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An Integrated Model For The Implementation of ERP Systems

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Abstract

Enterprise Resource Planning (ERP), an information system attempts to integrate all departments and functions across a company onto a single computer system. Little research, however, has been conducted on collective integrated implementation framework and operationalization of ERP system. The current research seeks to integrate a prominent model of information system implementation to develop holistic approach to ERP implementation. Using ERP implementation model and Critical Success Factors (CSFs), and integrated ERP implementation framework is proposed. This framework comprises of two important phases of ERP systems in the organizations, namely implementation processes and CSFs. Each phase comprises of four stages in which the process follows and then the success of ERP implementation is measured by project outcomes and organizational impacts. The process stages and critical success factors are then empirically tested.

Keywords

ERP, implementation, CSFs,

1. Introduction

The objective of this paper is to develop an integrated model for ERP implementation and to establish a set of criteria to empirically validate the performance of various components pertinent to the model. The integrated model is developed from theoretical models of information systems and comprises of the implementation process, critical success factors for both the success measures. The proposed process components in the model contain various phases, and each phase includes activities which are performed in a sequence during the process. The conceptualisation of this model shares many similarities with the models presented by Esteves and Pastor (2001a,b) and Markus and Tanis (2000). The components of the model are discussed briefly in the next section.

The constructs of the model are validated in two stages. In the first stage, the panel of academicians and practitioners analysed each construct item and made recommendations as to the suitability of each construct. The preliminary validation of the constructs was conducted to improve the scale reliability and validity. In this stage some of the items for the construct were dropped to improve the reliability. In the second stage, these items were employed in a survey instrument which was mailed to 200 top Australian companies to obtain their responses on each item for process stages, critical success factors and success measures to validate the model and the scale. The next section includes a discussion on literature of ERP implementation.

2. Literature Review

The concept of implementation is ordinarily related to the installation of hardware and software. In the world of ERP systems, “implementation is often used as a term to describe a well-defined project spanning from the choice of the systems through to the configuration and training until going live, when the system becomes operative. In the companies’ view, implementation means a continuous learning cycle wherein the organisational process supported by the ERP systems is gradually aligned with the business objectives. Concurrently, the business objectives are taken even further, driven by the market dynamics and also by the new internal opportunities.

The practice of implementation of ERP systems is flooded with stories of devastating implementation. It seems to be an accepted fact that ERP implementations are never on time, within budget or meet the desired business outcome. This is supported by a number of surveys and, at the same time, we see increasing attention being given to the extended implementation process, the so called second wave. That is why an understanding of the phenomena of implementation is an important issue for practitioners. Going live is not the end of the ERP journey. Many companies have reported a decline in performance after going live.

ERP implementation is a complicated large-scale project, it has far-reaching strategic and organisational implications, and can easily turn into a nightmare for implementing firms (Davenport, 1998). The reasons for the complexity stated in the literature are: (1) ERP integration is difficult and requires knowledge and understanding of an organisation’s business processes, capabilities and structure (Alvarez, 2002), (2) quantity of features available in an ERP system (Kraemmergaard and Moller, 2000), and (3) ongoing maintenance for interfacing the middleware links to the ERP (Kraemmergaard and Moller, 2000).

The Enterprise Resource Planning life cycle sets the background in which ERP implementation is studied. The ERP lifecycle is structured in phases, which consist of the several stages that an ERP system goes through during its whole life within the hosting organisation. Each of these phases has individual objectives, requirements, stakeholders and activities. Al-Mudimigh, Zairi and Al-Mashari (2001), Bancroft, Seip and Sprengel (1998), Markus and Tanis (2000) and Parr and Shanks (2000b) have all proposed models of ERP implementation in order to gain a deeper understanding of the process and provide guidelines for successful implementation.

Umble, Haft and Umble (2003) proposed a lifecycle model for ERP implementation which consists of phases such as reviewing the pre-implementation process to date, installing and testing any new hardware, installing the software and perform, system training, establishing security and necessary permissions, ensuring that all data bridges are sufficiently robust and the data are sufficiently accurate, document policies and procedures, bring the entire organisation on-line, either in a total cutover or in a phased approach, celebrate, and improve continually. Parr and Shanks (2000a) presented a project phase model of ERP implementation project that is based on a synthesis of the existing ERP implementation process models namely: Markus and Tanis (2000); Ross and Vitale (2000). The model focuses on the implementation project. The three phases of the model are: planning, project and enhancement. The authors claimed that the PPM, together with associated CSFs, provides guidance for practitioners when planning ERP implementation projects and also provides researchers with a foundation for further empirical research.

