ERP implementation: a compilation and analysis of critical success factors

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Abstract

Purpose – To explore the current literature base of critical success factors (CSFs) of ERP implementations, prepare a compilation, and identify any gaps that might exist.

Design/methodology/approach – Hundreds of journals were searched using key terms identified in a preliminary literature review. Successive rounds of article abstract reviews resulted in 45 articles being selected for the compilation. CSF constructs were then identified using content analysis methodology and an inductive coding technique. A subsequent critical analysis identified gaps in the literature base.

Findings – The most significant finding is the lack of research that has focused on the identification of CSFs from the perspectives of key stakeholders. Additionally, there appears to be much variance with respect to what exactly is encompassed by change management, one of the most widely cited CSFs, and little detail of specific implementation tactics.

Research limitations/implications – There is a need to focus future research efforts on the study of CSFs as they apply to the perspectives of key stakeholders and to ensure that this stakeholder approach is also comprehensive in its coverage of CSFs. As well, there is need to conduct more in-depth research into the concept of change management. One key limitation of this research is the occurrence of duplication in the frequency analysis of the success factors. This is attributed to secondary research being the main methodology for a large number of the articles cited.

Originality/value – This research provides a comprehensive compilation of all previously identified ERP implementation success factors, through a clearly structured methodological approach.

Keywords Manufacturing resource planning, Critical success factors, Change management

Paper type Literature review

Introduction

In an effort to remain competitive, there has been an increasing need in organizations to connect the information supplied by each department into a common entity. ERP systems are designed to address this problem of fragmentation as they integrate and streamline internal processes (Koch, 2003) by providing a suite of software modules that cover all functional areas of a business. However, increasingly we hear of the failures of ERP implementations (Ribbers and Schoo, 2002; Soh et al., 2000; Willis and Willis-Brown, 2002), or the complete abandonment of the system (Jesitus, 1997). Resultantly, there has been expanded research focusing on the implementation process and its critical success factors (CSFs) (Xu et al., 2002; Soh et al., 2000; Ribbers and Schoo, 2002; Scheer and Habermann, 2000; Esteves-Sousa and Pastor-Collado, 2000;

Bingi *et al.*, 1999; Al-Mashari *et al.*, 2003; Hong and Kim, 2002; Somers and Nelson, 2001; Umble *et al.*, 2003). It appears that much of the literature, however, has focused on success factors with very limited or no regard to stakeholder perspective. For a project implementation team, a more intimate understanding of CSFs of the various stakeholder groups would make it possible to assess the project planning phases and determine if the concerns of these relevant groups are being addressed as effectively as possible. Ultimately, this will enhance the probability of achieving higher success levels and, resultantly, timesaving, cost savings, quality and efficiency in their system. It is further suggested that in order to better manage implementations, focus should be placed on those persons who do not perceive the implementation as being successful (Welti, 1999). If those with negative perceptions can be identified, and if they belong to predominantly one stakeholder group, it might be possible to concentrate on those CSFs that are important to them and possibly increase the overall likelihood of implementation success. Stakeholder interest in information system success extends beyond the implementation stage, however. Particularly, various stakeholder groups view the new technology as a decision support tool (Chung *et al.*, 1993) or a method by which they can reinvent their business processes and increase their competitiveness (Chung, 2001).

In Rockhart's (1979) seminal work surrounding CSFs from the viewpoint of chief executives, he states that the process of identifying CSFs helps to ensure that those factors receive the necessary attention. As well, he further posits that the procedure allows for clear definition of the type of information that the company needs and moves away from the trap of building a system around data that are easy to collect. Rockhart's (1979) work was based on research by D. Ronald Daniel, who was, according to Rockhart, the first person to discuss "success factors" in the management literature. In Rockhart's view, CSFs were those specifically distinguished areas that an organization needed to "get right" in order for the business to successfully compete. In terms of an ERP implementation, the CSFs are those conditions that must be met in order for the implementation process to occur successfully.

There has been some criticism of the CSF approach, however, because it is felt that the approach relied on the opinions of managers only and it was, therefore, biased (Davis, 1980). Munro and Wheeler (1980) responded to this suggested weakness in the CSF approach by identifying a method that would incorporate the ideas of senior middle managers in determining information requirements. Similarly, Boynton and Zmud (1984) suggested that a cross-section of management be interviewed, so that all levels would be incorporated. Even when these weaknesses are addressed, the CSF approach, nevertheless, can still be biased and requires that an interviewer possess advanced skills (Munro, 1983) and that there be careful application of the technique (Boynton and Zmud, 1984). The CSF approach, however, can be further strengthened by allowing for even more widespread consultation within the organization. Given that a new technology can be expected to affect more than just senior managers or cross-sections of managers, it is, therefore, necessary to consider the opinions of all those affected stakeholders groups, regardless of their placement within the organizational chart. If CSFs are those factors that the organization must "get right" in order to achieve success, should not it be necessary to ask all those affected just exactly what "right" is? Further, different facets of an implementation affect some stakeholder groups more than others and some groups are more qualified to comment

on certain aspects than others. Through widespread stakeholder consultation, the CSF approach can be strengthened. These identified weaknesses of the CSF approach, identified by earlier researchers, need to be further explored in terms of how they have been addressed in the ERP literature.

