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Critical success factors in enterprise resource planning implementation

A review of case studies

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Abstract

Purpose – The purpose of this paper is to consolidate the critical success factors (CSFs) as published in enterprise resource planning (ERP) implementation case studies. The authors perform the analysis and propose the final CSFs based on the reported ERP implementation process stages.

Design/methodology/approach – The paper follows the eight category coding steps proposed by Carley (1993) and utilizes only ERP implementation case studies to identify a distinct set of critical success factors. The 37 case studies used in this paper provide a reasonable sample from different countries and contexts. Two methodologies were followed, one for the literature review process and the other for the analysis and synthesis.

Findings – Out of 64 reported CSFs that were extracted from the literature and subsequent detailed analysis and synthesis the authors found a total of 22 factors that are distinct. These factors which encompass change management, are proposed with five ERP implementation stages.

Research limitations/implications – The final set of success factors proposed in this study gives a consolidated and unified view of the significant variables to be considered during all the stages of ERP implementation. The research is limited to case study literature and does not account for ERP implementation models and frameworks. Another limitation would be the scope of the literature searched which is that of the Management Information Community.

Practical implications – The proposed CSFs can be used by practitioners in five ways: assess implementation of an ERP; *ex-ante* assessment; comparative analysis with other implementation experiences; utilize CSFs from model as part of key performance indicators; and utilize the model to establish a concise strategy to project management process for the ERP implementation.

Social implications – ERP implementation is complex. The promise has not yet been fully realized. An ERP-enabled organization entails primarily strategy and change management. To that effect, all stakeholders are impacted by ERP implementation. This paper, identified CSFs extracted from cases of ERP implementation and proposes a model to support its project management, user satisfaction and sustainability. The results aim at reducing costs, maintaining timeline, reducing employee anxieties and with a successful implementation, better service to customer base.

Originality/value – This paper is the first attempt to present a consolidated list of CSFs and mapping them to the stages of an ERP implementation as reported from the industry. It originality is its focus on utilizing rigorous published case studies with the hope that future case studies would utilize the work to report on the same factors. The value is that as the case studies are increased, comparison and differentiation between is enhanced.

Keywords Critical success factors, ERP, Implementation, Information management, Case studies

Paper type Literature review

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1. Introduction

Enterprise resource planning (ERP) refers to organizational information systems used to improve process efficiency by providing real time data (Holland and Light, 1999). The need of open and efficient flow of information between the company, its suppliers, distributors and customers was a primary driver to implement ERP systems. Moreover, the need for improved businesses processes has resulted from an ever increasing competitive environment plagued with delays in supply and whereby production challenges resulted in loss of financial resources and consequently competitive advantage. Umble *et al.* (2003), elaborates on the benefits of ERP to "provide information about all the functions of an enterprise by a single system which provides an enterprise wide view of the company." ERP helps in decision making and projecting a strategy for the future. Some of the various departments influenced by the implementation of an ERP system are: finance, human resources, operations, logistics, sales and marketing.

ERP is considered to solve the issues of efficiency of business processes and its successful implementation results in streamlining the organizations processes which results in savings of money and time (Shang and Seddon, 2000). But still it is noticed that a lot of companies even today are unsuccessful at the implementation of its ERP (Xue *et al.*, 2005; Al-Mashari and Al-Mudimigh, 2003). They have costly or delayed implementations and their ERP strategy keeps revolving around correcting the issues related to the implementation which leads to no progress toward the ERP strategy (Huang *et al.*, 2004). They calculated that 90 percent of ERP implementations are delivered late or are over budget and enterprise initiatives show a 67 percent fail rate in achieving corporate goals and are considered negative or unsuccessful. This has improved at an organic growth over the years as organizations are increasingly becoming aware of the factors needed to ensure a successful ERP implementation. The Panorama Consulting Solutions (2013) reports that on an average between 2008 and 2012, 53 percent of the ERP implementations have been delivered late and 58 percent of the implementations have gone over budget. Also, around 58 percent of the implementations failed to realize less than 50 percent of their corporate goals. There have been various issues identified as the reasons for the failure of these projects. So, it is possible that the understanding of critical success factors (CSFs) regarding ERP implementation have followed an organic growth over the years but still there is a long way to go before the success can be deemed as a substantial one.

The CSFs of ERP implementation outline aspects which are essential to ensure that a successful ERP implementation proves to be a profitable venture for an organization. Over the course of the last 15 years, there has been a lot of research done on ERP implementation critical success. Relatively few theoretical articles suggesting ERP implementation frameworks (Bajwa *et al.*, 2004; Bingi *et al.*, 1999; Buckhout *et al.*, 1999; Falkowski *et al.*, 1998) are found in the body of literature; empirical articles measuring the relationship between two or more critical ERP implementation success factors (Bhatti, 2005; Hong and Kim, 2002) are more prevalent; and a number of various case studies (Bozarth, 2006; Akkermans and van Helden, 2002; Motwani *et al.*, 2005) highlight a range of experience-based CSFs in different regions of the world. An overview of the three categories of paper reveal that some of the CSFs reported in theoretical and empirical articles are not mentioned in the case studies, thereby implying that they may not be very practical or observed in the real world. These ERP implementation "variable of success" can be termed as simply secondary success factors but not "CSFs."

