An Empirical Research of Successful ERP Implementation Based on TAM

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Abstract. The issues of enterprise resource planning (ERP) implementation have been given much attention due to its high failure rate. Some researches were focused on the influence of perceived use (PU) and perceived ease of use (PEU) on attitude and symbolic adoption based on the theory of technology acceptance model (TAM). Others studied the critical success factors from organizational or personal aspects. However, few scholars put them together to examine the influence of critical success factors on PU and PEU, which are key factors to user acceptance to ERP system. This study develops an integrative framework that links leadership's support, training abilities, change management abilities, business processing abilities and learning abilities with PU and PEU. The present structural equation model encompasses these relationships on the basis of a survey of 340 managers and end-users. This paper highlights two main results. First, leadership's support and training abilities have significant impacts on organizational business processing abilities. Second, change management abilities, business processing abilities and learning abilities, have significant impacts on user perceived ease of use. These findings will help managers to understand that user's perceived ease of use should be considered on organizational level in the construction and implementation of an ERP system.

Keywords: *Enterprise resource planning (ERP), Enterprise management, Enterprise information systems, Enterprise systems organizational issues, Human resource management, Business process reengineering, Technology acceptance model, Critical success factors*

1. INTRODUCTION

The enterprise resource planning (ERP) systems were introduced to enterprise mainly for improving information share and communication at first. Some researchers tried to find out what influences the acceptance of information system like ERP. They treat ERP as a new information technology. The technology acceptance model (TAM) was introduced as the fundamental model. A lot of variables were studied to test their impacts on user perceived use (PU) and perceived ease of use (PEU). Other researches were concentrated on the critical success factors. They try to find out some critical success factors to predict the adoption and implementation effectiveness of ERP systems. There are more than twenty factors identified. But how these factors

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influence the adoption and implementation effectiveness is still unknown. They may have direct impact on adoption or they may influence adoption through other variables like PU or PEU. Some critical success factors may be mediate. This study tried to find out the impacts of some critical success factors on PU and PEU of TAM. An integrative framework was developed which links leadership's support (LD), training abilities (TR), change management abilities (CM), business processing abilities (CM) and learning abilities (LG) with PU and PEU. The present structural equation model encompasses these relationships on the basis of a survey of 340 managers and end-users. The paper highlights two main results. First, LD and TR have significant impacts on organizational BP. Second, CM, BP and LG have significant impacts on PEU. These findings will help the manager to understand that user's perceived ease of use should be considered on organizational level in the construction and implementation of an ERP system.

2. LITERATURE REVIEW

The proposed framework in this research is based on researches in several fields, which concern technology acceptance, diffusion of innovation and critical success factors. These literatures which provided the necessary theoretical foundations in this study were briefly discussed in the following sections.

2.1 Researches on the Technology Acceptance

User attitude and behavioral intention have received much attention in literatures. Several models were developed from the aspect of social psychology: the theory of reasoned action (TRA) was proposed by Fishbein et al. [1] and Ajzen et al. [2]; the theory of planned behavior (TPB) was proposed by Ajzen [3, 4]; the technology acceptance model (TAM) was proposed by Davis [5]. TPB was an extension of TRA by taking into account of the effects of a use's volitional control on behavioral intention. TAM focuses on user acceptance of new technology. The PU, PEU and AT are three main aspects of TAM. They are the key determinants of user intentions. In parsimonious TAM [6], the attitude which was treated as a mediating variable was excluded.

In the implementation of ERP system, the adoption of ERP package is mandatory in most cases. Thus, a new variable was needed to substitute for behavioral intention to examine users' acceptance. Some researches [7, 8] proposed a new construct called symbolic adoption, which refers to one's mental acceptance to a new technology.

2.2 Researches on Diffusion of Innovation

Diffusion of innovation (DOI) is a similar model to TAM. Tornatzky et al. [9] reported the relationship between innovation characteristics, relative advantage, complexity and compatibility with adoption behavior. Relative advantage was found

similar to the notion of usefulness and complexity similar to ease of use [5]. In this research, we use TAM as our primary model.

2.3 Researches on Critical Success Factors

The concept of critical success factors has been well established in the information system literatures. While the implementations of ERP differ from traditional information systems in many aspects such as scale, complexity, business changes, etc., a more suitable theoretical frame or variables need to be developed for a successful ERP implementation.

