The Phases of ERP Software Implementation and Maintenance: A Model for Predicting Preferred ERP Use

Alan R. Peslak, Girish H. Subramanian & George E. Clayton

THE PHASES OF ERP SOFTWARE IMPLEMENTATION AND MAINTENANCE: A MODEL FOR PREDICTING PREFERRED ERP USE

ALAN R. PESLAK
Penn State University
Dunmore, PA 18512

GIRISH H. SUBRAMANIAN
Penn State Harrisburg

GEORGE E. CLAYTON
Penn State Harrisburg

ABSTRACT

Nearly all information technology educators and practitioners are familiar with the concept of a systems development life cycle (SDLC). The SDLC model is mainly based on new software development. The stages vary based on methodology, but mostly include planning and requirements definition, analysis, design of the new system, implementation, and post-implementation support such as maintenance and security. Less explored and known are the stages involved in commercial off the shelf installation. The actual implementation of commercial off the shelf software ERP (enterprise resource planning) systems is an area that is suggested to have a life cycle of its own. The importance of specific phases of this ERP implementation life cycle is the subject of this study. By surveying SAP enterprise resource planning implementations at two divisions of a major manufacturing company, a confirmatory factor analysis confirms the existence of four distinct phases of ERP implementation — preparation and training, transition, performance and usefulness, and maintenance. In addition, the overall preferred ERP use is studied and compared with these factors. It was found that the two significant phases which directly influenced preferred ERP use were preparation and training phase, and performance and usefulness phase. Neither transition nor maintenance was found to significantly affect preferred ERP use. This suggests to practitioners that more focus needs to be placed on the key determinants of preferred ERP use — preparation and training phase, and performance and usefulness phase.

Keywords: enterprise resource planning, systems development life cycle, preparation, training, performance, usefulness.

INTRODUCTION

One of the most important and costly processes in organizations today is the implementation of enterprise resource planning systems. An ERP system is an integrated commercial off-the-shelf (COTS) software package that can perform all the major business functions of an organization. These functions generally include all elements of the value chain from raw material purchases, inventory management, production, goods shipments, invoicing, accounting, and human resource management. ERP systems had their roots in manufacturing, including material resource planning, but quickly grew to include all the other related business functions. They now serve as the basic business systems for most of the large and mid-size organizations in the world today. The key elements of an ERP system according to Miller [32] are: one large real-time database which reduces data redundancy and improves accuracy; integrated business process that cut across business functions such as supply chain management; and seamless transitions between business transactions.

The importance and size of the ERP market have grown significantly. On the low end, it is estimated that ERP systems will exceed $11.9 billion in sales in 2007 [4]. Others suggest a 2004 market as high as $79 billion in 2004 [6]. According to Bingi, Sharma and Godla [9], seventy percent of the Fortune 1000 have or will have ERP systems. Fisher et al. [20] note that mid-level organizations are now a major market for ERP software implementations .With multiyear, multi-firm ERP implementation and financial data, firms that invest in ERP tend to show higher performance across a wide variety of financial metrics [26]. Clearly, with such a prevalent role in information technology, the importance of successful implementation of these systems is of great importance to practitioners. The massive ERP implementations that must take place within organizations are not without challenges. There have been many difficult and costly implementations of ERP systems that have adversely impacted many organizations including FoxMeyer Drug, Dell Computer, Applied Materials and Dow Chemical [16]. Over half of ERP implementations end in failure [8]. Hong and Kim [27] suggest even poorer results with 75% of "ERP projects judged to be unsuccessful." Scott and Vessey [43] believe that 90% of ERP projects are late. Huang et al. [29] note ERP systems cost "organizations a huge amount of money and manpower. Therefore, even major ERP vendors cannot guarantee the success of implementation." There can be gaps between business processes and software [23]. As a result, it is extremely important to understand factors that can influence success of an implementation.