The literature on CSFs, in specific, is scattered with no particular distinction in any specific domain. By aggregating all CSFs for ERP implementation, a relatively long

list is produced. To that effect, this paper identifies and combines (aggregation and consolidation) these CSFs aligned to reported stages in the ERP implementation process utilizing a smaller and a more consolidated list of CFS's obtained from real world case studies. Therefore, considering the financial, organizational and human impact of ERP implementation, and seeing that the level of understanding is still in its infancy, this paper is motivated to contribute to the body of knowledge by seeking to answer the following research question:

RQ1. What are the practical CSFs for ERP implementation?

This paper addresses *RQ1* by revieweing the research done in case studies (hence practical in *RQ1*) regarding ERP implementation to establish a list of CSFs which are more relevant in real life scenarios and have a higher impact than other CSFs. By understanding what went wrong in big, small and start-up companies and what decisions they took that ensured the success of their ERP implementation, it is possible to gain significant insight into the actual issues of ERP implementation. This paper also establishes a new understanding of ERP implementation stages implementation which is more understandable to the practitioners in the industry.

In this section of the paper, we make the case for the need to better understand the practical CSF when organizations are engaged in ERP implementation. We scope our work by specifying our research question. In the next section, we elaborate on the research methodology which is twofolds, namely, that for conducting the literature review (identifying the pertinent articles) and for the aggregation and consolidation of the CSFs found in the previous literature review step. Therefore Section 2 is split in two parts accordingly. In Section 3 we report on all relevant articles and conclude in this section with a comprehensive table showing all the CSFs extracted from the literature. In the next step (Section 4), we implement our analysis and synthesis approach (to aggregate and consolidate) the CSFs from the previous step and propose a final set of practical CSFs. Section 5 elaborates on the implications of our findings. Limitations to our research work are discussed in Section 6 followed by conclusions and future research (Section 7).

2. Research methodology

Our research work presented in this paper entails two methodologies: the first involves the literature review; and the second relates to the treatment (analysis and synthesis) of the content of the articles.

2.1 Literature review approach

There are a number of literature review methodologies that have been published in research as well as in practice (Levy and Ellis, 2006; Webster and Watson, 2002; Brock *et al.*, 2009). For example, Kitchenham *et al.* (2009) proposed a systematic approach to synthesize and analyze concepts, organize empirical findings, and identify gaps in the literature, with the purpose of understanding the viability and likely evolution of enterprise project management. Their approach entailed the following steps: identification of sources; group of researchers conducting individually their literature review for each source; conducting an inclusion and exclusion criteria for the selection process; performing a group peer quality assessment; data extraction from final set of articles; group peer assessment for data extraction; finally, all decisions are negotiated within the group until agreement is reached.

Brocke *et al.* (2009) suggested a literature review approach that is broad and extending to all fields. Their approach is cyclical whereby their literature review is

continuously extended and updated. The steps they suggested for the primary review entails definition and review of scope, conceptualization of topic, literature search, analysis and synthesis, and research agenda. These steps coupled with a set of proposed tables and process charts constitutes a framework they had proposed. A prominent and well-established literature review methodology is "The Cochrane Collaboration" used in the field of medicine and healthcare in general (www.cochrane.org). The Cochrane review is an established systematic review process that is evidence-based – a primary focus of research in the medial and healthcare industry. Their approach is very rigorous that starts with a clearly formulated question.

All the literature review methodologies have many parts in common. Comparing and differentiating the different methodologies is out of the scope of this paper. The literature review approach utilized in this study and presented below has many commonalities with other approaches (such as clearly formulated question, agreement for article selection and CSFs, and extraction and organization of data). Our selection of the method was utilize and accepted method and one that seems to be most appropriate to the nature and purpose of our research work and context of study. The literature review methodology used to identify and analyze articles critical to this research study followed the eight category coding steps proposed by Carley (1993), described below and show in Figure 1. These coding steps ensure that a comprehensive literature review is done with the existing articles in a particular field of research. The purpose of this methodology is to create a consolidated list of coded distinct CSFs obtained from case studies reporting on ERP implementation.

Step 1: levels of analysis: the literature review entailed organization-wide information synthesis from peer refereed journal articles. The search was focussed on ERP systems and more specifically to the implementation of ERP systems. Our focus was to find case study articles reporting on experiences in implementing ERP. We primarily scoped our search within MIS journals with various keyword combinations of "ERP," "Enterprise," "Resource Planning," "Organization," "Implementation," "Critical," "Success Factors," "Factors," "Planning," "Case Studies" for "successful" and "unsuccessful/failed" ERP implementations. The top tier journals that we focussed on are:

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

We attempted to keep the literature research scope as tight as possible by being specific to ERP systems and not other types of IS systems (which we found there were many).

