Critical factors for successful implementation of enterprise systems

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Abstract *Enterprise resource planning (ERP) systems have emerged as the core of successful information management and the enterprise backbone of organizations. The difficulties of ERP implementations have been widely cited in the literature but research on the critical factors for initial and ongoing ERP implementation success is rare and fragmented. Through a comprehensive review of the literature, 11 factors were found to be critical to ERP implementation success – ERP teamwork and composition; change management program and culture; top management support; business plan and vision; business process reengineering with minimum customization; project management; monitoring and evaluation of performance; effective communication; software development, testing and troubleshooting; project champion; appropriate business and IT legacy systems. The classification of these factors into the respective phases (chartering, project, shakedown, onward and upward) in Markus and Tanis' ERP life cycle model is presented and the importance of each factor is discussed.*

Introduction

Businesses today face a stark reality: anticipate, respond, and react to the growing demands of the marketplace, or perish. In a fiercely competitive environment, business strategy not only determines success, it governs business survival. Now, more than ever, effective business strategy centers on aggressive, efficient use of information technology. An enterprise resource planning (ERP) system is a packaged business software system that enables a company to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a total, integrated solution for the organization's information-processing needs. It supports a process-oriented view of the business as well as business processes standardized across the enterprise. Among the most important attributes of ERP are its abilities to:

- automate and integrate an organization's business processes;
- share common data and practices across the entire enterprise; and
- produce and access information in a real-time environment.

The difficulties and high failure rate in implementing ERP systems have been widely cited in the literature (Davenport, 1998), but research on critical success

factors (CSFs) in ERP implementation is rare and fragmented. To date, little has been done to theorize the important predictors for initial and ongoing ERP implementation success (Brown and Vessey, 1999). This research is an effort to achieve that. It identifies the CSFs in ERP implementation, categorizes them into the respective phases in the ERP life cycle model proposed by Markus and Tanis (2000), and discusses the importance of these factors in ERP implementation.

Literature review

ERP systems hold the promise of improving processes and decreasing costs. Furthermore, two important new frontiers for ERP are electronic business (e-business) and supply-chain management (Wang and Nah, 2001). By linking supply-chain applications with other business systems, users can slash cycle times and reduce inventory. They can also reach beyond their own corporate walls to better connect with suppliers, distributors, and customers to engage in e-business.

However, there are always two sides to the story. In reality, ERP implementation is costly. Although ERP software is expensive, an even more substantial amount of business cost is typically spent on consulting to overcome difficult software implementation. ERP is a packaged solution with long complicated interrelated code containing a set process. Usually businesses have their own existing proven competitive advantage processes set in place. Businesses will have to change their proven processes to fit the software in order to take advantage of future releases, benefit from the improved processes, and avoid costly irreparable errors.

Methodology

The high failure rate of ERP implementation calls for a better understanding of its critical success factors (Somers *et al.*, 2000). Through an extensive literature review, we found ten articles that provide answers to the question: what are the key critical factors for ERP implementation success? These ten articles were identified through a computer search of databases of published works and conference proceedings in the information systems area. The articles were searched by the title based on the following two criteria:

(1) it must contain either the keyword "success/succeed" or "critical issues/factors", and

(2) it must contain the term "ERP" or its equivalent, such as MRPII.

In the case where the authors published more than one article in the area, only the latest publication will be used. Among the ten articles identified, Roberts and Barrar (1992) was the earliest published work, whereas the other nine articles were published between 1998-2000 – the main reason being that Roberts and Barrar studied key factors for success in material requirements planning 2 (MRP-II) implementations. Because ERP evolved from MRPII, the

CSFs in MRPII implementations would apply to ERP as well. Table I summarizes the results of the review.

From the review, 11 factors emerged as critical to the successful implementation of ERP systems. These 11 factors were obtained after careful analysis and grouping of related sub-factors. These 11 factors are inclusive of all the sub-factors identified in the review.

Theoretical framework

A process theory approach (Markus and Tanis, 2000) was used to classify the CSFs identified. The process theory focuses on the sequence of events leading up to implementation completion.

Markus and Tanis (2000) identified the following four phases in an ERP life cyle:

(1) chartering – decisions defining the business case and solution constraints;

(2) project – getting system and end users up and running;

(3) shakedown – stabilizing, eliminating "bugs", getting to normal operations;

(4) onward and upward – maintaining systems, supporting users, getting results, upgrading, system extensions.