The acceptance of new systems, particularly large systems that transform the organization, is of vital importance to organizations today. As noted by Robey et al.[42] "newer technologies such as enterprise resource planning (ERP) systems continue to be associated with the agenda of organizational transformation, . . . (yet) despite the transformation agenda accompanying the new system, users initially chose to avoid using it as much as possible (inertia) and later to work around system constraints in unintended ways". Soh, Sia, Boh, and Tang, M. [46] found many misalignment issues which can adversely impact ERP acceptance Resistance to acceptance of the new system can adversely affect use and reduce the gains that can be realized with successful implementation. It is vital that key drivers for ERP system preference be identified and measured.

The extent and nature of ERP use does determine ERP success [5] and hence the need to study the determinants of ERP use. This study then is a review and enhancement of a specific ERP implementation model and an organizational study of how phases in this model can influence and affect preferred use of ERP systems. The study uses systems development theory to build the ERP implementation model. Using data on ERP implementation at two divisions of a manufacturing organization, the important determinants of ERP use are extended and empirically confirmed.

LITERATURE REVIEW

ERP Implementation Models and Phases

Boudreau and Robey [10] as noted, suggest a vital importance to acceptance of ERP systems. Currently they note that if not successfully implemented, users may work around the system and otherwise doom the project to costly duplication of effort, or worse, system failure. A phased implementation approach is highlighted in Robey et al, [42]. It is important to have a structured approach, similar to systems development, for the implementation and maintenance of ERP systems.

Systems development theory uses the concept of a lifecycle and stages in the lifecycle to indicate development of information systems. The waterfall model, incremental model, RAD (rapid application development) model and spiral model are some of the systems development methods prevalent in the literature [39]. Newer approaches to systems development address component-based development using off-the-shelf packages, agile development and the unified process for object-oriented software development [39]. The newer approaches have fewer stages in the development of systems. For example, the unified process which draws upon the best practices of conventional software process models [39] has inception, elaboration, construction and transition phases. A common aspect of all these models is that they focus little attention on implementation and the post implementation of the system.

Empirical research has addressed issues that organizations face on and after implementation of systems. Specifically, several studies have looked at ERP implementation [1], [27], [42]. The implementation and performance stage model [31], [15] is a useful tool for understanding the implementation of the ERP technology and provides six stages: initiation, adoption, adaptation, acceptance, routinization, and infusion. This six-stage model sets the framework to investigate the implementation and performance issues of utilizing an ERP system within an organization. The initiation stage analyzes the factors that influence the decision to utilize an ERP system such as incompatibility, need for connectivity, top management vision, and need to change. Implementation issues are addressed in the adoption and adaptation stages including: investment decisions, cost/benefit analysis, and choice of appropriate technology. Implementation and performance measures such as system modifications, training, integration of functional units, enhanced performance, user acceptance, flaws corrected, and organizational integration realized, are identified during the acceptance and routinization stages. Finally, the infusion stage addresses future innovations including IT integration at global levels and future opportunities.

Parr and Shanks [38] review different models of ERP implementation and suggest a PPM/CSF hybrid model that incorporates a project phase model (PPM) with critical success factors (CSF). The phases included in their model include planning, project, and enhancement. Our work is both an extension and a testing of their project phase model for ERP implementation. Parr and Shanks [38] are the first to suggest that "there is justification for creating a project phase model (PPM) of ERP implementation which is centered on the individual, discrete phases of the implementation project itself rather than one which treats the project as just another phase in the whole implementation enterprise." Our model explores preference for a new system based on Parr and Shanks model but the third phase of project is broken into two separate

phases — transition and performance to better understand what truly influences project acceptance.

What happens after ERP implementation, and the benefits derived from ERP implementation, is specifically addressed by Gattiker and Goodhue [22]. The model by these researchers looks at the subunit level of the organization, similar to our study, and looks at determinants of ERP benefits. Task efficiency, coordination improvements and data quality explain a large amount of the ERP benefits of the sub-unit [22].