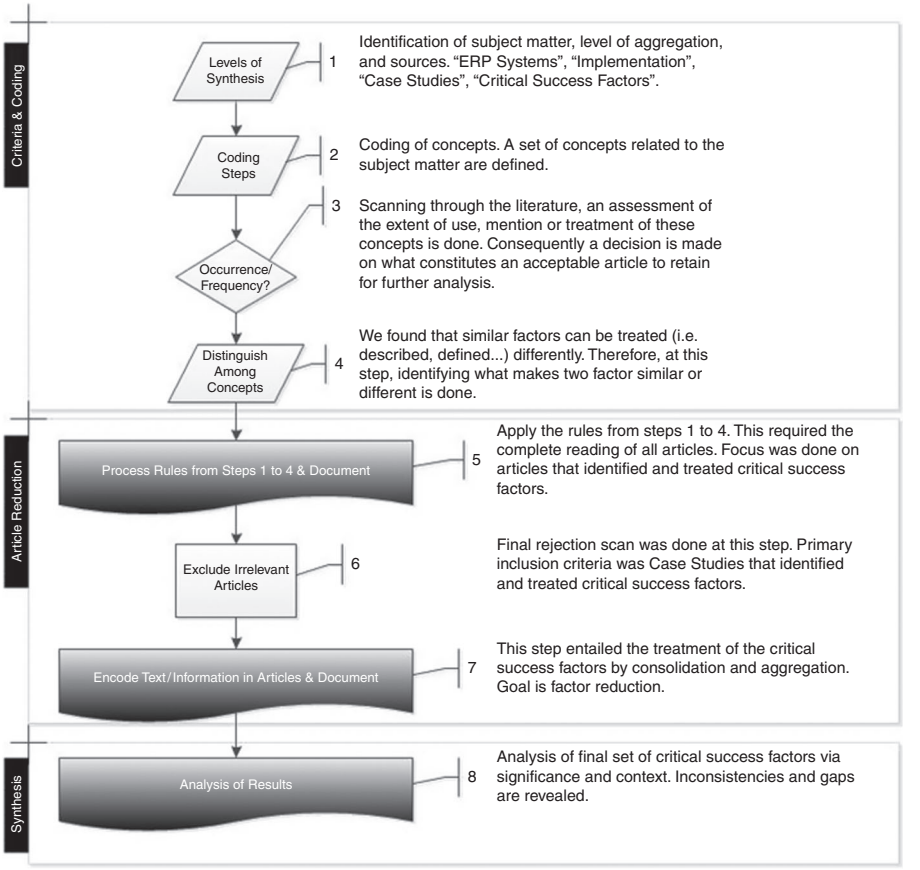

Figure 1.
Literature review process

Step 2: steps to code for: the coding process identifies whether a pre-determined set of concepts or an interactive approach for coding is followed. An interactive coding approach was used for this study to cover all the identified CSFs.

Step 3: decide whether to code for occurrence or frequency of a concept: the frequency of a concept was explored. By this measure, we were able to identify how many times a particular CSF has been mentioned in the body of literature of case studies.

Step 4: how to distinguish among concepts: the "distinguish factor" used was similarity/difference in the meaning. The success factors which sounded similar were put together and categorized as one. Finally, some CSFs were merged which improved the collection of factors and led to factors which were distinct.

Step 5: develop rules for coding the text: all the case studies were re-read to ensure that the factors mentioned were CSFs. Some articles were rejected because they entailed results of CSFs and not the CSFs. The factors were studied once again and merged into a new set of distinct CSF.

Step 6: "Irrelevant" information – only case studies articles were selected. From that set only articles which contained CSFs were kept for analysis.

Step 7: coding of text/information: during this stage, the actual coding process was conducted. All translation rules identified in step 5 were followed. Strauss and Corbin (1990, 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: analysis of results: the results analysis consisted of measuring the count of CSFs identified in each article and noting their context that helped to understand the areas which are more and less explored in the ERP implementation field. The factors were condensed into a single distinct set of CSFs.

2.2 Analysis and synthesis approach

An interpretive qualitative approach (IQA) was used for the treatment of the research question posited. The IQA is appropriate for the purpose of our research because the ERP implementation case studies used are qualitative and descriptive. Moreover, the nature of ERP implementation engages practitioners from various fields (computer science, management, support staff, etc.) with different subjective experiences of interaction with the ERP information systems. To better understand the CSFs via analysis and synthesis, the IQA is appropriate provide insight into the interplay between the diverse stakeholders as they have to implement one solution to meet all their needs. To the effect, and with the IQA, we focus on the context and associated meanings, concepts, perceptions, descriptions, and characteristics (Koumaditis *et al.*, 2013). Therefore, the use of the IQA for this part of our research work can be further justified due to the fact that ERP implementation is still struggling with major challenges as it is complex.

3. Literature review

During the synthesis of the final set of articles, we observed that the treatment of CSFs is highly inconsistent. Many approaches, styles and methods were used. This made the synthesis process the more complex because multiple readings by multiple participants, followed by many discussion were necessary to provide a reasonable interpretation of comparative meanings. In specific, the variations were as follows:

- focus on CSFs at every stage of the ERP implementation;
- focus on presenting the CSF's through case studies;
- presented the CSFs through their degree of occurrence;
- developed a framework of CSFs;
- empirically calculated the significance of factor; and
- researchers according to geographical location.