Markus and Tanis (2000) proposed an ERP implementation lifecycle model. The phases include: (1) Chartering, wherein the business case is defined, (2) Project, consisting of among

other things, getting the system running, (3) Shakedown – referring to the routine use of system, and (4) Onwards and upward phase, including system upgrading and support service. The phases of this model are in line with the stages of the traditional systems development lifecycle. The Bancroft, Siep and Sprengle (1998) model suggested five phases for system implementation. The first phase involves setting up a committee, selecting and structuring the project team, and developing a creative project plan. In the second phase, organisations develop a comprehensive configuration, write and test the system and conduct user testing. Finally, the actual implementation phase covers building networks, installing desktops and managing user training and support. Rajagopal (2002), using Kwon and Zmud's innovation-diffusion model, proposed six stages for ERP system implementation: initiation, adoption, adaptation, acceptance, routinisation and infusion. The model was validated with various case studies. Esteves and Pastor (2001a) proposed a six-phase ERP life-cycle for ERP implementation, namely (1) adoption, (2) acquisition, (3) implementation, (4) use and maintenance, (5) evolution, and (6) retirement phase. Ross and Vitale (2000) developed a five-phase ERP implementation model based on 15 case studies of ERP implementation. The five-phase model includes design, implementation, stabilisation, continuous improvement, and transformation. Mandal and Gunasekaran (2003) described the ERP implementation experience using a case study. The case study reveals some of the intricacies during the planning and implementation stages that occurred in the organisation. The success of ERP implementation depends closely on following pre-implementation (which includes risk analysis, preparing a change management plan, developing cross-functional communications, considering a phase-based approach for implementation, and using appropriate planning styles for different tasks). The Implementation phase involves activities such as formulating a network for collecting user requirements, setting up a monitoring and feedback network, providing a strong leadership, providing a professionally stimulating work environment, obtaining top management support for the project, promoting client consultation and user participation, and obtaining approval from parties for what is being undertaken throughout the project. Post-implementation comprises a decision leading to whether the objectives of the ERP system were fully realised, whether the scheme options were adequately considered, whether the estimates and project information were accurate, whether or not the agreed practices and techniques were complied with, and any other factors which are considered appropriate. Al-Mashari, (2002) proposed an integrative framework for ERP implementation based on an extensive review of the factors and the essential elements that contribute to success in the context of ERP implementation. This framework proposes the factors important for ERP implementation at the strategic, tactical and operational levels. Each level contains a number of critical factors such as: strategic factors involve current legacy system evaluation, business vision, implementation strategy, hiring consultants, and benchmarking, whereas tactical factors involve client consultation, business process change, software/vendor selection, implementation approach, while operational factors are business process re-engineering, configuring systems, final preparation, and going live. The levels of implementation proposed in this framework are not independent of each other and each level is used to derive the next level. Somers and Nelson (2004), using an innovative approach, proposed six phases of the ERP implementation model: initiation, adoption, adaptation, acceptance, routinisation and infusion. Using a survey methodology, they showed the impact of various critical success factors on each phase of ERP implementation process. Some models especially designed for implementation of ERP systems that can be found from the literature, do not cover all important parts of the ERP systems implementation project, but rather focus only on some part(s) of it.

Vendors and consultants have developed their own methodologies for implementation of an ERP system. According to Ahituv, Neumann and Zviran (2000), the four phases of an ERP

system implementation include: definition, selection, implementation and the operation process. Each phase contains several activities. Harwood (2001) proposed four stages of an ERP lifecycle model. In the first phase, organisations identify the needs for a new information system. The second phase involves system and vendor selection of an appropriate system to meet the needs identified by the organisation. In the third phase, the system is acquired and implemented. The fourth and last stage of this model is going live after the system is implemented. The implementation model by SAP is called ASAP and includes the phases: (1) Project preparation, (2) Business blueprint, (3) Realisation, (4) Final preparation, and (5) Go live and support continuous change. SAP assumes that the organisation has already made a decision on the selection of its product and ignores these phases in its methodology. Oracle Application Implementation methodology (AIM) involves: (1) project planning and initiation, (2) define business requirements, (3) application configuration and solution design, (4) build and test business processes, (5) transition/pre-production/training, and (6) production migration. The Deloitte & Touche Consulting group believes that their Fast Track implementation methodology can enhance and accelerate ERP software implementations, even if the business objective involves global re-engineering, process improvement or software replacement. The five phase Fast Track work plan with its specific activities to help achieve a rapid high-quality business transformation is: (1) scoping and planning, (2) visioning and targeting, (3) redesign, (4) configuration, and (5) testing and delivery. Table 1 presents the summary of studies from the literature in the area of CSFs of ERP implementation.