The chartering phase comprises decisions leading to funding of the ERP system project. Key players in the phase include vendors, consultants, company executives, and IT specialists. Key activities include initiation of idea to adopt ERP, developing business case, decision on whether to proceed with ERP or not, initiation of search for project leader/champion, selection of software and implementation partner, and project planning and scheduling.

The project phase comprises system configuration and rollout. Key players include the project manager, project team members (mainly from business units and functional areas), internal IT specialists, vendors, and consultants. (We will refer to this group of people as the implementation partners.) Key activities include software configuration, system integration, testing, data conversion, training, and rollout. In this phase, the implementation partners must not only be knowledgeable in their area of focus, but they must also work closely and well together to achieve the organizational goal of ERP implementation.

The shakedown phase refers to the period of time from "going live" until "normal operation" or "routine use" has been achieved. Key activities include bug fixing and rework, system performance tuning, retraining, and staffing up to handle temporary inefficiencies. In this phase, the errors of prior causes can be felt, typically in the form of reduced productivity or business disruption (Markus and Tanis, 2000). Hence, it is important to monitor and constantly make adjustments to the system until the "bugs" are eliminated and the system is stabilized.

	ERP teamwork and composition	Change management program and culture	Top management support	Business plan and vision	BPR and minimum customization	Effective communication	Project management	Software development, testing and troubleshooting	Monitoring and evaluation of performance	Project champion	Appropriate business and IT legacy systems
Bingi et al. (1999)	X	X	X		X			X			
Buckhout et al. (1999)	X		X	X							
Falkowski et al. (1998)	X	X		X		X	X		X	X	
Holland et al. (1999)	X	X	X	X	X	X	X	X	X		X
Roberts and Barrar (1992)		X	X	X	X				X		
Rosario (2000)	X	X		X	X	X	X	X	X	X	X
Scheer and Habermann (2000)								X			
Stefanou (1999)	X	X	X		X	X	X			X	
Sumner (1999)	X	X	X		X	X	X		X	X	
Wee (2000)	X			X				X			

Table I.
Survey of critical success factors in ERP implementations

The onward and upward phase refers to ongoing maintenance and enhancement of the ERP system and relevant business processes to fit the evolving business needs of the organization. It continues from normal operation until the system is replaced with an upgrade or a different system. Key players include operational managers, end users, and IT support personnel (internal and external). Vendor personnel and consultants may be involved when upgrades are concerned. Key activities include continuous business improvement, additional user skill building, upgrading to new software releases, and post-implementation benefit assessment.

The phases in Markus and Tanis' (2000) ERP life cycle model are in line with the stages of the traditional systems development life cycle, as presented in Figure 1. As different factors are important in different stages, it is important to classify the 11 CSFs identified into the phases of ERP implementation life cycle where the factors may come into play (see Figure 1). Figure 1 shows the classification of these factors into an integrative framework.

Critical factors of ERP implementation success
This section discusses the 11 factors that are critical to ERP implementation success.

ERP teamwork and composition
As shown in Figure 1, ERP teamwork and composition is important throughout the ERP life cycle. The ERP team should consist of the best people in the organization (Buckhout *et al.*, 1999; Bingi *et al.*, 1999; Rosario, 2000; Wee, 2000). Building a cross-functional team is also critical. The team should have a mix of consultants and internal staff so the internal staff can develop the necessary technical skills for design and implementation (Sumner, 1999). Both business and technical knowledge are essential for success (Bingi *et al.*, 1999; Sumner, 1999).

The ERP project should be their top and only priority and their workload should be manageable (Wee, 2000). Team members need to be assigned full time to the implementation (Wee, 2000). As far as possible, the team should be co-located together at an assigned location to facilitate working together (Wee, 2000).

The team should be given compensation and incentives for successfully implementing the system on time and within the assigned budget (Wee, 2000). The team should be familiar with the business functions and products so they know what needs to be done to support major business processes (Rosario, 2000).

The sharing of information within the company, particularly between the implementation partners, and between partnering companies is vital and requires partnership trust (Stefanou, 1999). Partnerships should be managed with regularly scheduled meetings. Incentives and risk-sharing agreements will aid in working together to achieve a similar goal (Wee, 2000).