Based on the results of a comprehensive compilation and analysis of ERP implementation success factors, this paper seeks to present a new agenda to further research on ERP implementation from a stakeholder perspective and to uncover deeper meaning of the strategic and tactical aspects of some of the more widely cited CSFs. In the following sections, the selected research methodology chosen to prepare the compilation will be explained. This will be followed by a summary of the CSF categories and concepts, as well as a critical analysis of the ERP CSF literature.

Research methodology – CSF compilation

Utilizing a conceptual analysis approach, this comprehensive literature review has involved extensive note taking that has highlighted any and all possible references to CSFs. As mentioned previously, a CSF is defined as reference to any condition or element that was deemed necessary in order for the ERP implementation to occur successfully. Those articles containing reference to CSFs of ERP implementations were then analyzed in more depth for the purpose of coding the identified constructs. This part of the analysis involved differentiating and combining the data collected (Miles and Huberman, 1994). Emphasis was placed not on the words themselves but rather the meaning of the words. Therefore, all CSFs, regardless of description, were noted with the understanding that the sorting phase would begin to place CSFs in like categories. This involved an inductive coding technique:

> Open coding is the part of analysis that pertains specifically to the naming and categorizing of phenomena through close examination of data. During open coding, the data are broken down into discrete parts, closely examined, compared for similarities and differences, and questions are asked about the phenomena as reflected in the data (Strauss and Corbin, p. 64.)

Part of this methodology also involved the technique described by Strauss and Corbin (1990b) that suggests the preparation of qualitative data category cards. Utilizing a bibliographic software program, coded constructs were recorded as they appeared in individual journal articles. Further, each noted construct was placed in a spreadsheet file that recorded the frequencies of each.

Given that the goal of this study was to gain a depth of understanding of the various CSFs already identified by other researchers, content analysis was an appropriate analysis approach. As suggested by Silverman (2000), it is the most common technique when analyzing texts. Silverman has also made another very insightful comment with respect to one's approach when coding, which is that "everyway of seeing is also a way of not seeing" (p. 147). Therefore, he further suggests that "a good coding scheme would reflect a search for 'uncategorized activities' so that they could be accounted for, in a manner similar to searching for deviant cases" (p. 147). As a result, this analysis has also searched for references to "success" factors that may not have necessarily been identified as such. This is part of the reason why some of the search terms used to select the articles did not always include "success," "critical success factor," etc.

Data collection procedures
The actual data collection procedure for the CSF compilation followed the eight category coding steps offered by Carley (1992).

Step 1: decide the level of analysis. This stage involved deciding whether to search for a single word, set of words or phrases. Similarly, Berg (2004) states that the first step of content analysis is to determine at what level the sample will be chosen and what units of analysis will be counted. For the current research, the unit of analysis or level of analysis involved entire journal articles.

The data collection phase of the literature review has involved an exhaustive search of many of the more prominent MIS journals including, but not limited to, those outlined in below:

- *Information & Management.*
- *Journal of Management Information Systems.*
- *MIS Quarterly.*
- *Information Systems Research.*
- *Decision Sciences.*
- *Management Science.*
- *IEEE Journals.*
- *Communications of the ACM.*
- *Information Systems Management.*
- *European Journal of Operational Research.*
- *European Journal of Information Systems.*
- *Business Process Management Journal.*
- *Information Systems Management.*

In addition to, the preceding journals, the following databases were searched: ABI/Inform Global, CBCA Business, Proquest Computing, Proquest European Business, Web of Science and J Stor. Collectively, these databases include hundreds of journals that are categorized as belonging to the business/IS field.

Articles were selected from the search results that had used the search terms and conditions outlined in Table I.

Keywords selected for this search were, in fact, chosen from the keywords supplied by the authors of some of the relevant articles identified in a preliminary literature review. As well, because of the uniqueness of an ERP system, the focus has been only on ERP and not other types of IS systems (data warehouse, DSS, etc.) Finally, as would be expected, the searches were limited to only those journals that were peer-reviewed or scholarly.

The actual selection of the article for inclusion in the compilation was dependent upon the researcher's decision after reading the article abstract and title. If it were determined that the article could possibly contain information that would be indicative of ERP implementation success factors, then the article was selected for further review.

Step 2: decide how many steps to code for. This stage of the coding process involved determining whether to code for a specific pre-determined set of concepts or to allow for a more interactive coding approach. It was decided that the more interactive, inductive approach would be most appropriate as it would allow for absolute inclusion

Individual journal searches	Searched: citation, abstract and title Database searches	
Critical success factors ERP implementation	Critical success factors "AND" enterprise systems	
Critical success factors ERP	Critical success factors "AND" ERP	
Success factors ERP	ERP implementation "AND" success	
Critical success factors enterprise systems	Enterprise software "AND" implementation	
Success factors enterprise systems	Enterprise systems "AND" implementation	
ERP implementation	Enterprise planning "AND" implementation	
ERP success	Enterprise systems "AND" success	
ERP implementation success	Enterprise software "AND" success	
ERP	Enterprise planning "AND" success	
Enterprise resource planning	ERP adoption	
	ERP assimilation	
	ERP	

of all identified CSFs. Berg states that theoretical classes are those that "emerge in the course of analyzing the data" (p. 277). As mentioned, the classes to emerge in this research included the categories of critical success factors as they exist in the literature.