ERP IMPLEMENTATION AND MAINTENANCE PHASES OF OUR STUDY

Based on an exploratory study, Rajagopal and Frank [41] revealed that at Owens Corning, marketing and manufacturing each had its own sales forecasting numbers prior to implementing their ERP system. As a result, there were discrepancies in the information used for strategic decision making in the same organization. This was a result of the incompatibility among the information systems used in various functions at Owens Corning [40]. System incompatibility can also impede performance, as observed at Eastman Kodak Company. At one point, Eastman Kodak was operating their business on 2600 different software applications, more than 4000 system interfaces, and about 100 different programming languages running on legacy-type mainframe systems [48]. It thus can be concluded that proper preparation and planning is needed for ERP implementation. Implementation planning influences ERP system performance [56].

User training that included both technical and business processes, along with a phased implementation approach, helped firms to overcome assimilation knowledge barriers [42] noting the importance of training and a phased approach to ERP implementation. Gupta [24] and Umble and Umble [53] saw training as one of the most important factors in ERP success. Training is also noted as an important factor by Gallivan et al. [21] and Barker and Frolick [8]. Training is seen as a crucial component in continuous improvement. Training helps to improve employee participation and involvement in quality programs through propagation of priorities and missions of the organization [25]. So, as ERP is tied closely with business processes and continuous quality improvement, it can be seen that training would influence ERP success. "One of the primary challenges is selecting an appropriate plan for end-user education. . . . Managers must avoid this mistake by looking at various options for end-user ERP training at the beginning." [24]. "People are one of the hidden costs of ERP implementation. Without proper training about 30 percent to 40 percent of front-line workers will not be able to handle the demands of the new system."[9] So, preparation for ERP implementation is extremely important. **In preparation and training phase**, we can include the initiation, adoption and adaptation phases of Cooper and Zmud [15].

This model includes the three phases of the Parr and Shanks [38] model but the second phase — project is broken into two subphases — **transition and performance**. Gupta [24] has noted the importance of performance as a key success factor in ERP implementation. Al-Mashari, Al-Mudimigh, and Zairi [2] note the importance of **transition** suggesting that "it is important that an organization approaches the transition of legacy system carefully and with a comprehensive plan". Davenport [16] suggests legacy systems represent a major issue for new IT projects. Boudreau and Robey [10] identified transition as a key factor in

ERP implementation. Transition is also an important phase in the unified process model [39].

"A key issue when implementing ERP is **performance**. Tying such an array of decision support logic to a single database engine process can generate huge amounts of load on conventional systems. . . . Modern businesses need a much faster and more dynamic decision structure — something that ERP supports but (these) earlier systems cannot. To combat this, ERP vendors are creating new versions of MRP and MPS under a single umbrella dubbed advanced planning and scheduling (APS). Though some of these engines are still being tested, they promise drastically faster response times and much better business results in the form of accurate inventory planning and precise delivery schedules. With faster background engines like APS combining with ubiquitous front-end Web browser access, you have the foundation to build self-service business systems like the insurance example cited earlier. Companies that set up limited self-service functions today will have a competitive edge." [24]. Nah, Zuckwiler, and Lau [36] in their survey of Fortune 1000 CIOs found performance as a major factor in ERP success. Siau [45] sees quality of service as essential in ERP implementations.

Usefulness is also related to performance. Perceived usefulness looks at productivity, job effectiveness, and ease of doing the job [44], [51] which could be argued as performance related variables. For example, our performance phase also looks at productivity and use of information from the ERP system by the user. Extensive research supports the notion that usefulness and ease of use are primary drivers of user intentions to adopt new technology [17], [18], [51], [54]. However, this research has been conducted primarily in environments in which adoption was voluntary [12]. Brown et al. [12] found significant impact on technology acceptance in mandated use environments and conclude that "results suggest that TAM (Technology Acceptance Model) and related variations of the model do not generalize directly to mandatory use situations." **Hence, we look at the performance and usefulness phase.**

"The problem of maintaining integrated applications is no means a simple one and requires an interdisciplinary approach" [33]. "Without the understanding of how the system is implemented, and how to maintain the efficiencies and functionality of that (ERP) system, it will be useless to the organization." [7]. The use of packaged software is shown to result in decreased software complexity and software enhancement effort [7] and so it is expected that ERP packages would have reduced maintenance in

comparison to traditional development. While studies on software maintenance have often considered maintenance as the dependent variable, the influence of maintenance on preferred use of a system is not studied. So, the final phase is **maintenance**.