Figure 1.
Classification of CSFs of
ERP implementation
into Markus and Tanis'
(2000) process-oriented
ERP life cycle model
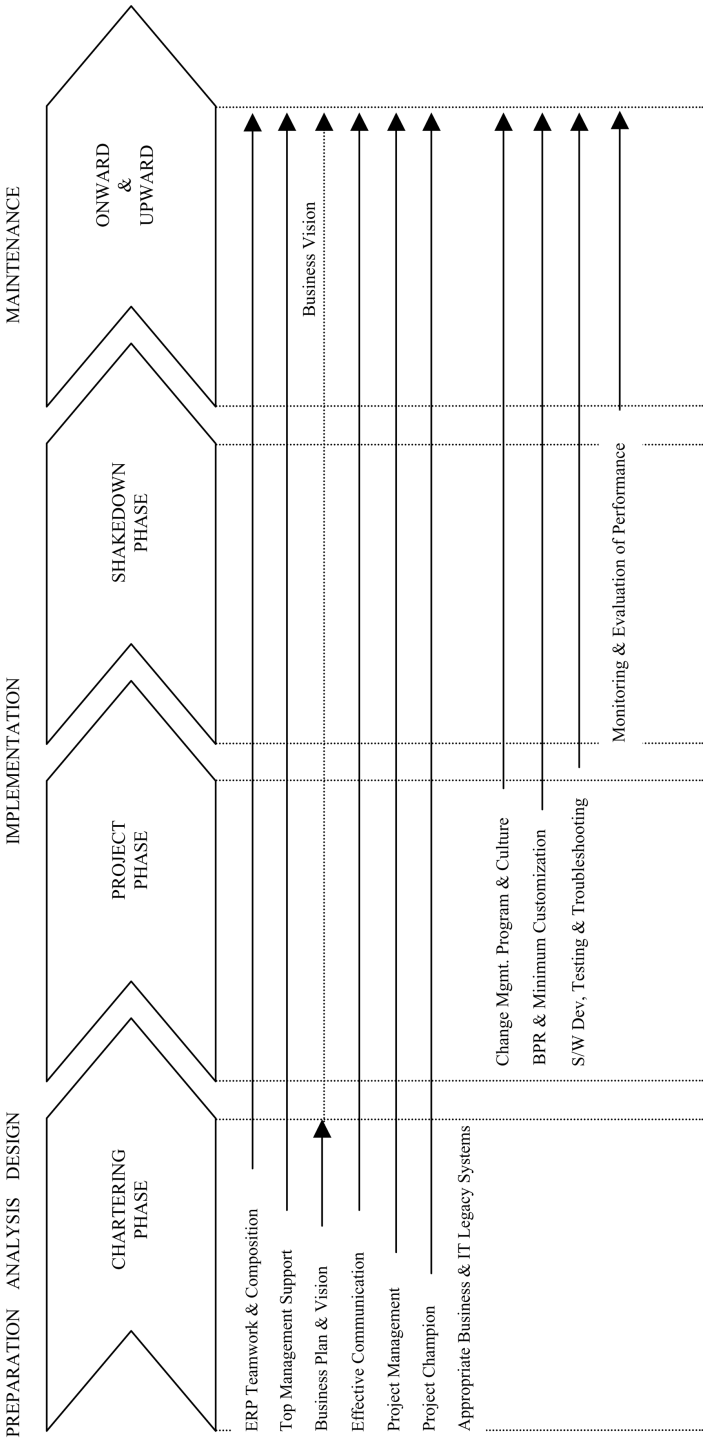
Top management support
Top management support is needed throughout the implementation. The project must receive approval from top management (Bingi, 1999; Buckhout, 1999; Sumner, 1999) and align with strategic business goals (Sumner, 1999). This can be achieved by tying management bonuses to project success (Wee, 2000).

Top management needs to publicly and explicitly identify the project as a top priority (Wee, 2000). Senior management must be committed with its own involvement and willingness to allocate valuable resources to the implementation effort (Holland *et al.*, 1999). This involves providing the needed people for the implementation and giving appropriate amount of time to get the job done (Roberts and Barrar, 1992).

Managers should legitimize new goals and objectives. A shared vision of the organization and the role of the new system and structures should be communicated to employees. New organizational structures, roles and responsibilities should be established and approved. Policies should be set by top management to establish new systems in the company. In times of conflict, managers should mediate between parties (Roberts and Barrar, 1992).

Business plan and vision
Additionally, a clear business plan and vision to steer the direction of the project is needed throughout the ERP life cycle (Buckhout *et al.*, 1999). A business plan that outlines proposed strategic and tangible benefits, resources, costs, risks and timeline is critical (Wee, 2000). This will help keep focus on business benefits.

