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ERP Implementation: Chief Information Officers' Perceptions of Critical Success Factors

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This article reports the results of a survey of Chief Information Officers (CIOs) from Fortune 1000 companies on their perceptions of the critical success factors in Enterprise Resource Planning (ERP) implementation. Through a review of the literature, 11 critical success factors were identified , with underlying subfactors, for successful ERP implementation. The degree of criticality of each of these factors were assessed in a survey administered to the CIOs. The 5 most critical factors identified by the CIOs were top management support, project champion, ERP teamwork and composition, project management, and change management program and culture. The importance of each of these factors is discussed.

1. INTRODUCTION

An enterprise resource planning (ERP) system is a packaged 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 its information-processing needs. An ERP system supports a process-oriented view of an enterprise and standardizes business processes across the enterprise. Although ERP systems can bring competitive advantage to organizations, the high failure rate in implementing such systems is a major concern (Davenport, 1998). This research investigates the critical success factors in ERP implementation to provide a better understanding of the key factors leading to implementation success. Al-

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though many researchers have identified or discussed the critical issues or key success factors in ERP implementation, we are not aware of any research that has systematically evaluated the degree of importance and criticality of these factors. In this research, we first examine the existing literature on critical success factors of ERP implementation and then assess Chief Information Officers' (CIOs) perceptions of the degree of criticality of these factors. Finally, we compare the results of the literature review and the results of the survey of CIOs' perceptions.

2. LITERATURE REVIEW

The high failure rate of ERP implementation calls for a better understanding of its critical success factors (Somers, Nelson, & Ragowsky, 2000). Through an extensive literature review, Nah, Lau, and Kuang (2001) found 10 articles that provide answers to the question: "What are the key critical factors for ERP implementation success?" These 10 articles were identified through a computer search of databases of published works and conference proceedings in the information systems (IS) area. The articles were searched by title based on two criteria: (a) an article must contain either the keyword "success/succeed" or "critical issues/factors" and (b) it must contain the term "ERP" or its equivalent, such as MRPII. In the case where the author(s) published more than one article in the area, only the latest publication was used. From the review, Nah et al. (2001) identified 11 factors as being critical to the successful implementation of ERP systems. These 11 factors are: appropriate business and IT legacy systems; business plan and vision; business process re-engineering (BPR); change management program and culture; communication; ERP teamwork and composition; monitoring and evaluation of performance; project champion; project management; software development, testing, and troubleshooting; and top management support. These factors were obtained after careful analysis and grouping of related subfactors (Nah et al., 2001).

We used the 11 factors identified by Nah et al. (2001) and expanded the content of the literature. Two articles—Shanks, Parr, Hu, Corbitt, Thanasankit, and Seddon (2000) and Murray and Coffin (2001)—were added to the reviewed literature. Articles that are not based on empirical studies were excluded from the review. Those that are based on a synthesis of prior studies were also excluded to avoid duplicate counting. Table 1 summarizes the results of the review. All factors identified, except "appropriate business and IT legacy systems," have been cited by 6 or more articles among the 12, indicating a high level of agreement among researchers. We believe that the 11 factors identified and the quantity of their citations were generated through ERP implementation knowledge accumulation and represent the convergent opinions of both academic and practitioner areas. In this research, we use this result as a benchmark to evaluate CIOs' perceptions of critical success factors for ERP implementation.

3. CRITICAL FACTORS FOR ERP IMPLEMENTATION SUCCESS

This section discusses the 11 factors that were identified as being critical to ERP implementation success. Each of these 11 factors can be broken down into detailed

Table 1: Review of Critical Success Factors for Enterprise Resource Planning (ERP) Implementation

