INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

ERP Solutions Acceptance in Different Business Environments

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Abstract:
Experience with Enterprise resource planning (ERP) solutions in numerous organizations over the last decade indicates that successful implementation of ERP solutions does not necessarily lead to successful ERP usage. ERP systems benefit organizations only to the extent that users accept and utilize them frequently and extensively. To improve the efficiency and effectiveness of ERP systems in their maturity stage of use, organizations need to understand the factors that impact user satisfaction. Technology acceptance model (TAM) proposed by Davis (1989) has been widely used and it is proven that it can enhance understanding of the influences that increase the efficiency and effectiveness of ERP system use. Our research which is based on TAM, is focused in ERP acceptance from the viewpoint of ERP users and we studied additional external factors, which can influence users' acceptance of ERP system. After research conducted in EU same research have been recently conducted in Gujarat in India.

Keywords: *Enterprise Resource Planning (ERP), technological acceptance model (TAM), partial least squares (PLS), maturity model*

1. Introduction

Enterprise resource planning (ERP) solutions have been implemented in most organizations recently, but it seems that organizations are unable to point out the most important impacts of their ERP systems. Supposedly, the use of ERP solutions significantly reduces the time to complete business processes and helps organizations share information [1] generally offer a better work environment for their users as they are given a more efficient system with which to work. However, instead, ERP systems have been plagued with high failure rates and an inability to realize the promised benefits [2]. Much of the success of ERP implementation lies in the maturity use phase of the ERP lifecycle. After the stabilization stage, companies enter a maturity stage during which time they should put more effort into people and process improvements [3]. In this stage, users accept the system, and the usage becomes a regular day-to-day activity.

To improve the efficiency and effectiveness of ERP system use, organizations need to understand factors that impact user satisfaction. Technology acceptance model (TAM) is one of the most widely used models for explaining the behavioral intention and actual usage and can improve our understanding of how influence on actual usage could help increase efficiency and effectiveness of ERP system use [4]. A review of the literature indicates that, in recent years, only a few studies examining users' adoption of ERP systems through TAM have been published (for the latest research, see [1], [4], [5], [6], [7]). However, all of them examine a few contextual factors that influence the intention to use an ERP system or ERP use in the stabilization stage. In addition, very few studies have been conducted regarding technology acceptance of ERP systems, especially those dealing with autonomous ERP users (i.e., [6]).

The goal of this paper is to present research regarding extended number of external factors that potentially influence attitudes and behaviour related to ERP use in the operation phase of the ERP lifecycle. Because of the large sample size required to apply TAM to multiple individual variables, we combine external factors into three groups: personal characteristics and information literacy (PCIL); system and technological characteristics (STC); and organizational-process characteristics (OPL). Within previous research conducted in EU we collected survey data from 293 users in organizations where ERP solution has been implemented. Recently we conducted same research in Gujarat in India where we collected survey data from 508 users. In all organizations ERP has been in operation for several years. Partial least squares (PLS) have been used to analyse the data. The rest of this paper is organized as follows: literature review, ERP acceptance model, methodology, results and analysis, discussion, and conclusion.

2. Technology Acceptance Model and ERP Solutions

Several theoretical models have been used to investigate the determinants of acceptance and use of new information technology (IT), such as the theory of reasoned action (TRA; [8]), the theory of planned behavior (TPB; [9]), and the theory of the technology acceptance model (TAM; [10]). Compared to competing models, TAM is believed to be more parsimonious, predicative, and robust ([11], [12], [13]); consequently, among the theoretical models, it is the most widely used by IS/IT researchers ([1], [10], [14], [15]). The key purpose of TAM is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions [10].