Authors	CSF of ERP implementation
Umble, Haft and Umble (2003)	Clear understanding of strategic goals, commitment by top management, excellent project management, organisational change management, data accuracy, user education and training, focused performance measures
Al-Mashari, Al-Mudimigh and Zairi (2003)	Management and leadership, visioning and planning, ERP package selection, communication, process management, training and education, project management
Somers and Nelson (2001)	Top management support, project champion, user training and education, management of expectations, vendor–customer partnerships, use of vendor’s development tools, careful selection of the appropriate package, project management, steering committee, use of consultants, minimal customisation, data analysis and conversion, business process re-engineering, defining the architecture, dedicated resources, project team competence, change management, clear goals and objectives, interdepartmental communication, interdepartmental co-operation, ongoing vendor support
Rosario (2000)	ERP teamwork and composition, business plan and vision, change management and culture, BPR and minimum customisation, effective communication, project management, project champion

Wee (2000)	ERP teamwork and composition, top management support, business plan and vision, change management and culture, BPR and minimum customisation, effective communication, project management, software development
Bingi (1999)	ERP teamwork and composition, change management and culture, top management support, BPR and minimum customisation
Buckhout, Frey, Nemec (1999)	ERP teamwork and composition, top management support, BPR and minimum customisation
Holland (1999)	ERP teamwork and composition, top management support, business plan and vision, change management and culture, BPR and minimum customisation, effective communication, project management, software development, monitoring and evaluations of performance, project champion, appropriate business and IT legacy systems
Holland and Light (1999)	Strategic: Legacy systems, business vision, ERP strategy, top management support, project scheduling and planning Tactical: Client consultation, software configuration, client acceptance, monitoring and feedback, communication, troubleshooting
Stefanou (1999)	ERP teamwork and composition, project champion
Sumner (1999)	ERP teamwork and composition, top management support, change management and culture, BPR and minimum customisation, effective communication, project management, monitoring and evaluation of performance, project champion
Falkowski, Pedigo, Smith and Swanson (1998)	ERP teamwork and composition, change management and culture, BPR and minimum customisation, effective communication, project management, monitoring and evaluation of performance, project champion

Table 1: CSFs of ERP Implementation

In summary, most of the implementation models and frameworks discussed above are based on the system development lifecycle approach. Authors have proposed that the amount and degree of detail of an ERP lifecycle are dependent on the context of the study and what level the researcher seeks to explore in the study. ERP lifecycle models are important to practitioners and academics for establishing a frame of study that defines and provides the point of reference in which phases and transitions from one phase are differentiated from those of another. The ERP lifecycle methodologies are inconsistent with the literature. Information systems lifecycle approaches, however, vary from academia and practice. As Lynch (1984) notes, in the average notebook on information systems, implementation is usually listed as one phase in the system analysis and design lifecycle. The names of the phases vary but, generally, they include phases for requirement definition, general systems design, detailed system design, coding and testing and implementation. From an industry

perspective, implementation methodology aims at assisting the physical implementation of the IS, and overseeing its implementation in an organisation. This lack of theoretical foundation is a significant drawback for ERP systems with the focus on implementation issues.

3. Methodology

Each process stage, critical success factors and outcomes of acquisition and implementation constructs and scale items were developed through the literature review and with the consultations of practitioners. Churchill's scale development methodology was applied to validate the scales for this research. In the second stage the survey methodology was adopted for this research. The survey instrument was developed on the findings from the practitioners and consultants through the manual sorting process. The survey was sent to top 200 Australian companies to validate the integrated research framework.

4. Model Development

Most ERP implementation projects are structured around phases. The predominant models containing roughly six stages have emerged in the literature (Rajagopal, 2002, Parr and Shanks, 2000). As Kumar *et al.* (2003) has noted, "All the stage models reported could be clubbed into four broad phases of planning, configuration, testing, and implementation". Implementation is defined for the purposes of this study as the process starting after the decision to acquire ERP software, or a related service, has been made and ending when the ERP software or the related service has been released into use with full planned functionality and scope. The second process of the proposed integrated model, "implementation", contains four phases, namely implementation planning, installation, final preparation and going live. Each phase further include several activities and tasks which the implementation team follows to complete the ERP implementation project. The important activities of these phases, including, for example, installation and customisation of the ERP system, training the users and management, documentation and data transfer from legacy systems. The goal of the implementation process is to have the ERP software in use within budget, on time, and with the planned functionality and scope.