	ERP Teamwork and Composition	*Change Management Culture and Program*	*Top Management Support*	*BPR with Minimum Customization*	*Business Plan and Vision*	*Project Management*	*Project Champion*	*Communication*	*Monitoring and Evaluation of Performance*	*Software Development, Testing and Troubleshooting*	*Appropriate Business and IT Legacy Systems*
Bingi, Sharma, and Godla (1999)	x	x	x	x						x	
Buckhout, Frey, and Nemec (1999)	x		x		x						
Falkowski, Pedigo, Smith, and Swanson (1998)	x	x			x	x	x	x	x		
Holland, Light, and Gibson (1999)	x	x	x	x	x	x		x	x	x	x
Murray and Coffin (2001)		x	x	x		x	x		x	x	
Roberts and Barrar (1992)		x	x	x	x				x		x
Rosario (2000)	x	x		x	x	x	x	x	x	x	
Scheer and Habermann (2000)										x	
Shanks et al. (2000)	x	x	x	x	x	x	x	x			
Stefanou (1999)	x						x				
Sumner (1999)	x	x	x	x		x	x	x	x		
Wee (2000)	x	x	x	x	x	x		x		x	
Number of citations	9	9	8	8	7	7	6	6	6	6	2

Note. BPR = Business Process Reengineering; IT = Information Technology.

Table 2: Subfactors for Enterprise Resource Planning (ERP) Implementation Success

Factor 1: Appropriate business and information technology legacy systems	
1. Business setting	Holland, Light, and Gibson, 1999; Roberts and Barrar, 1992
2. Legacy system	Holland et al., 1999
Factor 2: Business plan and vision	
1. Business plan or vision	Buckhout, Freya, & Nemec, 1999; Holland et al., 1999; Rosario, 2000; Wee, 2000
2. Project mission or goals	Roberts and Barrar, 1992; Shanks et al., 2000
3. Justification for investment in ERP	Falkowski, Pedigo, Smith, and Swanson, 1998
Factor 3: Business process reengineering (BPR)	
1. BPR	Bingi, Sharma, and Godla, 1999; Holland et al., 1999; Murray and Coffin, 2001; Roberts and Barrar, 1992; Shanks et al., 2000; Wee, 2000
2. Minimum customization	Murray and Coffin, 2001; Rosario, 2000; Shanks et al., 2000; Sumner, 1999
Factor 4: Change management culture and program	
1. Recognizing the need for change	Falkowski et al., 1998
2. Enterprise-wide culture and structure management	Falkowski et al., 1998; Rosario, 2000
3. User education and training	Bingi et al., 1999; Holland et al., 1999, Murray and Coffin, 2001; Roberts and Barrar, 1992; Shanks et al., 2000
4. User support organization and involvement	Wee, 2000
5. IT workforce re-skilling	Sumner, 1999
6. Commitment to change—perseverance and determination	Shanks et al., 2000
Factor 5: Communication	
1. Targeted and effective communication	Falkowski et al., 1998; Wee, 2000
2. Communication among stakeholders	Holland et al., 1999; Shanks et al., 2000
3. Expectations communicated at all levels	Holland et al., 1999; Rosario, 2000; Shanks et al., 2000; Sumner, 1999
4. Project progress communication	Holland et al., 1999; Sumner, 1999
5. User input	Rosario, 2000
Factor 6: ERP teamwork and composition	
1. Best people on team	Bingi et al., 1999; Buckhout et al., 1999; Falkowski et al., 1998; Rosario, 2000, Shanks et al., 2000; Wee, 2000
2. Balanced or cross-functional team	Holland et al., 1999; Shanks et al., 2000; Sumner, 1999
3. Full-time team members	Shanks et al., 2000
4. Partnership, trust, risk-sharing, and incentives	Stefanou, 1999; Wee, 2000
5. Empowered decisionmakers	Shanks et al., 2000
6. Business and technical knowledge of team members and consultants	Bingi et al., 1999; Shanks et al., 2000; Sumner, 1999

(continued)

Table 2: Subfactors for Enterprise Resource Planning (ERP) Implementation Success (Continued)