Holland et al. [10] proposed a framework for understanding success and failure in ERP implementation. In that research, the critical success factors were divided into the strategic and tactical headings. Based on literature review, Nah et al. [11] identified 11 key critical factors for successful ERP implementation. Somers et al. [12] proposed a comprehensive list of 22 critical success factors through an extensive review of the literature. Based on these three researches, a lot of studies were conducted from different aspects [13-20]. Most of these researches were trying to find out the relationship between critical success factors and implementation effectiveness.

3. MODEL AND HYPOTHESES

In this study, TAM is proposed as the fundamental model using symbolic adoption which substitutes for the traditional behavior intention. Therefore, it is hypothesized that:

H1: PEU will have a positive effect on PU.

H2: PEU will have a positive effect on AT.

H3: PU will have a positive effect on AT.

H4: AT will have a positive effect on SA.

H5: PEU will have a positive effect on SA.

H6: PU will have a positive effect on SA.

Altogether 11 to 22 critical success factors were proposed in literatures to explore their impacts on user acceptance or implementation effectiveness. Some critical success factors work on organizational level or personal level both. Others only work on personal level.

The learning ability (LG) refers to activities a company taken to identify cutting-edge ERP technique and pilot-test new methods of using capabilities of ERP system [21]. These organizational activities will improve the use of ERP on personal level. User perceived ease of use of ERP system may by improved through constant learning and pilot-testing of new way of using. Therefore, it is hypothesized that:

H7: LG will have a positive effect on PEU.

The business process ability (BP) refers to a clear process definition and strict compliance with the process. In most case, ERP packages were built around best practices in specific industries, they may not fit the practices of a special corporation. A company needs to customize the package or change its business process [22]. BP

will help employees to understand how the business operates and predict the impact of a particular action on the rest of the enterprise [23]. The business process of an enterprise will influence the fluency of user's work and then his perceived ease of use of an ERP system. Therefore, it is hypothesized that:

H8: BP will have a positive effect on PEU.

No matter how detailed the package or reengineering business process is customized, the work style of employees may change more or less. The change management ability (CM) refers to the managerial efforts which could help employees to adapt to or lower their worry of new process after implementation of ERP. These efforts will ease user attitude to change. Employees who have positive attitude to organizational change trend to believe that using new information system will help them attain gains in job performance. They believe that the system will give benefits to individuals and organization. User involvement in the design of a new information system may improve his attitude toward change [24]. The impacts of attitude to change on PU and PEU were reported [25]. Therefore, it is hypothesized that:

H9: CM will have a positive effect on PU.

H10: CM will have a positive effect on PEU.

The impacts of the degree of resistance to change from users across the organization on degree of BPR execution were reported [26]. An adequate change management can help employees understand how to adapt to their new duties. Members in organization will benefit from this to understand how the business operates and predict the impact of their own work on organizational goal. Therefore, it is hypothesized that:

H11: CM will have a positive effect on BP

Training ability (TR) refers to activities a company taken to teach general ERP concepts or hands-on operational skills. It included the need specification, preparation of material and training execution. All these require an overall consideration from organizational and business level. Therefore, it is hypothesized that:

H12: CM will have a positive effect on TR.

Training could help employees to understand how ERP affects the work of individuals, how to deal with conflicts created in implementation and how to adjust individual working process etc. Members in organization will benefit from this to understand and strictly comply with the process after the implementation. Therefore, it is hypothesized that:

H13: TR will have a positive effect on BP.

Since ERP implementation includes technological, operational, managerial components from strategic and organizational aspects, ERP may differ from other information technology or information system [27]. ERP is an enterprise-wide, cross-functional implementation. Both business process re-engineering and change management are beyond the scope of middle level manager and need to be promoted in the whole organization [13, 14]. The champion of ERP from leadership (LD) may minimize user resistance to change and hence improve the adoption through the whole organization [22]. Therefore, it is hypothesized that:

H14: LD will have a positive effect on CM.

H15: LD will have a positive effect on BP.

H16: LD will have a positive effect on SA.

The model we proposed is demonstrated in Figure 1.