Step 3: decide whether to code for existence or frequency of a concept. In this stage of the coding process, it was decided to code for the frequency of the concepts. By expanding the process to consider the frequency of concepts, the researcher can gain a better understanding of the relative importance of the factors.

Step 4: decide on how you will distinguish among concepts. During this step, it was necessary to decide whether concepts were to be coded exactly as they appeared, or if they could be recorded in some altered or collapsed form. In short, this stage referred to the level of generalization of terms. Specifically, in this research, any words that implied the same meaning were categorized under the same construct. For instance, "management support" and "management advocacy" have similar meanings and were placed within the same category.

Step5: develop rules for coding your texts. To ensure consistency, and thus internal validity when coding, it was necessary to establish a set of translations rules that could be applied throughout the coding process. The following translations rules were developed and applied:

- All articles were read for the first time and emphasis was placed on noting any reference to a possible "success factor." All highlighted concepts were recorded in the bibliographic program. It is important to note that categories were not yet determined at this point. In terms of "success factors" and how they are defined, Williams and Ramaprasad (1996) have offered four degrees of criticality: factors linked to success by a known causal mechanism; factors necessary and sufficient for success; factors necessary for success; and factors associated with success. This compilation included factors considered both necessary for and associated with success. To limit the compilation to only those factors that have been empirically proven to produce success would be too restrictive. In addition, this aspect of the data collection involved making a note of the chosen methodology, as well as the consideration or lack of stakeholder perspective regarding CSFs.

- All article notes were then re-read in an attempt to determine similarity in concepts. Similar concepts were then placed in like categories.
- Each category was then examined, and concepts were thoroughly reviewed again to determine if it were possible to collapse or subdivide and establish any additional categories.
- Once all categories were finalized, concepts were then reviewed in an attempt to determine construct terms. These might have come from one of the coded terms or it might have been an entirely new construct term.

Step 6: decide what to do with "irrelevant" information. This stage involved determining what to do with information in the text that was not coded. Because this literature compilation focused on the assemblage of all concepts considered success factors in ERP implementations, the content analysis included the entire document; however, it actually coded only those aspects of the text that clearly noted possible success criteria. Therefore, the question of what to do with irrelevant coded information did not become an issue.

Step 7: code the texts. During this stage, the actual coding process was conducted using a manual technique. All translation rules identified in step 5 were followed. Strauss and Corbin (1990a, p. 67) states that with respect to the name attached to the category, "it is usually the one that seems most logically related to the data it represents, and it should be graphic enough to remind you quickly of its referent."

Step 8: analyze your results. The actual analysis stage involved reviewing the constructs in terms of frequency as well as a critical evaluation of the CSF approach. These results will be reviewed in the following sections.

CSF literature compilation

Discovering categories

A total of 70 articles were reviewed and 45 were considered to contain "success factors" applicable to the research at hand. The first stage of the analysis involved categorizing or grouping like concepts into like categories. Success factors that, at least initially, appeared to refer to the same phenomenon were grouped together. At this point, the proposed relationship was still considered provisional. After completion of this stage, 55 possible success factor categories were identified. A successive round of analysis of the concepts resulted in the collapsing of several categories, producing 26 CSF categories in total.

Naming categories

In selecting names to identify each category, an attempt was made to make the name graphic enough to allow the reader to determine its referent. However, the selected category names are more abstract than the concepts they represent. In some instances, the selected category name was chosen from the pool of concepts. In other instances, the selected name was borrowed from technical terminology frequently used in the literature (i.e. "vanilla ERP") (Strauss and Corbin, 1990a). Strauss and Corbin (1990a) also warn, however, of the dangers of using borrowed terms and suggest that a researcher be precise about the meanings of the terms.

Table II shows the final 26 categories of critical success factors of ERP implementations. Considering the research of Holland and Light (1999), it was decided

Strategic critical success factors	Tactical critical success factors
Top management commitment and support	Balanced team
Visioning and planning	Project team: the best and brightest
Build a business case	Communication plan
Project champion	Empowered decision makers
Implementation strategy and timeframe	Team morale and motivation
Vanilla ERP	Project cost planning and management
Project management	BPR and software configuration
Change management	Legacy system consideration
Managing cultural change	IT infrastructure
	Client consultation
	Selection of ERP
	Consultant selection and relationship
	Training and job redesign
	Troubleshooting/crises management
	Data conversion and integrity
	System testing
	Post-implementation evaluation

to group the factors into strategic and tactical categories. Strategic factors are those that address the larger picture, and involve the breakdown of goals into do-able elements. Tactical factors, on the other hand, involve skillful methods and details. Specifically, they address accomplishing the various strategic elements that lead to achieving the goal (Pearce, 2004).

Understanding the CSF categories and their concepts

Each identified construct is outlined below with a detailed description of the concepts it represents.