Factor 7: Monitoring and evaluation of performance	
1. Track milestones and targets	Murray and Coffin, 2001; Roberts and Barrar, 1992; Rosario, 2000; Sumner, 1999
2. Performance tied to compensation	Falkowski et al., 1998
3. Analysis of user feedback	Holland et al., 1999
Factor 8. Project champion	
1. Existence of project champion	Shanks et al., 2000; Stefanou, 1999; Sumner, 1999
2. High level executive sponsor as champion	Falkowski et al., 1998; Murray and Coffin, 2001
3. Project sponsor commitment	Rosario, 2000
Factor 9: Project management	
1. Assign responsibility	Rosario, 2000
2. Clearly establish project scope	Holland et al., 1999; Shanks et al., 2000
3. Control project scope	Rosario, 2000; Shanks et al., 2000
4. Evaluate any proposed change	Sumner, 1999; Wee, 2000
5. Control and assess scope expansion requests	Sumner, 1999
6. Define project milestones	Holland et al., 1999
7. Set realistic milestones and end dates	Murray and Coffins, 2001; Shanks et al., 2000
8. Enforce project timeliness	Rosario, 2000
9. Coordinate project activities across all affected parties	Falkowski et al., 1998
Factor 10: Software development, testing, and troubleshooting	
1. Configuration of overall ERP architecture	Wee, 2000
2. Appropriate modeling methods/techniques	Murray and Coffin, 2001; Scheer and Habermann, 2000
3. Vigorous and sophisticated testing	Rosario, 2000
4. Troubleshooting	Holland et al., 1999
5. Integration	Bingi et al., 1999
Factor 11: Top management support	
1. Approval and support from top management	Bingi et al., 1999; Buckhout et al., 1999; Murray and Coffin, 2001; Shanks et al., 2000; Sumner, 1999
2. Top management publicly and explicitly identified project as a top priority	Shanks et al., 2000; Wee, 2000
3. Allocate resources	Holland et al., 1999; Roberts and Barrar, 1992; Shanks et al., 2000

subfactors. These subfactors are discussed in this section and listed in Table 2. It is worthwhile to note that many of the factors are interrelated; thus, overlooking one factor can affect other factors and the project as a whole (Cooke & Peterson, 1998).

3.1. Appropriate Business and IT Legacy Systems

Holland, Light, and Gibson (1999) found that business and IT legacy systems determine the degree of IT and organizational change required for ERP implementation

success. By this, they mean that the greater the complexity of legacy systems, the greater the amount of technological and organizational change required. Rogers (1995), in his diffusion of innovations theory, offered the generalization, "the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption." To be successful, ERP implementation efforts must overcome issues of complexity arising from business and IT legacy systems.

According to Roberts and Barrar (1992), a stable and successful business setting is essential, and success in other business areas is necessary for ERP implementation success. They indicated that a stable and successful business is more likely to have a strong organizational identity and be more open to change, which are enabling factors for ERP implementation. A strong organizational identity and openness to change can offset some of the challenges posed by complexity. In a research on SAP R/3 implementation, Slooten and Yap (1999) concurred, stating, "one of the critical success factors of a smooth and rapid ERP implementation is a stable, mature, and capable organization" (p. 227).

3.2. Business Plan and Vision

Because ERP implementations usually exceed the time frame for a typical business project, clear goals, a business plan, and vision are needed to guide ongoing organizational effort. Rosario (2000) emphasized the importance of having a business plan. Wee (2000) stated that the business plan should outline proposed strategic and tangible benefits, resources, costs, risks, and the timeline. ERP, being an enterprise-wide IS, needs a clear business plan and vision to steer the direction of the implementation project (Buckhout, Frey, & Nemec, 1999). The project mission should also be related to business needs and be clearly stated (Roberts & Barrar, 1992). Holland et al. (1999) pointed out the need for a clear business model of how the organization should operate behind the implementation effort, and the need for identifiable, measurable goals or benefits. Such goals should be clearly defined and well-understood (Shanks et al., 2000). Attaining stated goals or benefits is important to sustaining organizational commitment to ERP implementation. There should be justifications for investment in an ERP system based on a change in work processes that is aligned with the future direction of the organization involved (Falkowski, Pedigo, Smith, & Swanson, 1998). Furthermore, companies progressing toward continuous improvement in ERP implementation usually establish a long-term vision (Ross, 1999).