It is interesting to note that in most of the research, the approval and support of top management is deemed to be most critical. Patterns of other researcher's ERP implementation work (up to 2010) and of most significant CSFs are reported in Leyh (2012):

> In this paper we present the critical success factors extracted from case studies alone. This approach will provide us with an experiential-based ERP implementation CSFs and a better understanding of practical factors and their importance.

In this section, we review the literature according to four parameters: stages of ERP implementation; countries; industry and other contexts. Table I presents the final set of

S.No.	Article	Critical success factor	Context	Country
1.	Sarker and Lee (2003)	Strong and committed leadership	Air pollution, dust collection industry	
2.	Shanks *et al.* (2000)	Presence of a change champion, change management, external consultants expertise, project management, clear and measurable goals, data accuracy	Elevator company	China
3.	Shanks *et al.* (2000)	Presence of a change champion, change management, external consultants expertise, project management, clear and measurable goals, data accuracy	Petroleum products	Australia
4.	Soh *et al.* (2003)	ERP package selection, integration, process orientation, flexibility	Hospital	Singapore
5.	Motwani *et al.* (2005)	Clear understanding of strategic goals, commitment by top management, cultural and structural changes, project management, ERP selection, Open information and communications policy, BPR, data accuracy, knowledge capacity, great implementation team, focussed performance measures, small celebrations, Post-implementation audit, Documentation ERP success, benchmarking		n/a
6.	Wang *et al.* (2008)	Consultant competence, vendor support, project members competence, project management, top management support, user support, decision making and control, efficiency and profitability	Manufacturing firms	Taiwan
7.	Chen *et al.* (2009)	Scope management, outsource IT human resources to global ERP vendors, risk management, communications management, procurement management, integration management	Multinational company	California
8.	Tchokogue *et al.* (2005)	Capacity to change, right time for process re-engineering, project management, culture of results measurement, change management, well planned GO LIVE	Aircraft engine manufacturer	Canada
9.	Maguire *et al.* (2010)	Stakeholder consultation, vendor selection, project management, stakeholder commitment, training, risk management, BPR and customization	Telecommunication company	Oman
10.	Barker and Frolick (2003)	Employee involvement, recognition and retention, management support	Soft drink bottler	
11.	Fui-Hoon Nah *et al.* (2003)	Top management support, project champion, ERP teamwork and composition, project management, change management program, communication, business plan and vision, BPR, testing, monitoring and evaluating performance, business and legacy systems	Fortune 1,000 companies	World

Table I.
CSFs by article

(*continued*)

S.No.	Article	Critical success factor	Context	Country
12.	Rebstock and Selig (2000)	Co-ordinated analysis, harmonized modeling, implementation of country specific business processes	Oil and gas industry	Six western European countries
13.	Dezdar and Ainin (2011)	Top management support, communication of the vision, training and education	Corporate	Iran
14.	Xue *et al.* (2005)	Business process re-engineering, partnership with local vendors, human resources, communication, ERP package selection	Corporate	China
15.	Upadhyay and Dan (2009)	User education, goals and objectives, IT infrastructure, project champion, top management support, project team competency, scalability and scope, project management, ERP importance, user training, external consultants, interdepartmental communication, ERP package selection, vendor support	SME	India
16.	Al-Mashari and Al-Mudimigh (2003)	Scope, ownership and transfer of knowledge, change management, proper communication, performance measurement, BPR, project management	Manufacturing company	Middle East
17.	Snider *et al.* (2009)	Operational process discipline, small internal team, project management capabilities, external end user training, management support, qualified consultants	Public organizations	Canada
18.	Moohebat *et al.* (2011)	Top management support, project team and consultants, BPR, project management, user involvement	Corporate	Iran
19.	Akkermans and van Helden (2002)	Top management support, project management, project champion, software vendor	Aviation industry	n/a
20.	Yusuf *et al.* (2004)	Project management	Manufacturing firm – Rolls Royce	n/a
21.	Zhang *et al.* (2003)	Top management support, BPR, Company wide support, Effective project management education and training, User involvement, Suitability of software – hardware, Data accuracy, Vendor support, Chinese organizational culture	Corporate	China
22.	Plant and Willcocks (2007)	Top management support, clear goals and objectives, strong interdepartmental communication, change management	Large organization	USA
23.	Mandal and Gunasekaran (2003)	Risk management, quality management, phased based approach, training, user requirements and feedback, strong leadership, client consultation, pro-active communication, Multi functional project team, system integration, results measurement, performance evaluation	Water corporation	Australia

(*continued*)

Table I.