Top management commitment and support. Top management commitment and support was one of the two most widely cited CSFs. This concept referred to the need to have committed leadership at the top management level. In addition, this concept referred to the need for management to anticipate any glitches that might be encountered (Motwani *et al.*, 2002) and the need for senior management who would be involved in the strategic planning, but who are also technically orientated (Yusuf *et al.*, 2004). Sarker and Lee (2003) empirically proved that strong and committed leadership at the top management level is essential to the success of an ERP implementation.

Visioning and planning. Visioning and planning requires articulating a business vision to the organization, identifying clear goals and objectives, and providing a clear link between business goals and IS strategy. Goals should also be measurable (Al-Mashari *et al.*, 2003); planning should incorporate a certain degree of risk and quality management (Mandal and Gunasekaran, 2003); planning style should be reflective of tasks to be accomplished (Mandal and Gunasekaran, 2003); and finally, the planning should involve benchmarking internal and external best practices for ERP implementation (Al-Mudimigh *et al.*, 2001).

Build a business case. This concept involves conducting economic and strategic justifications for implementing an ERP (Tarafdar and Roy, 2003; Xu *et al.*, 2002; Chen, 2001).

Project champion. The need to have a project champion is considered another relatively important CSF. The individual should possess strong leadership skills (Mandal and Gunasekaran, 2003), as well as business, technical and personal managerial competencies (Kraemmergaard and Rose, 2002).

Implementation strategy and timeframe. Several researchers iterated the need to address the implementation strategy and to, specifically, implement the ERP under a phased approach (Mandal and Gunasekaran, 2003; Scott and Vessey, 2000; Cliffe, 1999; Robey *et al.*, 2002; Gupta, 2000; Motwani *et al.*, 2002). Other researchers addressed the question of whether the implementation should be centralized versus decentralized (Siriginidi, 2000a, b). Finally, this concept also considers implications of multi-site issues (Umble *et al.*, 2003) and the benefits of introducing a greenfield site (Siriginidi, 2000b).

Vanilla ERP. The concept of vanilla ERP means that organizations should be committed to the idea of implementing the "vanilla" version of an ERP. This is the basic version with no or minimal customization (Siriginidi, 2000a, b; Somers and Nelson, 2001, 2004; Nah *et al.*, 2001, Palaniswamy and Frank, 2002, Mabert *et al.*, 2003, Shanks and Parr, 2000).

Project management. Project management refers to the ongoing management of the implementation plan. Therefore, it involves not only the planning stages, but also the allocating of responsibilities to various players, the definition of milestones and critical paths, training and human resource planning, and finally the determination of measures of success (Nah *et al.*, 2001). Somers and Nelson (2001, 2004) also advocate the need to establish a steering committee comprised of senior management from different corporate functions, senior project management reps, and ERP end-users. Steering committee members should be involved in ERP selection, monitoring during implementation and management of outside consultants.

Change management. Change management is the other most widely cited critical success factor. This concept refers to the need for the implementation team to formally prepare a change management program (Nah *et al.*, 2001) and be conscious of the need to consider the implications of such a project (Bingi *et al.*, 1999). One key task is to build user acceptance of the project and a positive employee attitude (Abdinnour-Helm *et al.*, 2003; Ross and Vitale, 2000; Kumar *et al.*, 2002; Holland and Light, 1999; Shanks and Parr, 2000). This might be accomplished through education about the benefits and need for an ERP system (Somers and Nelson, 2001, 2004, Siriginidi, 2000a, b; Aladwani, 2001; Bajwa *et al.*, 2004; Motwani *et al.*, 2002; Mandal and Gunasekaran, 2003). Part of this building of user acceptance should also involve securing the support of opinion leaders throughout the organization (Aladwani, 2001). There is also a need for the team leader to effectively negotiate between various political turfs (Skok and Legge, 2002). Wood and Caldas (2001) further stress that in planning the ERP project, it must be looked upon as a change management initiative not an IT initiative.

Managing cultural change. This category could effectively be considered a subcategory of change management; however, given the number of citations that dealt specifically with the issue of cultural change, it was decided to consider it as a separate CSF. Davison (2002) suggests that there is a critical need to be consciously aware of the cultural differences and preferences from both organizational and geographical perspectives. Therefore, it is necessary to understand the business characteristics (Tarafdar and Roy, 2003) and the need for a culture that is conducive to

change (Nah *et al.*, 2001). Adoption costs from the perspectives of all stakeholders must be reduced as much as possible (Aladwani, 2001). Finally, consideration must be given to the identification and usage of strategies that are necessary to implement cultural change (Skok and Legge, 2002).

Balanced team. The need for an implementation team that spans the organization (Kalling, 2003; Shanks and Parr, 2000; Kumar *et al.*, 2002; Nah *et al.*, 2001; Somers and Nelson, 2001, 2004; Ribbers and Schoo, 2002; Willcocks and Stykes, 2000; Gupta, 2000; Mandal and Gunasekaran, 2003; Siriginidi, 2000b), as well as one that possesses a balance of business and IT skills (Kalling, 2003) is another significant critical success factor.