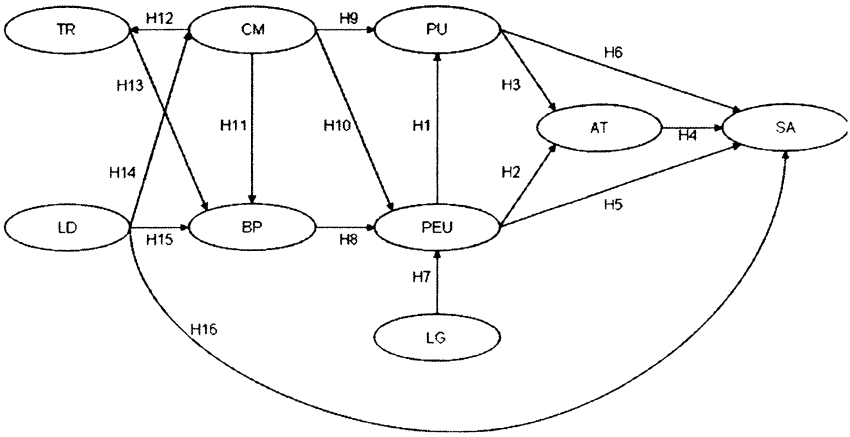

Figure 1. Proposed Structure Model

4. RESEARCH METHOD

Data were collected though questionnaires to test the hypotheses. The sample for this study consisted of ERP manager and users in more than thirty organizations. After five months, we obtained valid 340 answers out of 420 feedback questionnaires. The questionnaire items used a 5-point Likert-type scale. Each of these measures contained subscales ranging from 2 to 7 items.

A scale is thought to have content validity if the scale's items form a representative sample in the theoretical domain of the construct [28, 29]. In this study, we use the usual method of ensuring content validity which is extensive review of literatures. To ensure the content validity of the scale, items used in this study were mostly adopted and modified from previous studies which had been tested.

The most common method to measure the reliability of Likert scales is Cronbach's alpha. Normally, Cronbach's alpha more than 0.6 could be accepted. Cronbach's alpha within the range from 0.7 to 0.9 means high level of reliability. Cronbach's alpha and regression coefficient (R^2) were used to test the reliability and validity of the measures. Cronbach's alpha of all the variables in this research all stay above the level of acceptance. The measurement model was evaluated by completely standardized factor loadings and t-values. The values are showed in Table 1.

5. RESULTS

The data were analyzed using the LISREL structural equation modeling program (LISREL 8.72). To determine model quality, multiple gauges of goodness of fit were used. Absolute, incremental and parsimony fit indices [30] of the proposed model were reported in Table 2, 3, 4.

Table 5. Related Statistical Values of Factors and Scales

Factor	Indicator	Completely Standard factor loading	T-value	R^2	Cronbach's α
BP	BP1	0.721		0.519	0.862
	BP2	0.717	12.675	0.514	0.863
	BP3	0.696	12.297	0.484	0.867
	BP4	0.768	13.580	0.590	0.858
	BP5	0.678	11.991	0.460	0.867
	BP6	0.723	12.787	0.523	0.862
	BP7	0.703	12.436	0.495	0.867
TR	TR1	0.667		0.444	0.870
	TR2	0.751	12.204	0.565	0.860
	TR3	0.819	13.100	0.672	0.852
	TR4	0.792	12.752	0.628	0.854
	TR5	0.706	11.573	0.498	0.862
	TR6	0.636	10.559	0.404	0.872
	TR7	0.665	10.987	0.442	0.869
CM	CM1	0.856		0.732	0.848
	CM2	0.808	18.165	0.653	0.855
	CM3	0.674	13.948	0.454	0.869
	CM4	0.685	14.249	0.469	0.866
	CM5	0.649	13.248	0.421	0.867
	CM6	0.775	17.020	0.600	0.848
PU	PU1	0.876		0.768	0.892
	PU2	0.906	23.430	0.821	0.864
	PU3	0.882	22.364	0.778	0.892
PEU	PEU1	0.818		0.670	0.822
	PEU2	0.791	16.114	0.625	0.845
	PEU3	0.872	18.052	0.760	0.776
AT	AT1	0.937		0.878	
	AT2	0.919	29.073	0.844	
SA	SA1	0.866		0.749	
	SA2	0.564	11.476	0.318	
LD	LD1	0.705	14.269	0.496	0.824
	LD2	0.778	16.383	0.606	0.814
	LD3	0.684	13.723	0.468	0.832
	LD4	0.731	15.010	0.535	0.820
	LD5	0.721	14.723	0.520	0.814
LG	LG1	0.709	14.138	0.502	0.825