TAM posits that two beliefs—perceived usefulness (PU) and perceived ease of use (PEOU)—are of primary relevance for computer acceptance behavior [10]. PU is defined as 'the degree to which a person believes that using a particular system would enhance his or her job performance' ([15], p. 320). In contrast, PEOU refers to 'the degree to which a person believes that using a particular system would be free of effort' ([15], p. 320). The two central hypotheses in TAM state that PU and PEOU positively influence an individual's attitude towards using a new technology (AT), which in turn influences his or her behavioral intention (BI) to use it. Finally, intention is positively related to actual use (AU). TAM also predicts that PEOU influences PU; as Davis et al. ([10], p. 987) explained, 'effort saved due to improved perceived ease of use may be redeployed, enabling a person to accomplish more work for the same effort'.

A review of past ERP studies regarding TAM indicates that few studies have investigated ERP user acceptance and usage, and only a small number of articles have been published. Furthermore, all of them expose small numbers of external factors which could influence ERP acceptance and usage in different phases of an ERP system lifecycle (see Table 1). As several studies (i.e., [16], [17]) have revealed, a common reason for ERP failures can be attributed to users' reluctance and unwillingness to adopt and use the implemented ERP system. A better understanding of the factors leading ERP users' acceptance of ERP systems is necessary to facilitate successful ERP usage [16]. In the current study, we aim to identify factors leading users to better use of their ERP system. Thus, the goal of our research is to expand the basic TAM with more generic contextual factors and examine their influence on perceived ERP usefulness and perceived ERP ease of use. Studying the influence of external factors on constructs not only contributes to the theory development, but also helps in designing interventional programs for organizations.

3. Research Methodology and Results

Synthesizing prior research on TAM and research on ERP systems, a conceptual model that represents the cumulative body of knowledge from TAM and ERP research over the years has been developed (see Figure 1). The grey area within the dotted line denotes the original TAM. Because our research is focused on a group of external factors which influence the current usage of ERP system in the routine stage, there is no need to examine the behavioral intention on use and actual use; thus, behavioral intention and actual use were dropped from purposed research model.

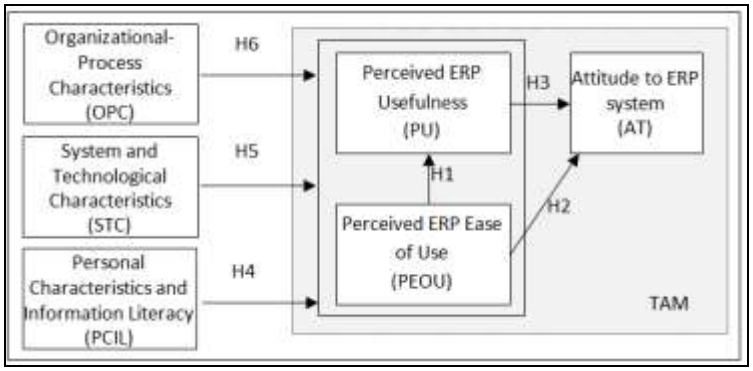

Figure 1: Conceptual Model

According to Davis perceived ease of use influences perceived usefulness while both perceived usefulness and perceived ease of use influence attitude toward using the system [15]. The problem of TAM research is that most researchers investigate small numbers of external factors that influence user acceptance and usage. In the context of ERP systems, more external factors exist that can influence users' acceptance. Thus, the conceptualization of higher-order factors (in our case second-order factors), in which more external factors jointly have to be included, have to be investigated if we want to extend our understanding of user behavior in ERP settings.

The constructs of the purposed model—perceived ERP usefulness, perceived ERP ease of use, and attitude toward ERP use for basic TAM of ERP systems—are influenced by constructs of external variables. The constructs of external variables are distributed among three second-level constructs: personal characteristics and information literacy (PCIL), system and technological characteristics (STC), and organizational-process characteristics (OPC). PCIL includes experience with computer, computer self-efficiency, personal innovativeness toward IT, and computer anxiety. STC includes ERP data quality, ERP system functionality, ERP system performance, and user manuals (help). OPC includes social influence, fit with business processes, ERP training and education, ERP support, and ERP communication. Thus, our model includes 17 first-order factors and 3 second-order factors.