Project team: the best and brightest. It has also been repeatedly mentioned throughout the literature that there is a critical need to put in place a solid, core implementation team that is comprised of the organization's best and brightest individuals. These individuals should have a proven reputation (Cliffe, 1999) and there should be a commitment to "release" these individuals to the project on a full-time basis (Shanks and Parr, 2000, Siriginidi, 2000b). Soh *et al.* (2000) have also cited the need for the team to possess the necessary skills to probe for details when conducting the planning phase of the implementation. Once the team has been established, it might then be necessary to train the individuals (Bajwa *et al.*, 2004).

Communication plan. Communication among various functions/levels (Mandal and Gunasekaran, 2003) and specifically between business and IT personnel (Grant, 2003) is another identified CSF. This requires a communication plan (Kumar *et al.*, 2002) to ensure that open communication occurs within the entire organization, including the shop-floor employees (Yusuf *et al.*, 2004), as well as with suppliers and customers (Mabert *et al.*, 2003).

Empowered decision makers. While not widely cited, this CSF deserves special consideration because it is felt to be a factor that might be overlooked if included within another category. This concept refers to the need for the team to be empowered to make necessary decisions (Shanks and Parr, 2000; Chen, 2001) in due time, so as to allow for effective timing with respect to the implementation (Gupta, 2000).

Team morale and motivation. This CSF is related to the need for the project manager/champion to nurture and maintain a high level of employee morale and motivation during the project (Trimmer *et al.*, 2002; Willcocks and Stykes, 2000; Bingi *et al.*, 1999). It is imperative that the team leader creates a stimulating work environment (Mandal and Gunasekaran, 2003) and recognizes the work of the members (Barker and Frolick, 2003). Ultimately, this should result in a high level of staff retention (Skok and Legge, 2002). The possibility of losing staff because of their marketability externally is a very real, but often overlooked, cause of project failure.

Project cost planning and management. It is important to know up front exactly what the implementation costs will be and dedicate the necessary monies (Trimmer *et al.*, 2002; Bingi *et al.*, 1999; Somers and Nelson, 2001, 2004). However, the nature of ERP implementations are such that there are usually unforeseen and unexpected occurrences that increase the overall costs (Holland and Light, 1999; Al-Mudimigh *et al.*, 2001). Therefore, a loose budget policy is recommended (Ribbers and Schoo, 2002).

BPR and software configuration. The need to conduct BPR and software configuration was the third most commonly cited CSF. BPR results in a complete description of how the business will operate after the package is in use

(Al-Mashari *et al.*, 2003; Nah *et al.*, 2001; Kraemmergaard and Rose, 2002; Siriginidi, 2000a, Bajwa *et al.*, 2004; Bingi *et al.*, 1999; Trimmer *et al.*, 2002; Palaniswamy and Frank, 2002, 2000) with the overall objective of matching the goals/requirements to the implemented system (Ribbers and Schoo, 2002; Gulledge and Sommer, 2002; Voordijk *et al.*, 2003; Grant, 2003; Hong and Kim, 2002). This stage might involve business process change techniques such as business process modeling (Al-Mudimigh *et al.*, 2001; Holland and Light, 1999) or other vendor development tools (Somers and Nelson, 2001, 2004). Special considerations during this phase might include the need to enhance the ERP interface quality (Aladwani, 2001) as well as the need to plan technology infrastructure (Mabert *et al.*, 2003). Vendors must also explain the embedded data requirements (Soh *et al.*, 2000).

Legacy system considerations. There must also be consideration of the current legacy system in place as this will be a good indicator of the nature and scale of potential problems. This could directly affect the technical and organizational change required (Nah *et al.*, 2001; Al-Mudimigh *et al.*, 2001; Al-Mashari *et al.*, 2003; Holland and Light, 1999). Whether or not there is a reasonably well working manual system in place is another consideration (Siriginidi, 2000b).

IT infrastructure. It is critical to assess the IT readiness of the organization, including the architecture and skills (Tarafdar and Roy, 2003; Somers and Nelson, 2001; Somers and Nelson, 2004; Bajwa *et al.*, 2004; Siriginidi, 2000a, b). If necessary, infrastructure might need to be upgraded or revamped (Kumar *et al.*, 2002; Palaniswamy and Frank, 2002).

Client consultation. Al-Mashari *et al.* (2003) and Al Mudimigh *et al.* (2001) mention the need for communication and consultation with various key stakeholders, but in particular with the client. Organizations need to keep its clients apprised of its projects to avoid misconceptions (Al-Mudimigh *et al.*, 2001). Holland and Light (1999) and Mandal and Gunasekaran (2003) also support this CSF.

Selection of ERP. The selection of the specific ERP package is one that requires careful attention (Kraemmergaard and Rose, 2002; Yusuf *et al.*, 2004; Al-Mashari *et al.*, 2003; Somers and Nelson, 2001, 2004). It is also necessary to keep in mind that the system must match the business processes (Chen, 2001).

Consultant selection and relationship. Many researchers have advocated the need to include an ERP consultant as part of the implementation team (Trimmer *et al.*, 2002; Bajwa *et al.*, 2004; Kraemmergaard and Rose, 2002; Al-Mudimigh *et al.*, 2001; Bingi *et al.*, 1999; Skok and Legge, 2002; Kalling, 2003; Willcocks and Stykes, 2000; Motwani *et al.*, 2002). However, as part of this relationship, it is imperative to arrange for knowledge transfer from the consultant to the company (Al-Mashari *et al.*, 2003) so as to decrease the dependency on the vendor/consultant (Skok and Legge, 2002).