S.No.	Article	Critical success factor	Context	Country
24.	Woo (2007)	Management style of the company, communication understandable to the Chinese language	Electronics manufacturer	China
25.	Allen *et al.* (2002)	Careful communication, change management, BPR, system integration, training and user license	Public sector higher education institutions	
26.	Sambasivan and Fei (2008)	Management approach, organizational change, technical aspects, external and social aspects	Electrical and electronics company	Malaysia
27.	Amoako-Gyampah (2004)	Training, effective communication	Corporate	North America
28.	Yen and Sheu (2004)	Alignment of ERP strategy with competitive strategy, national culture and government policies	Manufacturing firms	USA and Taiwan
29.	Motwani *et al.* (2002)	Careful change management, network relationships, cultural readiness, Top management support		
30.	Xu *et al.* (2002)	Training and user education, data integration, data accuracy	Corporate	Australia
31.	Loh and Koh* (2004)	Project champion, project management, business plan and vision, top management support, effective communication, ERP teamwork and composition, BPR and minimum customization, change management program and culture, social development, testing, monitoring and evaluation of performance	SME	UK
32.	Berchet and Habchi (2005)	Data integration, detailed planning	Alcatel telecom	USA
33.	Dowlatshahi* (2005)	Cost of ERP implementation, ERP employee and training, Effective use of ERP features	2 companies in different industries	n/a
34.	Saini *et al.* (2013)	Integration, IT infrastructure, data migration plan, system testing, cross-functional employees in team, empowerment on decision making, morale of implementation team, user training, organization's adaptability to change, Top management, customization, BPR, contingency plans, clarity of milestones, alignment of ERP strategy with business processes, comprehensiveness of implementation strategy, consultant expertise, project status disclosure, appraisal of clients about ERP strategy	SME	India
35.	Ziemba and Oblak (2013)	Factors related to public procurement procedure: Clear and precisely defined tender specification Realistic and chronologically arranged schedule	Public organization	Poland

Table I.

(*continued*)

S.No.	Article	Critical success factor	Context	Country
		Clear goals and objectives Factors related to government process management: Frozen information requirements Identified government processes Government process re-engineering Factors related to project team competencies: Project team competence on ERP system Project team competence on public administration Use of consultants Co-operation with research centers Expertise in IT Factors related to project management: Top management support Clear assignment of roles and responsibilities Change management Risk management User involvement Interdepartmental communication Proven management methodology Effective monitoring and control		
36.	Adam and O'doherty (2000)	Clear managerial objectives, collaboration with experienced implementer, performance evaluation	14 SME Corporations	Ireland
37.	Wickramasinghe and Gunawardena (2010)	Training and education, user involvement, managing user expectations, interdepartmental co-operation, ERP teamwork and composition, software development, testing and troubleshooting, project manager, project champion, BPR, change management, communication	Corporate	Sri Lanka

Table I.

case study articles and the CSFs reported. Top management commitment and support has been defined as the most CSF in the research on ERP implementation. (Bingi, 1999; Sumner, 1999; Kotter, 1990; Mabert *et al.*, 2003; Laughlin, 1999; Bradford and Florin, 2003; Vineets, 2006). The role of top management support has been explained in detail in the literature. Holland and Light (1999) mentioned that top management should provide all the required resources at every stage of the ERP implementation process. Roberts and Barrar (1992) mentioned that the Top management is also required during the conflicts and their involvement would ensure the smooth operation of the entire process. The top management support is important throughout the ERP implementation process but it is of prime importance at the earlier stages of the project when the change is being introduced in the organization. Somers and Nelson (2001) mentioned that the changes can lead to resistance from the employees and unrest in the organization and with complete top management support, the initial phase can be dealt with less resistance and ensuring that the vision is communicated to all the employees (Bharathi and Parikh, 2012).

Division into stages: the literature also focusses on identification of CSFs during the stages of ERP implementation. Somers and Nelson (2001) described the impact of CSFs for different stages of ERP implementation using case study of 86 companies and divided the ERP stages into initiation, adoption, adaption, acceptance, routinization and infusion and identified the factors which are most critical at each stage of the ERP implementation. Bharathi and Parikh (2012) also conducted a similar research but in a particular context of Indian automobile industry. They identified the different stages of ERP implementation as planning, acquisition, implementation, usage and percolation and extension. The paper mentioned that for the planning stage, top management commitment, organization's readiness to change, the vision of the company, project planning and the scope of the ERP are the main CSFs. During the acquisition phase, existing information technology (IT) compatibility of the SME, a thorough cost benefit analysis, the right ERP package selection, the analysis of implementation vendor, the roles of consultants and the interaction between owners of SMEs are the most CSFs. During the implementation phase, involvement of process owners, project management, identification of critical mission processes, business process re-engineering and GAP analysis, creation of an implementation road map, training needs and functional testing are the most important success factors. The usage and percolation phase requires periodical and timely communication, percolation of owner's commitment, GAP analysis before and after training, feedback on user satisfaction, review on implications on time and a mandatory ERP environment in the organization are the most important CSFs during the usage and percolation phase. There is the extension phase after the usage and percolation phase which requires more work and this is a process that should never stop exploration and exploitation of existing processes to make it better with the help of the ERP implementation.

But this distinction does not provide a true picture as these CSFs are not relevant only in a particular stage of the implementation process but are spread over a longer duration of the project. Also, these stages are not oriented to the industry terminologies of the stages of ERP implementation. The managers are not able to clearly relate to these stages as the terminologies are business oriented whereas these terminologies of the different stages are theoretical and provide a sound base for researchers. As a result, the practitioners are not able to follow these stages and as a result have not solved the issue of providing a high success rate for the ERP implementation.