All the items of factors were measured on a 7-point Likert scale, ranging from 'strongly disagree' to 'strongly agree'; the scale was adopted from relevant prior research and adapted to relate to the context of ERP usage. In addition, demographic information was

collected. The instrument was pilot tested with a group of 30 ERP users in one organization. Based on the results of the pilot testing, revisions and additions were made to the instrument. Pilot participants were included in the main data gathering effort since they were part of the population of interest.

Models, which include second-order factors, consist of higher-order factors that are modeled as causally impacting a number of first-order factors (i.e., standard factors with measured indicators; [23]). Therefore, these second-order factors are not directly connected to any measurement items. The partial least squares (PLS) approach allows the conceptualization of higher-order factors by repeated use of manifest variables [24]. The empirical data were analyzed in two stages involving a PLS technique, using Smart PLS 2.0 M3 [25]. In the first stage, all measurement scales were examined for their psychometric properties; the second stage focused on hypothesis testing and analysis. Path significance was estimated using bootstrapping resampling techniques with 500 sub-samples. Detailed results and analyses can be obtained from the authors.

First the research study in EU has been conducted. 293 questionnaires were properly filled out by respondents from 44 organizations and used for the analysis. Respondents were 51.5% male and 48.5% female. Most (67.2%) had a high school education or more. More than half (53.6%; 157 respondents) indicated that they were workers (experts and other employees); others indicated low management (e.g. manager of group or organization unit), middle management (e.g., CIO) or corporate government and/or top management. The average total working years was 15.4 years, and average working years at their current workplace was 7.6 years. The ERP system had been used for 4.73 years, on average.

Recently same research study has been conducted in Gujarat in India. 508 questionnaires were properly filled out by respondents from 10 organizations and used for the analysis (average 50.8 people per company). Respondents were 77 % male and 23 % female. Most (95.1%) had a high school education or more. 36 % (183 respondents) indicated that they were workers (experts and other employees), 40,6% (206 respondents) indicated low management (e.g. ,manager of group or organization unit), 20,5% (104 respondents) indicated middle management (e.g., CIO) and other indicated corporate government and/or top management (2,9 %). The average total working years was 7.44 years, and average working years at their current workplace was 5.66 years. The ERP system had been used for 4.91 years, on average.

We examined composite reliability (*CR*) as measure of reliability. As shown in Table 1 each of our 11 scales had composite reliability exceeding 0.7, assuring adequate reliability for our measurement scales.

		EU				India			
Construct	**Indicators**	**Item Mean**	**Loadings [c]**	**CR**	**AVE**	**Item Mean**	**Loadings [c]**	**CR**	**AVE**
Personal Innovativeness Toward IT	pcil_pi1	5.40	0.86	0.91	0.77	4.57	0.83	0.85	0.66
	pcil_pi2	4.57	0.86			4.53	0.78		
	pcil_pi3	5.14	0.92			4.60	0.84		
Computer Anxiety	pcil_ca1 [a]	1.57	0.87	0.87	0.69	2.65	-	-	-
	pcil_ca2 [a]	1.42	0.87			2.70	-		
	pcil_ca3	6.37	0.73			5.17	-		
Data Quality (Content)	stc_dq1	5.41	0.82	0.93	0.69	5.26	0.85	0.86	0.61
	stc_dq2	5.43	0.85			5.33	0.80		
	stc_dq3	4.90	0.82			5.40	0.72		
	stc_dq4	5.41	0.88			5.39	-		
	stc_dq5	4.96	0.85			5.17	-		
	stc_dq6	5.21	0.74			5.20	0.75		
System Performance	stc_sp1	5.14	0.79	0.90	0.64	5.29	-	-	-
	stc_sp2	5.14	0.72			5.18	-		
	stc_sp3	5.45	0.87			5.47	-		
	stc_sp4	5.33	0.73			5.39	-		
	stc_sp5	5.23	0.88			5.33	-		
User Manuals (Help)	stc_um1	5.00	0.88	0.91	0.76	5.24	-	-	-
	stc_um2	5.00	0.84			5.32	-		
	stc_um3	4.54	0.90			5.32	-		
Business Processes Fit	opc_bpf1	5.61	0.91	0.94	0.84	5.33	-	-	-
	opc_bpf2	5.56	0.89			5.31	-		
	opc_bpf3	5.39	0.89			4.61	-		
Social Influence	opc_si1	5.94	0.76	0.90	0.68	5.24	0.85	0.85	0.65
	opc_si2	6.01	0.79			5.36	0.83		
	opc_si3	5.98	0.88			5.41	0.74		
	opc_si4	6.03	0.87			5.02	-		
Usefulness	us1	5.51	0.91	0.97	0.89	5.24	0.81	0.88	0.58
	us2	5.44	0.96			5.34	0.80		