3.3. BPR

In the process of configuring the ERP system, a large amount of reengineering should occur iteratively to take advantage of the best practices offered by the system. Enterprises should be willing to accept the embedded best practice, whenever possible, and model their business processes according to those depicted by the system. Wee (2000) noted that, once the system is in use, reengineering should continue with new ideas and updates to take full advantage of the ERP system capabil-

ities. Organizations should be willing to change their businesses to fit the software in order to minimize the degree of customizations needed (Bingi, Sharma, & Godla, 1999; Holland et al., 1999; Murray & Coffin, 2001; Roberts & Barrar, 1992; Shanks et al., 2000). Software should be minimally modified (Murray & Coffin, 2001; Shanks et al., 2000; Sumner, 1999) to minimize the possibility of errors and take advantage of newer versions and releases (Rosario, 2000). Murray and Coffin (2001) noted that many firms have made unnecessary, complex customizations to ERP software because the people making the changes do not fully understand the firm's business practices or the interrelations between various business practices. This further underscores the importance of a clear business plan and a clear understanding of existing business practices.

3.4. Change Management Culture and Program

Recognizing the need for change is very important as the stronger the need for change, the more likely top management and stakeholders will support the ERP implementation (Falkowski et al., 1998). Enterprise-wide culture and structure change should be managed (Falkowski et al., 1998), which includes people, organization, and culture change (Rosario, 2000). A culture with shared values and a strong corporate identity that is conducive to change is critical. User involvement in the design and implementation of new business processes and the ERP system is recommended and formal education and training should be provided to help users understand how the ERP system will impact their jobs (Bingi et al., 1999; Holland et al., 1999; Roberts & Barrar, 1992; Shanks et al., 2000). In reality, training and education are usually some of the first items on a budget to be cut when a project overruns the allotted budget. However, training should not be neglected because the people handling the system may now be making decisions that affect other business functions and are possibly learning new processes themselves (Murray & Coffin, 2001).

Wee (2000) advocated establishing a support organization (e.g., help desk, online user manual) to meet users' needs and manage organizational change. Training, re-skilling, and professional development of the IT workforce are also critical (Sumner, 1999), especially in ERP software design and implementation methodology. An organization's commitment to change is reflected in its perseverance and determination in facing implementation problems (Shanks et al., 2000).

3.5. Communication

Expectations or goals at every level need to be communicated (Falkowski et al., 1998; Wee, 2000). Goals and expectations help an organization recognize milestones in ERP implementation. Communication should be complete and open to ensure honesty. Users need to know that the feedback they offer regarding the processes and problems with ERP will be received and acted on. Complete and open communication can leverage successes and facilitate enterprise-wide learning (Falkowski et al.,

1998). Communication includes the formal promotion of project teams and the announcement of project progress to the rest of the organization (Holland et al., 1999). Employees should be notified about the project plan, scope, objectives, activities, and updates in advance (Sumner, 1999). User input should be managed in collecting their requirements, comments, reactions, and approval (Rosario, 2000).

Clearly communicated goals help companies achieve continuous improvement in ERP implementation (Ross, 1999). Jiang, Klein, and Balloun (1996) conducted an empirical study on the ranking of IS implementation success factors. In their research, "adequate communication channels" is ranked sixth among the 13 success factors of systems implementation.

Communication among stakeholders was identified as a critical success factor by the companies that Holland et al. (1999) studied. Monthly bulletins, newsletters, weekly meetings, or other communication tools were used to keep users informed of project progress. In the interviews conducted by Shanks et al. (2000), many project managers and consultants stated that ERP implementation was likely to fail when dates were not communicated well in advance, especially to stakeholders.