According to countries: Upadhyay *et al.* (2011) studied the factors influencing the ERP implementation in Indian manufacturing organizations and divided them into four broad categories namely project execution competency, product and vendor perspective, organizational climate and technical perspective. They mentioned that all the CSFs are a part of these four broad categories. But the paper could not put a detailed light on the components of these four factors. Tambovcevs (2012) studied the ERP implementation in a Latvian manufacturing company and concluded that some of the main CSFs are effective project management, top management support, project scope, project team, defining KPI's and clear accountability. The paper identifies a need for more research to be done in the ERP implementation in construction companies.

There has been a considerable amount of interest in the identification of factors in emerging countries. The study by Amid *et al.* (2012) focusses on identifying the critical failure factors in Iranian organizations which are facing a large number of ERP implementation failures. They identified 47 failure factors and grouped them into seven CFF's as vendor and consultant, human resources, managerial, project management, processes, organizational and technical. The paper mentions that the presence of these

failure factors would result in the failure of a large number of ERP implementations. Shad *et al.* (2012) performed a study in Pakistan to "dig" out the five most impactful technical factors which can lead a project to a success or a failure. They have identified these factors as business process re-engineering, architectural choices, effective usage of process database, education on new business processes and a quality consultant. The study by Elmeziane and Elmeziane (2012) deals with the low ERP success in China and puts a light on the factors which need to be put in place to ensure that the ERP implementation success rate is high among Chinese market. Some of the specific CSFs identified for Chinese market are HR factors, training factors, change management factors, communication factors and reward system factors.

Shah *et al.* (2011) conducted a research on the socio-technical factors influencing the ERP implementation success in Pakistan and concluded 13 CSFs which they identified to be important for the success of ERP projects. Liu (2011) studied the influence of the CSFs on ERP knowledge management on the performance of the top management in Taiwan hi-tech industry and concluded that support from senior managers and a right vision, re-engineering and proper project management, appropriate consultants and software suppliers, best employees for the job and proper training are some of the CSFs in the field of ERP implementation. Supramaniam and Kuppusamy (2011) performed an analysis of the ERP implementation in Malaysian firms and grouped the CSFs into three distinct categories, i.e. knowledge management, business process and requirements study and project and communication management. So, the research has shown a trend of moving toward the identification of CSFs in emerging economies.

Xue *et al.* (2005) studied the ERP implementation in China with case studies mentioning the implications of ERP vendors and identified the factors which were responsible for failure of ERP implementation in these companies in China. The factors included business process re-engineering according to the local trends which were understandable by the people, partnership with local vendors to understand the needs of the community, lack of human resources, language issues with international vendors and reporting in the local formats. These can apply to an organization as well as they have to carefully select an ERP package that fits their social and cultural factors of that location and which is understandable by everyone. Al-Turki (2011) studied the ERP implementation in Saudi Arabia and concluded that top management commitment, clear strategic objectives, change management, proper training and software selection are the most important factors in a successful ERP implementation. Li (2011) performed an exploratory study to identify CSFs for ERP adoption in Chinese small industries and concluded that top management commitment and support, readiness to change, project management, external consultants and time to accommodate the learning effects of the new system are some of the major factors for a successful ERP adoption in a firm. Shanks *et al.* (2000) compared the CSFs for ERP implementation in Australia and China and identified commitment to change, BPR, user education and training, proper communication, best and full time people in the team, empowered decision makers, results measurement (realistic goals and measuring it), top management support, minimum customization and existence of change champion as some of the common success factors for both Australia and China. It puts a light on the commonality of the success factors for ERP implementation across various geographical locations.

According to industry: some of the case studies focus on a particular industry irrespective of the region as they argue that the success factors are primarily influenced by the industry and so linking them with the industry is of more importance than linking them with the region. Dixit and Prakash (2011) performed a study on the issues

affecting the ERP implementation at small and medium enterprises and mentioned top management support, training, data collection to measure results, software design and testing as some of the critical factors for successful ERP implementation. Tsai *et al.* (2011) performed an empirical research to identify the internal and external facilitators in an ERP implementation and concluded that clear vision and understanding, commitment by top management, proper system selection and an effective change management program result in an ERP project success. Koh *et al.* (2011) performed a critical analysis of the drivers, barriers and CSFs in the ERP implementation in supply chain industry and concluded that top management, clear vision, robust planning, availability of resources, BPR, change management, pro-active culture, data accuracy, training and monitoring and evaluation as the most CSFs in supply chain industry.

The exploratory study of four cases performed by Motwani *et al.* (2005) concluded that clear understanding of goals of the project, top management commitment, cultural and structural changes, project management, ERP selection, open communication, data accuracy, effective change management program, proper documentation and benchmarking are some of the CSFs for a successful ERP implementation. Sarker and Lee (2003) explored the role of social enablers in the ERP implementation and concluded that the strong and committed leadership, open and honest communication and balanced and empowered team are the three social enablers which can result in a successful ERP implementation.