A set of 12 CSFs for ERP implementation systems were synthesised from the literature, in consultation with practitioners and from the respondents who participated in the survey. The CSFs included in the integrated model for this research are project management, business process re-engineering, user training and education, change management, technological infrastructure, risk management, top management support, effective communication, balanced team, users' involvement, consultants' involvement and clear goals and objectives. The purpose of these CSFs is to provide practitioners with guidance in planning and monitoring an ERP implementation project.

In the model the results of the acquisition and implementation processes are divided into two components according to the two processes: success of acquisition and success of implementation. Success of acquisition refers to how well an organisation has been able to find all the potential ERP systems available and to choose from them the one that best suits its needs and objectives. Success of acquisition is whether the requirements of the organisation's operation were taken sufficiently into account and the ERP system was purchased with the allocated budget and within schedule. The organisation may, however, have understood its needs incorrectly or set improper objectives and thus, have used incorrect criteria as the basis of the acquisition. Success of implementation refers to how well an organisation has been able to release the ERP system into use within budget, time allocation, users' satisfaction and user-friendliness of the system.

5. Analysis and Findings

Research question 1: What are the important phases of ERP Implementation processes?

The objective of this question was to investigate whether ERP-implementing organisations perceive the phases of acquisition and implementation identified for this study as important. The issues of question were investigated by means of a survey carried out among Australian companies utilising the research questionnaire constructed earlier.

Hypothesis 1 (omitted) is supported by this research and confirms that the implementation planning, installation, final preparation and going live phases are perceived as important for ERP implementation by respondents. The implementation process begins after the decision to acquire an ERP system has been reached and ends when the system is fully operational. The implementation process includes phases such as: the implementation planning phase comprises activities such as preparation of implementation plan (implementation goals, strategies and outcomes), team formation, and development of project scope. The installation phase includes activities such as installation of network and hardware, configuration of ERP architecture and system customisation. In the third phase, the final preparation phase, data is imported from the legacy system to the new system and testing is performed. In the last phase, the system becomes operational, the progress of the system is monitored and user feedback is reviewed. The success of this process is measured by whether the project is completed on budget, on time, by users' satisfaction in terms of accessibility and ease of use. This research has built upon the studies of Parr and Shanks (2000) and Bancroft *et al.* (1998) by successfully identifying the four phases and their activities which respondent feel important for the implementation of ERP. These phases, albeit using labels, have been identified in the literature by Parr and Shanks (2000) and Bancroft *et al.* (1998) but have been empirically analysed for the first time in this research study. Therefore, the results of this hypothesis prove that organisations consider planning, installation, final preparation and going live as important phases of ERP implementation process.

Research question 2: What are the important success factors for ERP implementation processes?

Initially, a set of 24 factors were identified as generic and common factors for both processes from the literature and through discussions with ERP experts. These factors were validated through the manual sorting technique and statistical analysis using the SPSS software. However, studies pertaining to the critical success factors for the acquisition process are limited. In this study, research the success factors have been classified into two main areas: key players and activities. Top management support, balanced team, users' involvement, consultants' involvement and vendor-client partnerships in acquisition are key players of ERP implementation, whereas planning, accurate information, selection criteria, structured process and effective communication are deemed as playing a major role as activities in the acquisition process. All the factors for ERP implementation are identified as being important for the implementation process. Studies such as those by Somers and Nelson (2004), Esteves, Pastor and Carvalho (2003), Parr and Shanks (2000), to mention a few, have also found similar factors important for the implementation process. Hypothesis 3 and 4 are supported.

Research question 3: Which process phases impact on implementation success?

This research question deals with whether the implementation phases impact on the success of implementation processes. This question investigates whether the implementation

planning, installation, final preparation and going live phases impact on the implementation success. The implementation success is measured in this study through four items, which are whether the implementation was completed on time, within budget, whether the users are satisfied and whether users find it easy to use the system. However, results showed that the implementation planning and installation phases had a higher impact on the implementation success than the remaining two phases. It is natural that without the implementation planning phase, which consists of activities such as defining the scope, objectives, strategies, identification of risks and project deliverables are pivotal for the success of implementation. Similarly, activities such as the customisation of the system, configuration of architecture, system integration and change management plan execution found in the installation phase were not conducted properly. Hypothesis 3(omitted) was tested using the multiple regression technique in which the dependent variable was implementation success and the independent variables were four phases of implementation process.

6. Conclusion

The key contributions of this thesis is the theoretical framework developed from the analysis of the findings of the this research, which is built on empirical study. The study also made a contribution to the body of knowledge of ERP systems by identifying the critical success factors for ERP implementation. The findings of this study helps to find out that the critical success factors that are important for implementation processes. This research is the first to empirically investigate critical factors that contribute success to implementation of ERP processes, which have not been previously addressed. This study also investigates the impact of critical factors on particular phase of ERP implementation processes.

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