	us3	5.49	0.97			5.39	0.77		
	us4	5.40	0.93			5.48	0.65		
Ease of Use	eou1	5.25	0.94	0.93	0.87	5.23	0.85	0.79	0.66
	eou2	4.90	0.93			5.42	0.77		
Attitude toward ERP	at1	5.93	0.94	0.95	0.90	5.40	0.87	0.82	0.69
	at2	5.68	0.96			5.48	0.79		

Table 1: Psychometric properties of the instrument (n_{EU}=293, n_{India}=508) [b]

[a] Items have been inverted before processing of statistical data in SmartPLS.
[b] *CR* = Compose Reliability; *AVE* = Average Variance Extracted
[c] A loadings is significant when above 0.50 [26], scale reliability is considered satisfactory when the composite reliability (*CR*) is above 0.70 [27] and convergent validity is considered satisfactory when the *AVE* is above 0.50 [28].

The final version of EU model is presented in Figure 2. Because all of the external factors did not meet assessment requirements of the measurement model, we excluded them from further analysis. These external factors included computer self-efficacy and experience with computer from PCIL group, ERP functionality from STC group and ERP support, ERP communications and ERP training, and education from OPC group (dotted shapes in Figure 2).

The final version of India model is presented in Figure 3. Because all of the external factors did not meet assessment requirements of the measurement model, we excluded them from further analysis. These external factors included computer anxiety, computer self-efficacy and experience with computer from PCIL group, system performance, user manuals and ERP functionality from STC group and business processes fit, ERP support, ERP communications and ERP training, and education from OPC group (dotted shapes in Figure 3).The next step in analysis was to examine the path significance. The hypotheses testing results are based on bootstrapping (with 500 subsamples) to test the statistical significance of each path coefficient using *t*-tests, as recommended by Chin [23]. Results of this analysis are shown in Figure 2 and Figure 3.

Empirical research has shown support for original relationships of TAM in ERP settings in the routine stage (for example, see [1], [4], [6], [20]). As shown in Figure 2 and in Figure 3, our research confirms their results of the influence of perceived ERP ease of use (PEOU) and perceived ERP usefulness (PU) on attitude toward using ERP system (hypotheses H2 and H3) as well as influence of perceived ERP ease of use (PEOU) on perceived ERP usefulness (PU).

Figure 2 and Figure 3 also indicates that the loadings of the first-order factors on the second-order factors exceed 0.7, and second-order factors have significant positive effect on ERP usefulness and on ERP ease of use. PCIL has a weak but significant positive effect on ERP ease of use (EU: b = 0.11, p<0.05; India: b = 0.26, p<0.01) in both models. STC has a strong positive effect on perceived ERP ease of use (EU: b = 0.61. p<0.01) in EU model and strong positive effect on perceived ERP usefulness (India: b=0.45, p<0.01) in India model. OPC has a strong positive effect on perceived ERP usefulness in both models (EU: b = 0.45. p<0.01; India: b = 0.29, p<0.01) and also strong effect on perceived ERP ease of use in India model (India: b=0.45, p<0.01).