Tchokogue *et al.* (2005) studied the ERP implementation at Pratt and Whitney Canada and concluded that the key lessons to be learnt from a successful implementation are that an organization should have a capacity to change. By capacity to change, it means that the organization should encounter no resistance to change. That can be achieved by creating an atmosphere that demands the change process or in other words, creates an urgency to change so that the entire organization is on the same page regarding the change. They also mention that Pratt and Whitney were very particular of the right time to start the process re-engineering. This enabled them to have enough time to carefully study their business processes and after a thorough consultation with all the functional areas of the organization. There needs to be a rigorous and expert project management detailing all the steps required for achievement of a particular goal. Tracking the progress of the project and ensuring that all deliverables are achieved and completed on time is achieved by effective project management. They also mentioned that it is very important to develop frameworks to measure the results of the implementation on a timely basis and document it. One of the winning points of Pratt and Whitney was the detailed and strategic change management which was well planned and well executed. The GO LIVE was well orchestrated with the overall strategy and the timing was ensured to be one where the organization was not involved in its peak operations so that it gave enough time to the employees to get accustomed to the system before they started using it completely.

Maguire *et al.* (2010) studied the ERP implementation at Omantel, a telecommunications firm at Oman and identified some of the success factors for the implementation. They identified the factors as establishing a fit between the vendor and the business and choosing a vendor that is adequate for the business. The importance of project management and stakeholder management was recognized in Omantel as a CSFs. Effective and detailed training along with risk management and minimum customization of the ERP by maximizing the business process re-engineering ensured that the implementation was a successful one which helped in benefit realization of the ERP. Barker and Frolick (2003) studied a failed ERP implementation

of a soft drink bottler and found the factors that were not present in the ERP implementation were employee involvement in all the project stages of the implementation process. It also mentioned the absence of recognition and retention leads to low motivation among the employees. Absence of top management support can lead to absence of direction for teams to follow and can prolong a project.

Bozarth (2006) studied the ERP implementation at three firms which implemented the ERP at the same time and compared the factors which lead to the success of one firm and failure of two other firms. The various CSFs founded by them were specification and selection process in achieving broad participation and managing stakeholder commitment. This lead to no long-term vision which lead to poor vendor management and there was no buy in from the end users. Upadhyay and Dan (2009) studied the growing use of ERP in the SMEs of India and researched on the factors which are important for the successful implementation of ERP in SMEs. They outlined factors such as user knowledge, defining goals and objectives, IT supportive infrastructure, project champions in the functional areas, top management commitment and support, competency of the project team, definition of the scope of the project, project management, communicating the importance of the ERP, user training, balancing the use of external consultants, package selection and vendor support as the most critical factors for a successful ERP implementation in small and medium sized organizations.

Al-Mashari and Al-Mudimigh (2003) studied the case study of a failed ERP implementation of a large manufacturer and mentioned that one of the main factors to ensure the success is the well definition of the scope. The team should take complete ownership and ensure that the transfer of knowledge is done by the time the system goes LIVE. The change management techniques and tools must be defined and evaluated with the best practices in the industry. Effective communication throughout the implementation stages and performance measurement after the implementation ensure that the process and benchmarks are set for throughout the process. Enterprise wide project management would ensure that the project activities are covered on time and all the activities are co-ordinated for efficient process delivery. The presence of a competent IT team which ensures the proper integration with business process re-engineering needs to be done at all the stages even after the implementation to ensure the continuous optimization of the ERP system.

Snider *et al.* (2009) studied the ERP implementation at five Canadian SMEs and concluded that discipline of the operational process is an important factor in ensuring all the processes are followed on time during the ERP implementation. They mention that a small internal team having project management capabilities would be capable of ensuring the vision of the project is communicated to the entire team and all the project activities are followed properly to ensure timely delivery of the ERP. External end user training conducted by professional trainers would ensure the training process is conducted in a professional manner and all the aspects of training are covered. This has to be supported by the top management providing guidance and vision to the team. The paper concluded by mentioning the importance of qualified consultants throughout the implementation and post-implementation stages of the implementation to explore possibilities of improvements and optimization.

There are some studies which indeed focussed on the SMEs as the concern was raised by Leyh (2012) and at the same time, it also shows the importance of classifying the CSFs at all the steps of the implementation similar to the study by Bharathi and Parikh (2012) which was also SMEs. This paper by Shaul and Tauber (2012) focussed

on the CSFs in detail and classified the different aspects such as managerial, organizational, strategic, tactical, software and exogenous at all the stages of an ERP implementation. It clustered 94 CSFs into 15 categories using validity, reliability, principal component and multi-colinearity analyses.

Other contexts: it is very important for the organization to select an ERP which suits its business needs and which establishes a fit with the organization. The case studies by Soh *et al.* (2003) and Somers and Nelson (2001) focus on the selection of proper ERP package selection as one of the CSFs for a successful ERP implementation. There are a lot of solutions for the industry offered by various ERP vendors. Nah *et al.* (2004) studied the perception of chief information officers about the CSFs for successful ERP implementation and concluded that CIOs believe that top management support, project champion, ERP teamwork and composition, project management, change management, effective communication, business plan and vision, BPR, proper development and testing of the software, monitoring and evaluation of the ERP performance and an appropriate balance of ERP systems and the legacy systems are the factors that are necessary to ensure that an ERP implementation is successful.