3.6. ERP Teamwork and Composition

An ERP project involves all of the functional departments in an enterprise. It demands the effort and cooperation of technical and business experts as well as end-users. Hence, teamwork and team composition among the implementer, vendor(s), and consultants are emphasized in the ERP literature. The best people in the organization should be recruited into the ERP team (Bingi et al., 1999; Buckhout et al., 1999; Falkowski et al., 1998; Rosario, 2000; Shanks et al., 2000; Wee, 2000). The ERP team should be balanced, or cross-functional, and comprise a mix of external consultants and internal staff so the internal staff can develop the necessary technical skills for design and implementation (Holland et al., 1999; Shanks et al., 2000; Sumner, 1999). Further, the members of the project team(s) must be empowered to make quick decisions (Shanks et al., 2000).

Both business and technical knowledge are essential for success (Bingi et al., 1999; Shanks et al., 2000; Sumner, 1999). The release of business experts with relevant knowledge onto the project on a full-time basis is very important (Shanks et al., 2000). The sharing of information among the various parties involved, particularly between the implementation partners, 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 common goals (Wee, 2000).

According to Jiang et al.'s (1996) survey, having competent members in the project team is the fourth most important success factor for IS implementation. Ross (1999) also emphasized the importance of a good ERP team composition. Her study showed that companies demonstrated their commitment to ERP by assigning the best people to the project. Haines and Goodhue (2000) noted that the interaction between consultants and employees has a direct impact on the success of ERP implementation.

3.7. Monitoring and Evaluation of Performance

Milestones and targets need to be actively monitored to track the progress of an ERP project (Murray & Coffin, 2001; Roberts & Barrar, 1992; Rosario, 2000; Sumner, 1999). Roberts and Barrar (1992) indicated that two criteria may be used: (a) project management-based criteria should be used to measure against completion dates, costs, and quality and (b) operational criteria should be used to measure against the production system. Additionally, team members' compensation should be tied to project performance (Falkowski et al., 1998). Performance monitoring and feedback also involves the exchange of information between project team members and analysis of feedback received from end users (Holland et al., 1999).

Ideally, there should be early proof of success to manage skepticism (Rosario, 2000). Management needs information on the effect of the ERP system on business performance, for which reports must be designed. Users of the report applications should be trained (Sumner, 1999). Regular reports and project updates can help management monitor the progress of the implementation effort.

3.8. Project Champion

A project champion is more important in ERP implementations than in other IS implementations because ERP success hinges on overall organizational commitment and perseverance. Project sponsor commitment is critical to drive consensus and to oversee the entire life cycle of ERP implementation (Rosario, 2000). Someone should be placed in charge to "champion" the ERP project throughout the organization (Shanks et al., 2000; Stefanou, 1999; Sumner, 1999). Falkowski et al. (1998) indicated that the project champion should be a high-level executive sponsor who has the power to set goals and legitimize change. Rogers (1995) also emphasized the importance of a project champion to innovation success and noted that for costly, visible, or radical projects (common characteristics of ERP projects), the champion needs to be a powerful individual with a high office in the organization.

Shanks et al. (2000) stated that the champion should act as an advocate for the system who is unswerving in promoting the benefits of the new system. Additionally, the project champion's transformational leadership skills play a critical role in implementation success, as the champion must continually resolve conflicts and manage resistance (Stefanou, 1999), as well as manage change (Murray & Coffin, 2001). ERP implementation usually requires employees putting in long hours in excess of their regular job duties. Long hours and stress may decrease employees' morale, requiring the project champion to boost the morale of project team members and ensure the commitment of all members.

3.9. Project Management

Good project management is essential because success in ERP implementation, as in most IS projects, is commonly evaluated based on the degree to which time and

budget requirements are met. An individual or group of people should be given responsibility to drive success in project management (Rosario, 2000). Jiang et al. (1996) found that a competent project manager is the second most important factor in IS implementation. Several authors point out that the scope of the project—in terms of the amount of system implementation, involvement of business units, and BPR needed—should be clearly established (Holland et al., 1999; Shanks et al., 2000) and controlled (Rosario, 2000; Shanks et al., 2000). Ross (1999) also indicated that establishing program scope is key to successful ERP implementation. Any proposed changes should be evaluated against business benefits and, insofar as possible, implemented at a later phase (Sumner, 1999; Wee, 2000). Falkowski et al. (1998) noted that, as part of disciplined project management, changes should be coordinated across all affected parties. Additionally, scope expansion requests need to be assessed in terms of the additional time and cost of proposed changes (Sumner, 1999). The project must be formally defined in terms of its milestones or clear delivery dates (Holland et al., 1999). Realistic milestones and end dates should be set (Murray & Coffin, 2001; Shanks et al., 2000). Timeliness of the project should be enforced and escalation of issues and conflicts should be managed (Rosario, 2000).