RELATIONSHIP OF ERP IMPLEMENTATION PHASES TO PREFERRED ERP USE — RESEARCH MODEL AND HYPOTHESES

An organization has to **prepare** itself for ERP implementation much before the actual ERP decision is taken [5] and these researchers believe that such preparation is key to ERP success. It may take years of build-up and requisite preparation with IT diffusion and infusion to determine, in large part, whether users demonstrate a combination of a positive predisposition to a new system when they view it from the standpoint of their work. Additional support for such requisite build-up comes from Bresnahan & Brynjolfsson [11], who use the phrase 'complementary investment.' "We have reason to believe that organizations that are better **prepared** to absorb information technology will be able to leverage the benefits of information technology"[5]. One of the critical factors for influencing users' attitudes and involvement can be understood in terms of the 'tuition paid for the learning' [19] that precedes any part of ERP implementations showing the importance of **training** for ERP use. **Hence, we expect a positive relationship between preparation and training phase and preferred ERP use.**

Boudreau and Robey [10] identified transition as a key factor in ERP implementation. Transition is also an important phase in the unified process model [39] used in building information systems. The unified process model combines all the different systems development frameworks into a unified process model. **So, we expect a positive relationship between transition phase and preferred ERP use.**

Zviran et al, [57] note that perceived usefulness influences user satisfaction in ERP systems. Amaolo-Gympah and Salam [3] show that training and project communication influence shared beliefs about benefits of technology and these beliefs influence perceived usefulness and ease of use of the technology. Job relevance, output quality, and result demonstrability significantly influenced user acceptance in the TAM2 model showing the importance of performance related variables and their influence on user acceptance [54]. Task efficiency, coordination improvements and data quality (key performance variables) explain a large amount of the ERP benefits of the sub-unit [22] pointing
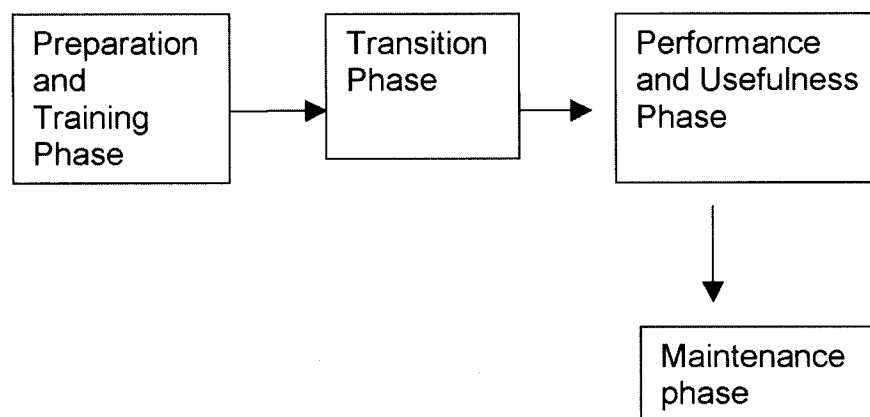
Figure 1 shows the four ERP implementation and maintenance phases.

to the importance of performance in ERP systems. Zviran et al, [57] report that ERP systems are associated with high levels of user satisfaction and perceived usefulness. Perceived usefulness (productivity, job effectiveness, ease of doing job) is shown to influence predicted future usage [51]. **Hence, we expect a positive relationship between performance and usefulness phase and preferred ERP use.**

Staehr, Shanks, and Seddon [49] found strong importance in the post implementation period of ERP implementation. The use of packaged software is shown to result in decreased software complexity and software enhancement effort [7] and so it is expected that ERP packages would have reduced maintenance in comparison to traditional development. This result could be a factor for users to prefer ERP use as it would involve reduced maintenance. **So, we expect a positive relationship between the maintenance phase and preferred ERP use.**

We argue, through our research model, that preparation and training, transition, performance and usefulness, and maintenance phases of ERP implementation and maintenance activity in organizations would positively influence the preferred use of ERP system.