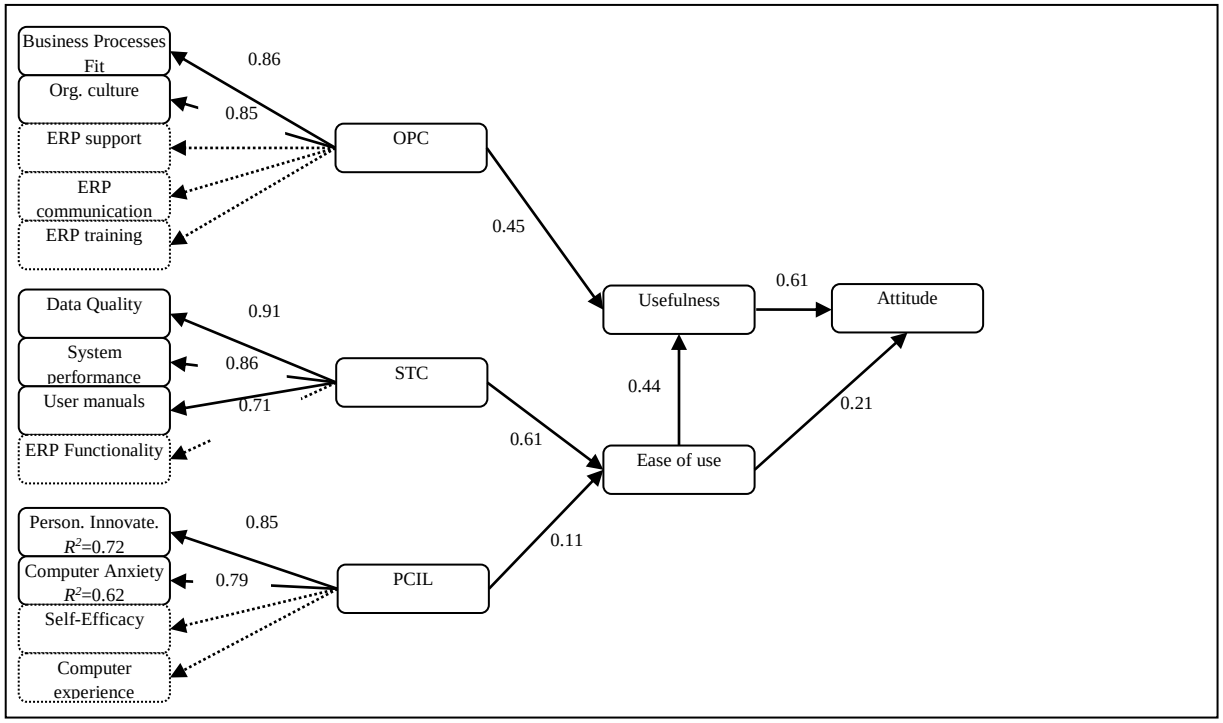

Figure 2: Results of structural model analysis EU[a]

*[a] Path significance: ** p < 0.01, * p < 0.05, n.s. = not significant (shapes are marked dotted).*