Training and job redesign. A significant number of citations also made reference to the need to include training as a critical aspect of an implementation. Additionally, it is necessary to consider the impact of the change on the nature of work and the specific job descriptions. While most researchers have generally mentioned the need for training, some researchers have specifically mentioned the need for project team training (Kumar *et al.*, 2002) while others have focused on user training (Robey *et al.*, 2002; Bingi *et al.*, 1999; Kumar *et al.*, 2002; Mandal and Gunasekaran, 2003; Trimmer *et al.*, 2002). It has been suggested that the training should encompass the development of IT skills (Stratman and Roth, 2002; Voordijk *et al.*, 2003; Tarafdar and

Roy, 2003) and that it should be hands-on (Aladwani, 2001). The need to plan for training facilities is another vital consideration (Siriginidi, 2000a, b). Finally, management needs to take into account how staff may need to be restructured (Mandal and Gunasekaran, 2003, Motwani *et al.*, 2002) or how compensation plans may need to be evaluated and modified (Cliffe, 1999).

Troubleshooting and crises management. Scott and Vesey have emphasized the need to be flexible in ERP implementations and to learn from unforeseen circumstances. Similarly, Mandal and Gunasekaran (2003) echoed the need to prepare to handle unexpected crises situations. The need for troubleshooting skills will be an ongoing requirement of the implementation process (Al-Mashari *et al.*, 2003; Holland and Light, 1999; Nah *et al.*, 2001).

Data conversion and integrity. Much of the success of the implementation process and ultimately the success of the system relies on the ability of the team to ensure data accuracy during the conversion process (Umble *et al.*, 2003; Bajwa *et al.*, 2004; Somers and Nelson, 2001, 2004; Xu *et al.*, 2002). This stage of the implementation might also involve the cleaning up of suspect data (Yusuf *et al.*, 2004).

System testing. During the final stages of the implementation process, the project team should consider the inclusion of testing exercises (Kumar *et al.*, 2002; Nah *et al.*, 2001; Al-Mashari *et al.*, 2003) as well as simulation exercises before the system "goes live" (Yusuf *et al.*, 2004).

Post-implementation evaluation. Any project is not complete without the allowance for some kind of post-evaluation (Nah *et al.*, 2001; Al-Mashari *et al.*, 2003; Tarafdar and Roy, 2003; Holland and Light, 1999). Mandal and Gunasekaran (2003) also suggest that there should be an allowance for a feedback network. Ross and Vitale (2000) stress the need for continued management support. The post assessment will be difficult to complete, however, unless there had been established metrics (Ross and Vitale, 2000) or focused performance measures (Umble *et al.*, 2003).

As previously mentioned, part of the content analysis involved recording the frequency of the success citations. Table III reveals that the five most widely cited categories, top management commitment and support, change management, BPR and software configuration, training and job redesign, and project team: the best and brightest, are significantly more often researched than the others.

Analysis of ERP implementation literature

The preceding compilation has provided a foundation with respect to the range of success factors that are cited in the literature, and the frequency associated with each. However, there was additional analysis conducted that sought to uncover any obvious gaps in the literature to date. As a result, what has become most apparent from this review is the lack of depth in the coverage of CSFs. Additionally, another significant observation was the lack of stakeholder perspective in the success factors cited. Either success factors were presented with no explanation of whose perspective was represented, or stakeholder perspective was provided, but for only a single success factor. Finally, the concept of change management, one of the most widely cited success factors, appeared to have varied definitions and there was little explanation of the specific tactics that could be used to implement such a program. Each of these limitations will be explored in further detail.

CSF category	Number of instances cited in literature
Top management commitment and support	25
Change management	25
BPR and software configuration	23
Training and job redesign	23
Project team: the best and brightest	21
Implementation strategy and timeframe	17
Consultant selection and relationship	16
Visioning and planning	15
Balanced team	12
Project champion	10
Communication plan	10
IT infrastructure	8
Managing cultural change	7
Post-implementation evaluation	7
Selection of ERP	7
Team morale and motivation	6
Vanilla ERP	6
Project management	6
Troubleshooting/crises management	6
Legacy system consideration	5
Data conversion and integrity	5
System testing	5
Client consultation	4
Project cost planning and management	4
Build a business case	3
Empowered decision makers	3