The dependent variable of our study is preferred ERP use. Usage variables are seen as the *key* variables in systems studies [50]. End-users' reluctance or unwillingness to adopt or use the newly implemented ERP system is often cited as one of the main reasons for ERP failures [30], [36], [55]. Perceived compatibility and perceived ease of use have both direct and indirect effects (mediated by attitude) on symbolic adoption, while perceived fit and perceived usefulness influence symbolic adoption by being

fully mediated through attitude [55]. We argue that, in situations of mandatory use, we need to study the preferred use of the ERP system (as a measure of user acceptance of mandated ERP system) in comparison to the system it replaced.

Hypothesis 1. There are preparation and training, transition, performance and usefulness, and maintenance phases in the ERP implementation and maintenance activity of an organization.

Hypothesis 2. The preparation and training, transition, performance and usefulness, and maintenance phases in the ERP implementation and maintenance activity of an organization have a positive influence on preferred ERP use.

Hypothesis 3. There are differences in the influence of the preparation and training, transition, performance and usefulness, and maintenance phases in the ERP implementation and maintenance activity of an organization on preferred ERP use.

The first hypothesis explores the idea that ERP project implementation and maintenance consists of phases as proposed by Parr and Shanks [38]. Their general model was used as the basis for developing an approach to answer whether specific phases of SAP ERP implementation can be identified. Other researchers such as Cooper and Zmud [15] have also identified an ERP implementation model. Several other researchers have identified specific phases — preparation [56], transition [2], [10], [39], performance [24], and maintenance [7], [33] in the ERP implementation and maintenance activity of an organization. We would like to confirm the existence of these phases in ERP implementation and maintenance.

The second hypothesis tests the influence of these four phases on preferred ERP use. The third hypothesis is a logical
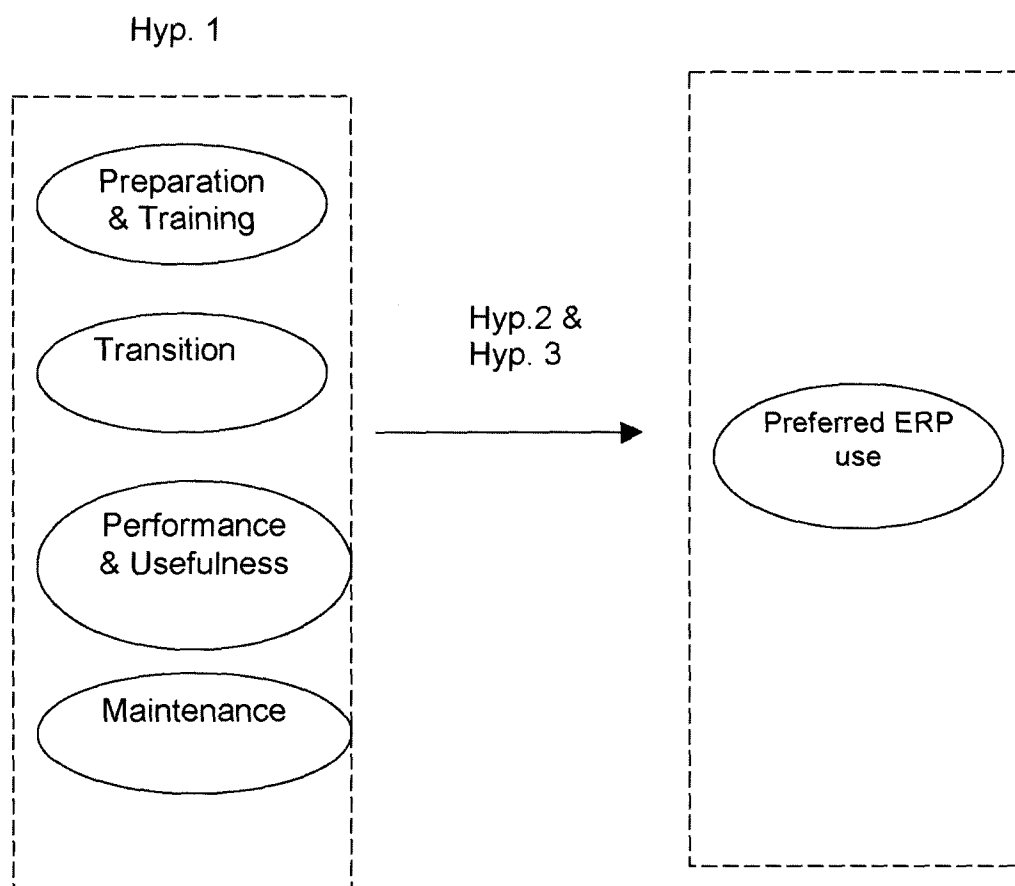