Factor	Indicator	Completely Standard factor loading	T-value	R^2	Cronbach's α
	LG2	0.777	16.016	0.604	0.789
	LG3	0.790	16.400	0.625	0.787
	LG4	0.760	15.526	0.577	0.802
overall					0.958

Table 6. Absolute Fit Indices of the Proposed Model

Fit Indices	Absolute					
Name	X^2 / df	GFI	RMSEA	RMR	SRMR	AGFI
Value	3.601	0.831	0.087	0.094	0.061	0.893

Table 7. Incremental Fit Indices of the Proposed Model

Fit Indices	Incremental		
Name	CFI	NNFI	IFI
Value	0.962	0.959	0.962

Table 8. Parsimony Fit Indices of the Proposed Model

Fit Indices	Parsimony	
Name	PGFI	PNFI
Value	0.641	0.873

The model exhibited an overall good fit, with several exceptions. GFI at 0.831 and AGFI at 0.893 were slightly below but close to the recommended level 0.90. Although the GFI level could be improved by dropping some items, the dropping procedure was stopped by the consideration on the content of the measurement. RMSEA at 0.087 and SRMR at 0.061 were slightly above but close to the recommended level.

The structural model was evaluated by standardized path estimates and t-values. Path coefficients of latent variable refer to direct influence of reason variables to result variables. Absolute T value greater than 1.96 (α=0.05) means significant level. Parameter Estimates are showed in Table 5. Fifteen among sixteen proposed direct relationship are statistically significant. H1, H2, H3, H4 and H6 were supported, the results confirmed the TAM. The result indicates that AT should be a mediate variable to the impact of PEU on SA. H7 was supported, the result indicated that learning activities a company taken will improve user perceived ease of use of ERP system. H8 was supported, the result indicated that a clear process definition and strict compliance with the process will help employees to understand how the business operates, thus improve their perceived ease of use of the ERP systems. H9 and H10 were supported, the results indicated that managerial efforts on change management will improve user perceived use and ease of use of an ERP system. H11 was supported, the result indicated that an adequate change management can help employees understand and comply with the new business process after the implementation of ERP. H12 was supported; the result indicated that change

management from organizational and business level will help employees to get benefit from training activities. H13 was supported; the result indicated that training could help employees to deal with conflicts created in implementation and adjust individual working process to comply with the ERP business process. H14, H15 and H16 were supported; the results indicated that leadership support is a fundamental factor which will influence change management, business process and symbolic adoption.

Table 9. Parameter Estimates and Hypotheses Test

Hypotheses		Std. loading	T-value	Conclusion
H1	PEU→PU	0.518	8.353	Supported
H2	PEU→AT	0.486	6.746	Supported
H3	PU→AT	0.293	4.269	Supported
H4	AT→SA	0.920	16.104	Supported
H5	PEU→SA	-0.095	-1.502	
H6	PU→SA	0.149	2.704	Supported
H7	LG→PEU	0.207	3.439	Supported
H8	BP→PEU	0.268	3.059	Supported
H9	CM→PU	0.354	6.176	Supported
H10	CM→PEU	0.272	3.167	Supported
H11	CM→BP	0.276	3.233	Supported
H12	CM→TR	0.685	10.268	Supported
H13	TR→BP	0.213	3.353	Supported
H14	LD→CM	0.730	12.864	Supported
H15	LD→BP	0.438	5.928	Supported
H16	LD→SA	0.110	2.589	Supported

6. CONCLUSIONS

The critical success factors have been identified and tested in literatures for years, but in which way these critical success factors influence implementation of ERP system is still unclear. This research tested the impacts of some critical success factors on the user perceived use and ease of use based on TAM. The results confirmed the impacts of change management, business process and learning ability on perceived use and ease of use. Change management ability will contribute to the definition and clarification of business process. Good change management could provide suitable and enough training to employees, helping them to understand and comply with the new business process. Leadership champion of ERP plays a fundamental part in the support of change management, business process and the overall symbolic adoption of ERP system.

In general, the results imply that the implementation environment such as leadership support, change management, business process are critical to user perceived use and ease of use of an ERP system, they influence the adoption then the implementation effectiveness of an ERP system. To pursue a successful

implementation, it is vital to create a suitable atmosphere around the enterprise. The more useful and easier to use an ERP system, the more value the system will produce.

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