3.8
Enhancement of Management control	Poor	55	20.7
	Deficient	124	46.6
	Good	82	30.8
	Excellent	5	1.9
Improve efficiency of Development and operating service	Poor	49	18.4
	Deficient	114	42.9
	Good	94	35.3
	Excellent	9	3.4
Overall evaluation	Poor	36	13.5
	Deficient	116	43.6
	Good	106	39.8
	Excellent	8	3.0

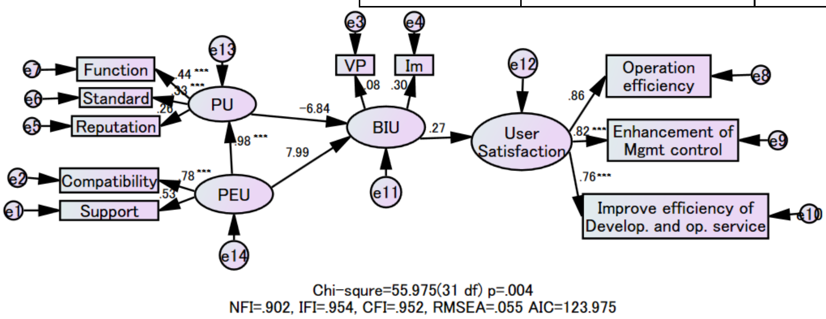
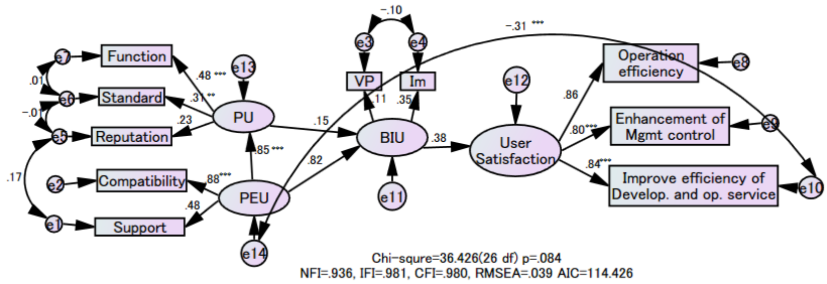


Fig. 2: The Estimated Structural Model



***significant at 0.01 level, **significant at 0.05 level

Fig. 3: The Modified Structural Model

Table. 2: Results of Hypotheses

D-1. Percieved Usefulness(PU)		D-3. Behavioral Intention to Use	
H-1: Function	+***	H-6: Upgrading Version	+
H-2: Standard	+**	H-7: ERP Implementation	+
H-3: Reputation	+		
D-2. Perceived ease of use (PEU)		D-4. User Satisfaction (US)	
H-4: Compatibility	+***	H-8: Operational Efficiency	+
H-5: Support	+	H-9: Enhancement of mana	+***
		H-10: Improve Efficiency	+***

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