Figure 2. Research Model and Hypotheses

extension of the second. If a model of ERP implementation can be developed, it is logical that some steps in this process may be more important than others. Many studies find varying influences of independent variables on dependent variables. Chau [13] for example found variability in the influences of computer attitude and self-efficacy on IT usage behavior.

Finally, though variability may exist and be found, some factors may not have statistical significance on the overall dependent variable of preferred ERP use. Chau [13], as an example, found no statistical significance at $p < .05$ of computer attitude on perceived ease of use.

METHODOLOGY

To determine the answers to the preceding research questions, a paper based survey was prepared and administered at two divisions of a mid-size organization that had implemented an SAP R/3 ERP system. SAP is the German based, largest seller of ERP systems in the world. The survey population included employees in the areas of management, production, human resources, engineering, administration, quality, and maintenance who were employed at the two companies during the SAP implementation and who used the SAP system. A cover letter and survey questionnaire were distributed to employees who were employed during the ERP implementation and also used the ERP system in their day-to-day job. Twenty five surveys completed in the first division were reported in Subramanian and Hoffer [52] and twenty eight surveys completed in the second division were reported in Clayton [14]. Subramanian and Hoffer [52]'s study was an exploratory study that reported on the twenty five surveys and preliminary results for the first division only. Clayton [14]'s work reported the data set and some preliminary descriptive data results in his Master thesis report. The authors of this study obtained these datasets, combined the datasets from Subramanian and Hoffer [52] and Clayton [14] and used the combined dataset of 53 surveys. The literature review, research model, hypotheses, confirmatory factor analysis, and regression analysis are all original to this research. The complete set of questions with the abbreviations used in the data analysis is presented in table 1. Fourteen questions were prepared that suggested issues and steps in the implementation of an ERP system. An additional question (15) was included to measure preferred ERP use as an indicator of acceptance of the new system. This is the dependent variable in this study.

Responses to the questions were measured on a 5 point Likert scale from 1 = strongly disagree to 5 = strongly agree. All responses were analyzed using SPSS 10.0 and AMOS 4. Techniques included confirmatory factor analysis, scale reliability, and structural equation modeling.

DATA ANALYSIS AND RESULTS

In total, there were 53 valid responses to our questionnaire. As noted, the responses came from two divisions of a manufacturing organization that had converted to SAP R/3 ERP systems. All of the respondents were employed in their respective organizations during the transition/implementation of SAP. The length of time the individuals were employed by their organizations was generally long. Only 27% of the respondents had 10 years or less of service. It is suggested that the long time in service would yield an established pattern of work processes that would be difficult to alter. A very high percentage of the respondents (85%) had used

Table 1. Survey Questions

USDTY	1.	I feel that I understand why our company implemented SAP as our Information System. (understand)
RECEIVED	2.	I was provided with on-the-job training before we went live with SAP. (training)
PREPARED	3.	On the day we went live with SAP, I felt prepared to work on SAP. (prepared to work)
TEAM	4.	Everyone worked together to help the transition to SAP be successful. (team work)
SMOOTH	5.	From my perspective, the transition to SAP went smoothly.(Smooth transition)
PRODUCT	6.	I am able to be more productive with SAP than I was before SAP. (productivity)
ACCESS	7.	I can access information easier with SAP than I could before SAP. (access information)
NEW	8.	SAP provides me with information that was previously unavailable to me. (new information)
DATAENTR	9.	With SAP, there is less entering of data than before SAP. (data entry)
DATE	10.	With SAP, the data I use is more accurate than before SAP. (data accuracy)
EXPECT	11.	I understand what is expected of me to maintain/update/confirm the information in SAP. (expectations)
RELEVANC	12.	I understand how the information I input/change/confirm in SAP is relevant to our company. (relevancy)
ACCURACY	13.	I feel confident that the information I input/change/confirm in SAP is accurate and correct. (accuracy)
UNDERY	14.	The information I use from SAP makes sense to me. (understandability)
PREFER	15.	I would rather use SAP than our previous system. (perceived use)

the systems that were previously in place. Finally, the respondents had high experience levels with 92% experienced in two or more systems during their career.