Table III.
Frequency analysis of
CSFs in literature

Researchers have very often focused on only a specific aspect of the implementation process or a specific CSF. Consequently, there is little research documented that encompasses all significant CSF considerations. For instance, Abdinnour-Helm *et al.* (2003) recognized the importance of employee attitude to ERP implementation success; Hong and Kim (2002) studied the impact of organizational fit as a CSF and discovered a direct link between it and ERP implementation success. Research by Davison (2002) involved a case study on a Hong Kong University to learn more about culture as a factor that affects success. Other researchers, considered other perspectives: Soh *et al.* (2000) looked at embedded data requirements; Tarafdar and Roy (2003) interviewed executives about the issue of organizational acceptance; Robey *et al.* (2002) used case study to address the issue of knowledge barriers; and Kumar *et al.* studied project managers to determine key success strategies of government organizations adopting ERP. Further, Grant (2003) researched the importance of IS alignment as a CSF and used a combined methodology of secondary data and a case study of one company. Finally, program management was also found to be a key CSF of ERP implementation projects (Ribbers and Schoo, 2002). In each of the aforementioned articles, investigation was based on some form of primary research (survey, case study, or observation). The following research, however, has used only secondary sources. An article by Aladwani (2001), centered on the relationship between marketing as a change management strategy, and proposed that marketing theories may be applied to ERP adoption. Dong (2001) focused on the influence of top management support; Gulledge and Sommer (2002)

studied business process management as a CSF; and Scott and Vessey used organizational theory to identify factors that require consideration when implementing an ERP. Regardless of methodology, all the aforementioned studies have been narrowly focused, affording readers a constricted, yet detailed, view of a specific success factor. In the following instances, the research was broader in scope.

While some investigators had set out to prepare a taxonomy of CSFs (Al-Mashari *et al.*, 2003; Kalling, 2003; Siriginidi, 2000b; Umble *et al.*, 2003), based on literature reviews, others had presented CSFs according to stages of implementation, had been more focused on a specific area of the implementation, or had attempted to categorize CSFs according to planning frameworks. Bajwa *et al.* (2004) looked extensively at the range of success factors and presented them according to assimilation stages. Work by Chen (2001) attempted to identify CSFs according to planning stages, and similarly, Nah *et al.* (2001) and Somers and Nelson (2001) presented CSFs by stage of implementation. Work by Stratman and Roth (2002) identified eight constructs associated with ERP success. Finally, Trimmer *et al.* (2002) offered a list of generic CSFs based on a literature review, but then expanded this with a list of CSFs specific to health care, compiled through their own case studies.

Other researchers were more comprehensive in their coverage of CSFs but attempted to categorize them differently. Al-Mudimigh *et al.* (2001) categorized CSFs according to strategic, tactical and operational categories. Similarly, another study produced a framework of CSFs according to strategic and tactical categories only (Holland and Light, 1999). Finally, work by Bingi *et al.* (1999), in their article entitled "Critical issues affecting an ERP implementation," highlights several CSFs, but there is no indication of the methodology used. Clearly, there is limited research that has attempted to produce an expansive collection of CSFs. Next, consideration is given to the lack of stakeholder perspective.

The observation that there has been no research conducted to date that has considered and presented the major ERP implementation CSFs from the perspectives of key stakeholders is a significant finding. While there have been several studies, as outlined below, that have attempted to interview representatives from various stakeholder groups, they have not reported findings so that individual views of different stakeholder groups are clearly represented. Research by Motwani *et al.* (2002) stated that interviews were conducted at various levels of the organization, but there was no further detail than this. Were the interviews with various levels of management? Were consultants considered? Work by others (Shanks and Parr, 2000; Ross and Vitale, 2000; Xu *et al.*, 2002; Mabert *et al.*, 2003; Voordijk *et al.*, 2003) did attempt to incorporate various stakeholder groups in their data collection; however, their research did not report the views of stakeholder groups. While it was clear in the work of Sarker and Lee (2003) that there was consultation with stakeholder groups, it was noted by the researchers that managers were significantly more represented than users/lower level employees and consultants. Perhaps, work by Kraemmergard and Rose used methodology that would come closest to providing complete reporting of stakeholder perspectives. They used a case study research design and collected data through unstructured interviews with all key stakeholder groups (senior managers, ERP manager, internal consultant, superusers and regular users). However, their work focused on only managerial competencies, and therefore, limited its research to only one specific category of ERP implementation success factors. The relatively small

degree of stakeholder consultation and the lack of reporting of their individual views, as evidenced in the preceding citations, is a significant gap in the current literature base and it demonstrates the main weakness of the CSF approach identified by Davis (1980) as early as 1980. This is concerning.

The final key observation of the literature review relates to the CSF compilation itself and the definitions applied to the terms. For instance, while the success factor, change management, appears to have emerged as one of the most widely cited success factors, there is still much confusion with respect to what exactly is included in the construct. As evidenced in the research cited below, the range of activities encompassed by change management is varied. Further, there is very little offered in the literature that attempts to identify or explain the specific tactics required to successfully manage and implement these change management activities.