There should be a clear business model of how the organization should operate behind the implementation effort (Holland *et al.*, 1999). There should be a justification for the investment based on a problem and the change tied directly to the direction of the company (Falkowski *et al.*, 1998). Project mission should be related to business needs and should be clearly stated (Roberts and Barrar, 1992). Goals and benefits should be identified and tracked (Holland *et al.*, 1999). The business plan would make work easier and impact on work (Rosario, 2000).

Effective communication
Effective communication is critical to ERP implementation (Falkowski *et al.*, 1998). Expectations at every level need to be communicated. Management of communication, education and expectations are critical throughout the organization (Wee, 2000). User input should be managed in acquiring their requirements, comments, reactions and approval (Rosario, 2000).

Communication includes the formal promotion of project teams and the advertisement of project progress to the rest of the organization (Holland *et al.*, 1999). Middle managers need to communicate its importance (Wee, 2000). Employees should be told in advance the scope, objectives, activities and updates, and admit change will occur (Sumner, 1999).

Project management

Good project management is essential. An individual or group of people should be given responsibility to drive success in project management (Rosario, 2000). First, scope should be established (Rosario, 2000; Holland *et al.*, 1999) and controlled (Rosario, 2000). The scope must be clearly defined and be limited. This includes the amount of the systems implemented, involvement of business units, and amount of business process reengineering needed. Any proposed changes should be evaluated against business benefits and, as far as possible, implemented at a later phase (Sumner, 1999; Wee, 2000). Additionally, scope expansion requests need to be assessed in terms of the additional time and cost of proposed changes (Sumner, 1999).

Then the project must be formally defined in terms of its milestones (Holland *et al.*, 1999). The critical paths of the project should be determined. Timeliness of project and the forcing of timely decisions should be managed (Rosario, 2000). Deadlines should be met to help stay within the schedule and budget and to maintain credibility (Wee, 2000).

Project management should be disciplined with coordinated training and active human resource department involvement (Falkowski *et al.*, 1998). Additionally, there should be planning of well-defined tasks and accurate estimation of required effort. The escalation of issues and conflicts should be managed (Rosario, 2000).

Delivering early measures of success is important (Wee, 2000). Rapid, successive and contained deliverables are critical. A focus on results and constant tracking of schedules and budgets against targets are also important (Wee, 2000).

Project champion

Project sponsor commitment is critical to drive consensus and to oversee the entire life cycle of implementation (Rosario, 2000). Someone should be placed in charge and the project leader should "champion" the project throughout the organization (Sumner, 1999).

There should be a high level executive sponsor who has the power to set goals and legitimize change (Falkowski *et al.*, 1998). Sumner (1999) states that a business leader should be in charge so there is a business perspective. Transformational leadership is critical to success as well. The leader must continually strive to resolve conflicts and manage resistance.

Appropriate business and legacy systems

Appropriate business and legacy systems are important in the initial chartering phase of the project. According to Roberts and Barrar (1992), a stable and successful business setting is essential. Business and IT systems involving existing business processes, organization structure, culture, and information technology affect success. It determines the IT and organizational change required for success (Holland *et al.*, 1999). Roberts and Barrar also

argue that success in other business areas is necessary for successful MRPII implementations.

Change management program and culture
Change management is important, starting at the project phase and continuing throughout the entire life cycle. Enterprise wide culture and structure change should be managed (Falkowski *et al.*, 1998), which include people, organization and culture change (Rosario, 2000).

A culture with shared values and common aims is conducive to success. Organizations should have a strong corporate identity that is open to change. An emphasis on quality, a strong computing ability, and a strong willingness to accept new technology would aid in implementation efforts. Management should also have a strong commitment to use the system for achieving business aims (Roberts and Barrar, 1992). Users must be trained, and concerns must be addressed through regular communication, working with change agents, leveraging corporate culture and identifying job aids for different users (Rosario, 2000).

As part of the change management efforts, users should be involved in design and implementation of business processes and the ERP system, and formal education and training should be provided to help them do so (Bingi *et al.*, 1999; Holland *et al.*, 1999). Education should be a priority from the beginning of the project, and money and time should be spent on various forms of education and training (Roberts and Barrar, 1992).

Training, reskilling and professional development of the IT workforce is critical. User training should be emphasized, with heavy investment in training and reskilling of developers in software design and methodology (Sumner, 1999). Employees need training to understand how the system will change business processes. There should be extra training and on-site support for staff as well as managers during implementation. A support organization (e.g. help desk, online user manual) is also critical to meet users' needs after installation (Wee, 2000).