Project management must extend beyond a clear scope and goals to include other aspects and issues of the project. Some key issues mentioned in the literature as potential pitfalls in IS implementation are unrealistic schedules and budgets (Boehm, 1991), people crash, lack of effort, and lack of a measurement system (Block, 1983). All of these issues are relevant to ERP implementation and can cause program failure if not anticipated or managed well.

3.10. Software Development, Testing, and Troubleshooting

Development and testing perspectives unique to ERP projects must be well-thought-out and managed. 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). Murray and Coffin (2001) and Scheer and Habermann (2000) indicated that the use of appropriate modeling methods, architecture, and tools will aid in achieving ERP success. Requirements definition can be created and system requirements definition can be documented. Troubleshooting errors is critical (Holland et al., 1999). Organizations implementing ERP should work closely with vendors and consultants to resolve software problems. Rigorous and sophisticated software testing eases implementation (Rosario, 2000). Integration of homegrown systems and specialized software products (that serve a company's unique needs) with the ERP suite is necessary to achieve the full benefits of the implementation. When middleware is not available, organizations have to develop their own interfaces to achieve such integration (Bingi et al., 1999).

3.11. Top Management Support

Top management support is identified by many researchers as one of the key success factors of ERP implementation. The project must receive approval and support

from top management (Bingi et al., 1999; Buckhout et al., 1999; Murray & Coffin, 2001; Shanks et al., 2000; Sumner, 1999). Top management needs to publicly and explicitly identify the project as a top priority (Shanks et al., 2000; Wee, 2000). Senior management must be committed with their own involvement and willingness to allocate valuable resources to the implementation effort (Holland et al., 1999; Shanks et al., 2000). This involves providing not only an appropriate amount of time and resources to get the job done, but also the necessary personnel for the implementation (Roberts & Barrar, 1992).

In Jiang et al.'s (1996) survey of general IS implementation success factors, top management support is ranked third most important among 13 factors. Another related factor, sufficient resource allocation, is ranked fifth in importance. The attitude of the top management to the project determines the amount of resources allocated to the implementation project. In ERP projects, top management support is even more important. Top management advocacy and support, as a symbol of enterprise priority, may reinforce the commitment of all the employees in the enterprise to the project. Top management commitment results in organizational commitment, which is a key factor influencing ERP implementation success (Bingi et al., 1999).

3.12. Summary

The aforementioned 11 factors and their respective subfactors appear repeatedly in the literature concerning ERP implementation success. In this review, we not only discuss how these factors are relevant to successful implementation of ERP, but also provide a framework for studying CIOs' perceptions of critical success factors in ERP implementation.

4. DATA COLLECTION METHOD

To assess CIOs' perceptions of the critical success factors for ERP implementation and the degree to which each factor is considered critical, we developed a survey questionnaire (see the Appendix) that was mailed to the CIOs of Fortune 1000 companies. For each of the factors, a brief description of the factor and a 5-level rating scale ranging from *extremely critical and important for success* to *neither critical nor important for success* was provided. The numerical anchors for the 5-level rating scale are indicated in Table 3.