Many researchers have been specific in their reference to the change management activities required for success. In some cases, they have referenced the need to build acceptance and commitment to the change (Shanks and Parr, 2000; Motwani et al., 2002; Bajwa et al., 2004; Holland and Light, 1999; Abdinnour-Helm et al., 2003; Kumar et al., 2002) and address resistance (Ross and Vitale, 2000; Hong and Kim, 2002; Skok and Legge, 2002); the need to communicate (Ribbers and Schoo, 2002); the need to understand benefits and drawbacks (Bingi et al., 1999; Aladwani, 2001); the need to educate (Siriginidi, 2000a, b); and the need to consider and address organizational culture issues (Davison, 2002; Al-Mashari et al., 2003; Aladwani, 2001; Nah et al., 2001; Scott and Vessey, 2000; Tarafdar and Roy, 2003; Skok and Legge, 2002). In addition, several researchers (Nah et al., 2001; Voordijk et al., 2003) cite the need for a change management program. In the view of Nah et al. (2001) such a program should, among other things, create a culture with shared values and common aims, emphasize quality, build management commitment, train users, involve users in the system design, and provide a support structure. Tarafdar and Roy (2003) note the importance of the need to manage organizational change throughout the implementation stage. They acknowledged that some employees find it difficult to accept new reporting structures and new job processes. Similarly, Umble et al. (2003) also recognize the impact that such a project has on corporate culture and suggest that people need to be prepared for the change. They further state, "if proper change management techniques are utilized, the company should be prepared to embrace the opportunities provided by the new ERP system" (p. 245).

As evidenced by the above references, the views on change management and exactly what change management involves vary greatly. This needs to be further explored, so that these ideas can be better presented in a manner that makes it possible for the "change manager" to effectively implement and control this success factor. As well, although there is no doubt that change management is a necessary consideration, it is less clear exactly how it should be handled.

Work by Abdinnour-Helm et al. (2003) considered the impact of attitudes on implementation success, and though they did highlight some factors that influence attitudes, further exploration is required in terms of tactics that might impact these factors. Further, Kumar et al. offer some strategies to build user acceptance, one aspect of change management. Some of their ideas include: support and training, increased communication, user guidelines, demonstration of benefits. Yet, these still leave one to wonder about the specific tactics required. Finally, an article by Motwani et al. (2002)

states that a well-managed change process requires "evolutionary and revolutionary change tactics," but the authors offer no suggestions as to what these devices might be. Aladwani (2001), however, might offer the only literature that actually suggests strategies and tactics that may be introduced to implement an ERP project. His work ties ERP projects to marketing theories and proposes an implementation framework. The author acknowledges, however, that this framework has yet to be tested.

In summary, the concept of change management as it applies to ERP implementation is extremely important and requires further examination. Many strategies have been uncovered; however, strategies alone are not sufficient. What tactics are required? Are there differing stakeholder views regarding what are appropriate tactics? How do influences like power, control and resistance have an impact on the selection of proper tactics? Answers to these questions will help us understand and better control the change management process, one of the most critical of all ERP implementation success factors.

Concluding thoughts and directions for future research

Research on ERP implementation and critical success factors can be a valuable step toward enhancing chances of implementation success. A review of the ERP critical success factor/implementation literature reveals that in many cases, CSFs are presented based on a review of already published literature or limited case studies. As a result, one key limitation of this research is the occurrence of duplication in the frequency analysis of the success factors. Further, in situations when previous researchers have attempted to identify CSFs through their own empirical research, they have very often focused on only a specific aspect of the implementation or a specific kind of CSF. Therefore, there is little or no research that encompasses all significant CSF considerations. Past approaches in studying CSFs have been very similar in manner to the fragmented approach taken for ERP implementation projects. Wood and Caldas (2001) argued that the implementation process is one that must be regarded as a complex process that takes a non-reductionist approach; therefore, they recommend that future research should place emphasis on the implementation process from a holistic perspective. Such a project is just as much about change and business transformation as it is about information technology; therefore, a CSF approach that moves beyond the scope of hardware and software is required. Work by Al-Mashari (2002) also presented an agenda for future research in this field. Specifically, he suggested that case study and empirical study methodology be used to apply the CSF approach to a company that has already completed an implementation project.

As well, it has been revealed that there has been no research conducted to date that has considered the key ERP implementation CSFs from the perspectives of key stakeholders. This is a significant finding. While several studies have attempted to interview representatives from various stakeholder groups, they have not reported findings so that individual views of different stakeholder groups are identified. Nah et al. (2001) identified the need to study the perceived importance of success factors from stakeholder perspectives. Similarly, Skok and Legge (2002, p. 82) have argued that there is a need to "increase the multiplicity of relevant stakeholders" to include groups such as customers, suppliers, wholesalers, etc. A similar perspective was expressed by Bajwa et al. (2004). They suggested that future research should validate the role of external stakeholders in ERP implementations.

Finally, while change management appears to emerge as one of two most widely cited success factors, there still appears to be much variance with respect to what exactly is encompassed by the construct and what specific change management tactics would work. Aladwani (2001) proposes that change management through marketing techniques could prove to be a valuable approach for overcoming resistance to ERPs, and as a result, he presents a model for formal testing.

In view of the limitations of the above mentioned literature and based on the recommendations of other researchers, there is a need to focus future research efforts on the study of CSFs as they apply to the perspectives of key stakeholders and to ensure that this stakeholder approach is also comprehensive in its coverage of CSFs. Finally, there is need to conduct more in-depth research into the concept of change management and what it entails. All of the ERP success factors are important in their own rite; however, the need to approach the implementation from a change management perspective is central to the success of any ERP project. The gap in this aspect of the literature needs to be explored in more detail. Expressly, there is a need to identify the strategies to be employed and the explicit tactics to be used to successfully manage an ERP implementation project.

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