In order to address the first hypothesis, confirmatory factor analysis (CFA) was performed on the fourteen SAP ERP implementation questions. The extraction method was principal component analysis with Varimax rotation. Some questions were discarded after a few attempts at CFA but 10 questions remained and were found to measure four unique factors — preparation and training, transition, performance and usefulness, and maintenance. These components are shown in table 2 and 3. Table 2 shows that four factors exceeded an eigenvalue of 1 which is used for acceptable cutoff [34]. The four factors represent a very high 74% of the variance in the dependent variable, preference for the new system.

In addition scale reliability was performed on the factors and

Table 2. Confirmatory Factor Analysis Total Variance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.680	26.803	26.803	2.680	26.803	26.803
2	2.259	22.587	49.389	2.259	22.587	49.389
3	1.370	13.704	63.093	1.370	13.704	63.093
4	1.097	10.975	74.068	1.097	10.975	74.068
5	.747	7.469	81.537			
6	.587	5.872	87.409			
7	.456	4.558	91.967			
8	.378	3.783	95.750			
9	.234	2.343	98.093			
10	.191	1.907	100.000			

Table 3. PCA (Principal Component Analysis) Rotated Component Matrix

	Component			
	Performance and Usefulness	Preparation and training	Maintenance	Transition
RECEIVED	-0.03985	**0.919088**	0.150648	0.077621
PREPARED	0.094718	**0.828303**	0.003379	0.275953
TEAM	0.059332	0.175064	0.076498	**0.863091**
SMOOTH	-0.00632	0.141407	0.139667	**0.830844**
PRODUCT	**0.753657**	-0.17567	-0.02085	0.270157
ACCESS	**0.826232**	-0.03514	0.170766	-0.05761
NEW	**0.884221**	0.05052	-0.07478	-0.0956
DATE	**0.603083**	0.167818	0.019928	0.031331
EXCT	0.080288	0.232754	**0.863194**	0.146275
ACCURACY	-0.00154	-0.05009	**0.910473**	0.078177
Alpha	.7969	.7674	.7354	.7314

Table 4. Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.817	.668	.637	.5955

all factors were above .70, the minimum for acceptability [37]. These are shown along with the factors and Varimax rotation in Table 3. Table 3 also shows the loadings of the questions on the four factors.

Hypothesis 1 has been supported. Preparation and training, transition, performance and usefulness, and maintenance phases

are evident in the ERP implementation and maintenance activity of an organization.

Since it was found that there were separate phases and factors in ERP implementation, the second hypothesis requires an analysis of the relative influences of each factor. The factors developed in the CFA were saved and entered into SPSS 10.0 for multiple regression analysis. The analysis finds that a statistically significant regression equation is formed. The R squared is relatively high .67 and shown in table shown in Table 4.

The detailed results of the model are shown in table 5. All phases of the ERP implementation have a positive impact on preferred ERP use with the exception of transition. The positive coefficient of the estimate demonstrates the positive impact. As noted, transition is marginally negative (-.06) but the table also shows

Table 5. Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.544	.086		41.162	.000
Preparation	.377	.089	.373	4.233	.000
Transition	-6.422E-02	.087	-.065	-.734	.467
Performance	.691	.088	.695	7.899	.000
Maintenance	.122	.086	.125	1.417	.164

a Dependent Variable: PREFER

the significance of each phase. Transition is negative but is not significant at p < .05. In addition, though positive, maintenance is not a significant factor in ERP preference. Hypothesis 2 is partially supported. The preparation and training, and performance and usefulness phases of an ERP implementation have a positive influence on preferred ERP use. The transition and maintenance phases do not.