Business process reengineering (BPR) and minimum customization
Another important factor that begins at the project phase is BPR and minimum customization. It is inevitable that business processes are molded to fit the new system (Bingi *et al.*, 1999). Aligning the business process to the software implementation is critical (Holland *et al.*, 1999; Sumner, 1999).

Organizations should be willing to change the business to fit the software with minimal customization (Holland *et al.*, 1999; Roberts and Barrar, 1992). Software should not be modified, as far as possible (Sumner, 1999). Modifications should be avoided to reduce errors and to take advantage of newer versions and releases (Rosario, 2000). Process modeling tools help aid customizing business processes without changing software code (Holland *et al.*, 1999).

Broad reengineering should begin before choosing a system. In conjunction with configuration, a large amount of reengineering should take place iteratively to take advantage of improvements from the new system. Then when the system is in use reengineering should be carried out with new ideas (Wee, 2000).

Quality of business process review and redesign is important (Rosario, 2000). In choosing the package, vendor support and the number of previous implementers should be taken into account (Roberts and Barrar, 1992).

Software development, testing and troubleshooting

Software development, testing and troubleshooting is essential, beginning in the project phase. The overall ERP architecture should be established before deployment, taking into account the most important requirements of the implementation. This prevents reconfiguration at every stage of implementation (Wee, 2000).

There is a choice to be made on the level of functionality and approach to link the system to legacy systems. In addition, to best meet business needs, companies may integrate other specialized software products with the ERP suite. Interfaces for commercial software applications or legacy systems may need to be developed in-house if they are not available in the market (Bingi *et al.*, 1999).

Troubleshooting errors is critical (Holland *et al.*, 1999). The organization implementing ERP should work well with vendors and consultants to resolve software problems. Quick response, patience, perseverance, problem solving and firefighting capabilities are important (Rosario, 2000). Vigorous and sophisticated software testing eases implementation (Rosario, 2000).

Scheer and Habermann (2000) indicate that modeling methods, architecture and tools are critical. Requirements definition can be created and system requirements definition can be documented. There should be a plan for migrating and cleaning up data (Rosario, 2000). Proper tools and techniques and skill to use those tools will aid in ERP success (Rosario, 2000).

Monitoring and evaluation of performance

Finally, monitoring and evaluation come into play at the shakedown phase. Milestones and targets are important to keep track of progress. Achievements should be measured against project goals. The progress of the project should be monitored actively through set milestones and targets.

Two criteria may be used (Roberts and Barrar, 1992). Project management based criteria should be used to measure against completion dates, costs and quality. Then operational criteria should be used to measure against the production system. Monitoring and feedback include the exchange of information between the project team members and analysis of user feedback (Holland *et al.*, 1999).

There should be an early proof of success to manage skepticism (Rosario, 2000). Reporting should be emphasized with custom report development, report

generator use and user training in reporting applications (Sumner, 1999). Management needs information on the effect of ERP on business performance. Reports or processes for assessing data need to be designed. These reports should be produced based on established metrics. It must include effective measurable project goals that meet business needs and are reasonable. Additionally, performance should be tied to compensation (Falkowski *et al.*, 1998).

Conclusions

A total of 11 critical success factors for ERP implementation have been identified, based on a review of the ERP literature. Teamwork and composition in the ERP implementer-vendor-consultant partnership is a key factor influencing ERP implementation success. Good coordination and communication between the implementation partners are essential. Since ERP covers a wide range of functional areas, it is also important to have a cross-functional ERP core team. It is extremely critical that partnership trust is present and the team members are working well together. Another very critical factor is change management program and culture. An organizational culture where the employees share common values and goals and are receptive to change is most likely to succeed in ERP implementation. Furthermore, user training, education and support should be available and highly encouraged. Change agents should also play a major role in the implementation to facilitate change and communication, and to leverage the corporate culture. Other critical factors include top management support, business plan and vision, BPR and minimum customization, effective communication, project management, software development, testing and troubleshooting, monitoring and evaluation of performance, project champion, and appropriate business and IT legacy systems.

In the next stage of this research, we will send out survey questionnaires to companies to evaluate the degree of criticality and importance of the success factors identified in the ERP literature. We are also interested in studying how the perceived importance of these factors may differ across implementation partners such as top executives, users, project team members, internal IT specialists, vendors, and consultants. With a better understanding of the issues involved in ERP implementations, management will be able to make critical decisions and allocate resources that are required to make ERP implementation a success.

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