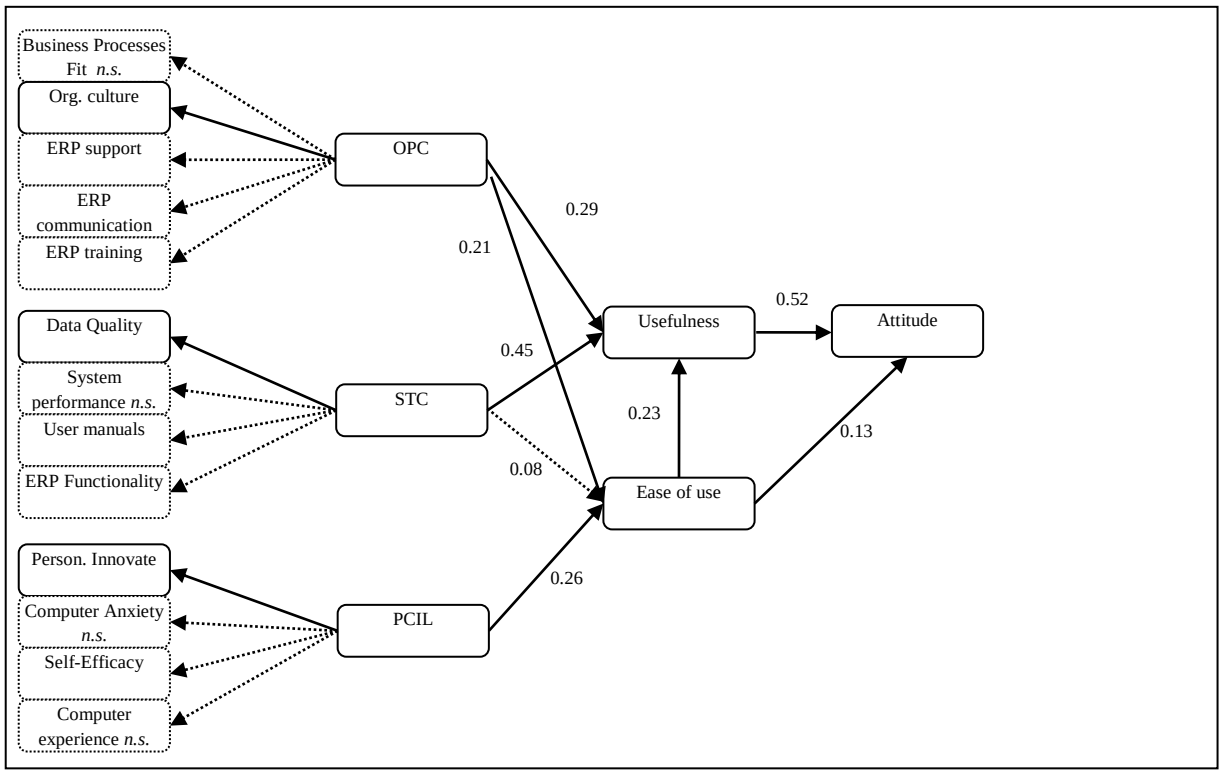

Figure 3: Results of structural model analysis India[a]

*[a] Path significance: ** p < 0.01, * p < 0.05, n.s. = not significant (shapes are marked dotted).*

4. Conclusion

Although the most important contributions of ERP systems are that they significantly reduce the time to complete business processes, help organizations share information [1], and lead organizations to offer a better work environment for their employees as by providing them a more efficient system with which to work, ERP systems have been plagued with high failure rates and an inability to realize promised benefits [2] in the maturity stage of the operational phase. One of the most important reasons seems to be that ERP users do not use it properly. The aim of this research was to improve the understanding of how the influence of 13 external factors can increase the degree of attitude of ERP users toward the ERP system. This work extended previous research by incorporating groups of external factors—namely, personal innovativeness, computer anxiety, self-efficacy, and computer experience for the conceptual factor personal characteristics and information literacy (PCIL); data quality, system performance, user manuals, and ERP functionality for the conceptual factor system-technological characteristics (STC); and business processes fit, organizational culture, ERP support, ERP communication, and ERP training for the conceptual factor organizational-process characteristics (OPC). These three conceptual factors influence perceived ERP ease of use (PEOU) and perceived ERP usefulness (PU), which further influence attitude towards using the ERP system (AT). This study also employed structural equation modeling (PLS approach) to assess overall model fit to verify the causal relationships between factors. Studying the influence of more external factors on constructs and researching them in different business environments contribute to the theory development and also helps understanding potential cultural differences.

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