The relative regression weights show large difference between the factors. Performance and usefulness is largest at .691 and significant at p < .001, followed by preparation and training at .377 and significant at p < .001. The other factors are much less important and are found not to be significant. Hypothesis 3 has been supported. There are differences in the influence of the preparation and training, transition, performance and usefulness, and maintenance phases in the ERP implementation and maintenance activity of an organization on preferred ERP use.

LIMITATIONS

The major limitation of the study is the small sample size. Though the results are based on two real world implementations of SAP software systems, results may not be applicable to all SAP R/3 implementations. A more detailed study involving more participants in more industries is a fruitful avenue for further research. Nevertheless, the results are strong and indicate a direction for both further research and practical use.

DISCUSSION

A confirmatory factor analysis verified the existence of four distinct phases of ERP implementation — preparation and training, transition, performance and usefulness, and maintenance. It was also found that the two significant factors which directly influenced preferred ERP use were preparation and training phase and performance and usefulness phase. Neither transition nor maintenance was found to significantly affect preferred ERP use. Bagchi et al [5] believe that ERP preparation is a key to ERP success. Gupta [24] points to training as an important factor for ERP success. Somers and Nelson [47] found that user training had a higher than expected importance in ERP implementation. As ERP use is a key aspect of ERP success, it is no wonder that preparation and training phase has a significant effect on preferred ERP use. Usefulness is shown to impact usage [17], [44] and predicted future use [51]. Performance variables also influence user attitude [54] and ERP benefits [22]. So, performance and usefulness have a significant effect on preferred ERP use. While transition

and maintenance are key phases in the ERP implementation and maintenance [7]; [33], they do not have a significant effect on preferred ERP use. It is possible that maintenance did not play a role in preference due to the commonality of maintenance issues on both old and new systems. The need for proper maintenance exists in both situations therefore preference may not be impacted. The lack of effect of the transition phase is a bit more puzzling. This is an area that deserves further exploration.

There are two main implications of this study for researchers. This study has developed specific phases in ERP implementation. This study has found that two phases of ERP implementation are more important than others for overall preference of the new system. These areas provide fertile opportunities for further research in ERP implementations but they also provide a framework for further studies on other IT implementations. The study can be extended and tested on other COTS packages such as CRM (customer relationship management), on custom developed applications, and on coordinated outsourced projects. There are large potential opportunities across a broad spectrum of information technology projects.

There are also significant implications for practitioners as a result of this study. Estimates suggest that at least 30% of all IT projects fail and it is suggested that a higher proportion of ERP projects fail, run well over budget, or fail to achieve projected cost savings and strategic advantages. This study, as noted, has prepared a model for phases of ERP implementation. It has also found that preparation and performance are the key influences in preference for the new system. If resources and efforts are concentrated in these two phases of the ERP implementation, it is likely that costs will be reduced, projects will exhibit higher levels of success, and greater strategic advantages will be garnered. The opportunity to test this approach in other information technology projects may suggest even greater opportunities.

CONCLUSION

The installation of an ERP system can be one of the most costly and critical projects that an organization undertakes. Generally, all other information technology projects pale in comparison to ERP systems. ERP systems are used to run all standard business processes in an organization. The success or failure of the implementation can be vitally important to both current profits and the future viability of a business. As a result, understanding the processes and phases involved in the implementation of this endeavor can pay major dividends. This study has explored a phased model for ERP implementation and found four distinct

phases — preparation and training, transition, performance and usefulness, and maintenance. The model is an empirical confirmation of the implementation phased approach of Parr and Shanks [38] with the extension of the middle phase of their model ("Project") into the two sub-phases of transition [24], [10] and performance and usefulness [24], [17], [54]. The model was empirically confirmed at two manufacturing implementations. The discovered significance and importance of two particular phases in the model — preparation and training, and performance and usefulness are important results of the study. This study, though limited, has explored an area that can hold significant opportunity for more successful ERP implementations. The authors seek to expand these preliminary findings in more companies and on a wider array of projects.

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