5. DATA ANALYSIS

A total of 76 responses was received. Of the 76 responses, only 54 are relevant because the other 22 companies did not implement ERP systems. The low response rate is a limitation of this research, which we hope to overcome in future research. Table 3 presents the results of the survey. Based on the ratings presented in Table 3, the results indicate that the top five critical success factors for ERP im-

Table 3: Ratings of Critical Success Factors by Chief Information Officers

	Top Management Support	*Project Champion*	*ERP Teamwork and Composition*	*Project Management*	*Change Management Culture and Program*	*Communication*	*Business Plan and Vision*	*BPR*	*Software Development, Testing and Troubleshooting*	*Monitoring and Evaluation of Performance*	*Appropriate Business and IT Legacy Systems*
Extremely critical and important for success (rating = 5)	42	41	37	33	35	25	23	27	18	22	9
Critical and important for success (rating = 4)	11	9	15	20	12	25	26	15	29	22	22
Somewhat critical and important for success (rating = 3)	1	3	2	1	6	4	4	9	7	8	13
Important but not critical/necessary for success (rating = 2)		1			1		1	3		2	6
Neither critical nor important for success (rating = 1)											4
Average rating	4.76	4.67	4.65	4.59	4.50	4.39	4.31	4.22	4.20	4.19	3.48
Number of citations (out of 12)	8	6	9	7	9	6	7	8	6	6	2

Note. ERP = enterprise resource planning; BPR = business process reengineering; IT = information technology.

plementation, as ranked by CIOs, are: top management support, project champion, ERP teamwork and composition, project management, and change management program and culture. The next group of important factors is communication, business plan and vision, BPR, software development, testing and troubleshooting, and monitoring and evaluation of performance. Appropriate business and IT legacy systems was identified as a critical success factor in 2 out of the 12 articles reviewed and it correspondingly received the lowest rating from CIOs among the 11 factors.

6. DISCUSSION AND CONCLUSION

CIOs rated top management support, project champion, ERP teamwork and composition, project management, and change management program and culture to be most critical to ERP implementation success.

Top management support has been widely acknowledged as a key success factor in ERP implementation. It influences both commitment to resources and commitment to change management (Dong, 2001), which are necessary factors for success in ERP implementation. Sarker and Lee (2000) demonstrated the key role of top management support in ERP implementation and suggest that strong and committed leadership may be able to compensate for the absence of other key social enablers. As one CIO noted in our survey, top management support is "the only way to get started" and to get "compliance and commitment from divisions." Senior management commitment is needed to identify the project as a top priority and to allocate the necessary resources to the project.

Having a project champion was rated second in importance by CIOs. The project champion should be a visible senior manager (or team) committed to promoting the ERP implementation process and to enabling change in the process. Because a project champion is usually a senior executive, this factor is related to the previous factor (i.e., top management support). However, the role of a project champion is unique in that it is transformational—the champion not only promotes highly the ERP implementation and its associated changes throughout the organization, but also manages resistance to change. As one CIO put it, the project champion "must own (the system) and push forward (the implementation)."

Teamwork and composition in the ERP implementer–vendor–consultant partnership is another key factor. Good coordination and communication between implementation partners are essential. Additionally, a balanced (IS and business) team should be chosen and provided with clear role definitions (Bancroft, Seip, & Sprengel, 1997). As noted by one CIO, having "a cross-functional business knowledgeable team" is essential. Another CIO specifically noted, "assembling a good team is critical." One CIO indicated that "only the top performers" should be used for the ERP team.

Next, project management is critical. The project manager must not only be capable of balancing the technical, business, and change management requirements (Bancroft et al., 1997), but also be given broad authority to manage all aspects of the project (Welti, 1999). As noted by one CIO, a "good, experienced project manager

(is) essential" and "setting and meeting milestone[s] is most important and is the best way to manage the project."

Another critical factor is a change management program and culture. An organizational culture where employees share common values and goals and are receptive to change is most likely to succeed in ERP implementation. Change agents should also play a major role in the implementation to facilitate change and communication and to leverage the corporate culture. Commitment to change is necessary for the implementation to succeed. One CIO who rated this factor as being "extremely critical and important for success" also indicated that change management "requires major effort usually beyond capabilities of the implementation teams," thus highlighting the challenge involved.

This research has some interesting findings. The results of CIOs' ranking of ERP critical success factors are largely consistent with the literature review, though the relative ranking of some factors varies. In the literature, ERP teamwork and composition, change management program and culture, top management support, and BPR with minimum customization are four most often cited critical factors (cited by 8 or more articles out of 12). These factors were also rated highly by CIOs. In addition, CIOs noted project champion and project management to be extremely important. All 10 factors that received six or more citations out of 12 in the review were rated as critical (rating > 4) by CIOs. Only one factor, appropriate business and IT legacy systems, cited in 2 out of 12 articles, was not rated as highly as the others (rating < 3.5). Hence, the results of CIOs' perceptions of ERP critical success factors are consistent with the findings reported in the literature.

This study is limited to factors that are critical to ERP implementation success in the early phases. For a discussion on the characteristics of ERP software maintenance (i.e., post implementation), see Nah, Faja, and Cata (2001). A comparison of this study with Jiang et al.'s (1996) study of IS implementation success factors indicated that three of the factors identified in the review are unique to ERP—ERP teamwork and composition, change management program and culture, and BPR and minimum customization. Two of these factors—ERP teamwork and composition, and change management program and culture—are highly regarded in both the literature and by CIOs. BPR and minimum customization, though widely cited in the literature, was not rated as highly by CIOs. Finally, this research considers all 11 critical success factors without grouping them according to phases or stages of ERP implementation. For a discussion of the stages of ERP implementation and the factors that correspond with each stage, see Esteves and Pastor (2001).

Because the target group of our survey was CIOs, the survey results may not be representative of the perceptions of other stakeholders. For ERP implementation to succeed, we need to take into account the critical success factors as perceived by the various stakeholders. In the next stage of this research, we plan to send out questionnaires to different groups of people involved in ERP implementation projects to evaluate their perceptions of the degree of criticality of these factors. These groups of people include ERP project team members, internal IS implementers, vendors, consultants, and users. By comparing the perceptions of these different groups of ERP participants, we hope to obtain a more complete and objective view of the degree of importance of these factors as well as the differences in perceptions

among ERP implementation stakeholders. With a better understanding of the issues involved in ERP implementation and the perspectives from multiple stakeholders, management would be more able to achieve organizational consensus, make critical decisions, and allocate resources that are required to make ERP implementation projects successful.

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APPENDIX

Please evaluate each of the following factors in terms of its importance in determining success in implementing a prepackaged Enterprise Resource Planning (ERP) system. Check the statement that applies.

• Appropriate Business and Information Technology (IT) Legacy Systems
(stable and successful business setting with business and IT systems supporting existing business processes)

___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Business Plan and Vision
(contain objectives, benefits, resource allocation, costs, risks, and timeline; with a clear and focused long-term vision that is integrated with company initiatives)

___ Extremely critical and important for success

___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Business Process Reengineering
(adapt business processes to fit the new system requirements)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Change Management Culture and Program
(regular communication of expectations and challenges to dispel fears; education, training and support; acceptance of change; shared values and goals)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Communication
(consistent, timely, open, and honest two-way communication of expectations, requirements, and comments; updates on progress)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• ERP Teamwork and Composition
(team members who possess the best business and technical knowledge and leadership; team is cross-functional, co-located together, and is on the project full time as their top and only priority; given motivation and direction; familiar with product; empowered to make decisions)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Monitoring and Evaluation of Performance
(milestones set to measure progress against goals with customized reports)
___ Extremely critical and important for success
___ Critical and important for success

___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Project Champion
(a visible senior manager or team committed to promote the implementation process; has power to set goals and legitimize change)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Project Management
(management of scope, schedule, budget, and measurements of success)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Software Development, Testing, and Troubleshooting
(functionality and link with legacy systems established; vigorous and sophisticated testing; troubleshooting and quick response)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success

• Top Management Support
(publicly and explicitly identify project as top priority; involve legitimizing change and provide encouragement and incentives; allocate appropriate resources; share system vision and role)
___ Extremely critical and important for success
___ Critical and important for success
___ Somewhat critical and important for success
___ Important but not critical/necessary for success
___ Neither critical nor important for success