Rebstock and Selig (2000) studied the complexities associated with ERP projects that span geographical boundaries. They specifically studied the business process re-engineering which has been concluded to be a very important success factor for a successful ERP implementation. They mention that the processes resulting from the business process re-engineering should be understandable to the local community. For that they should be provided in-depth training and they should be also involved in the business process creation. There should be an independent evaluation of the business processes created because this stage once passed, it becomes very expensive for the organization to reinvent the wheel and this stage is the basic foundation for the next few years of the ERP usage. The catalogue of best business processes should be followed and referred to stay on the right track during the process and the harmonization of the processes followed by the company and the best practices. Continuous monitoring and evaluation over a period of time of the business processes is required to ensure that the organization is following the most recent and best processes in the industry.

Umble *et al.* (2003) mentioned some implementation procedures which are the CSFs for an ERP implementation that yields the expected benefits. Clear understanding of the strategic goals of the ERP implementation is mentioned the most critical to start an ERP implementation. Commitment by top management, excellent project management, a competent implementation team, accuracy of the data, extensive education and user training, focussed measures to evaluate performance and celebrating small wins during the implementation process are some of the procedures which are critical to the success of an ERP implementation. Dezdar and Ainin (2011) researched the impact of top management support, effective communication and training and education as the organizational factors on the ERP implementation in Iranian companies and concluded that these three factors are critical to the success of ERP implementation in Iranian companies. Hung *et al.* (2012) examined the impact of knowledge transfer climate and relationship bonding on the success of an ERP implementation. The paper concludes that a positive relationship with the ERP implementation partners is highly critical for a successful ERP implementation.

Aloini *et al.* (2012) researched on the risk factors associated with ERP implementation by a case study and identified ten critical risk factors which can be termed as factors which can reduce risks in an ERP implementation. The factors identified were improper selection, ineffective strategic thinking and planning, ineffective project management, poor managerial conduct, inadequate change

management, inadequate training and instruction, poor project team skills, inadequate BPR, low top management involvement and low key user involvement. Wang *et al.* (2008) studied the consistency among the facilitating factors and ERP implementation success and concluded through empirical analysis that consultants competence, vendor support, ERP project team members competence, project management leadership, top management support, end user support, decision making and control, efficiency and profitability of the system are the facilitating factors which are related to the success of the ERP implementation.

The above-mentioned factors that are derived from the literature review are in the form of a laundry list. This step is necessary for the subsequent analysis stage and synthesis stage whereby the CSFs can be consolidated into a more organized and clear way (Koumaditis *et al.*, 2013).

4. Analysis, synthesis and discussion

The consolidation of the CSFs is presented in Table II. In this table the first column from the left refers to the proposed CSF while the right-hand column presents the factors identified in the literature (from Table I). This process of assigning or mapping the original CSF into the consolidated list was the lengthiest of all the steps in our research work. This process involved the following three steps:

(1) establish linkages between articles *vis-à-vis* the CSFs identified;

(2) synthesis of meanings (same or different); and

(3) interpretation of factors.

To produce the aggregated view of the CSFs, many discussions over a period of five months were carried out, with the analysis producing six different comprehensive tables showing the different possible relationships between the CSFs. This process was similar to that proposed in Kitchenham *et al.* (2009).

At the same time Table II shows which original factors were grouped together into one CSF. This decision takes into account the context, the technologies used, the process and other data identified in the articles of interest. The original factors found on the left right-hand column of Table II can be traced to their source in Table I, thereby maintaining traceability of the factors.

Following the consolidation of the CSFs found in Table II, we classify the CFSs using the Shang and Seddon (2000) model. In their article, Shang and Seddon present a framework that was used to assess the business benefits of ERP systems. They produced a consolidated framework of five benefits dimensions. In the same vein, we follow a literature review method to produce a consolidated framework of five ERP implementation dimensions (which we refer to herein as CFS categories as shown in Table III). The categories can be efficiently used to present the proposed consolidated factors in a more organized and clear way. The proposed categories and corresponding CSFs is implemented to help practitioners and researchers focus their attention to the significant role that each identified CSF plays. In addition, the categorization of the factors illustrates specific aspects of each factor (e.g. organization, requirements, technical, project implementation and usage).

The 37 case studies (given in Table I) reflect the trend of ERP research and list all reported CSFs during an ERP implementation. It was evident from the first scan that most of the articles findings can be put into five categories that represent the stages of ERP implementation. The stages are: first, organization state which represents the

Proposed CSFs	Original CSFs (from Table I)
1. Cultural change readiness (CCR)	Cultural and structural changes; cultural readiness; social aspects
2. Top management support and commitment (TMSC)	Company wide support; empowered decision makers; stakeholder commitment; supportive IT infrastructure; top management support
3. Knowledge capacity production network (KCPN)	Network relationships; knowledge capacity; detailed planning; client consultation
4. Minimum customization (MC)	Minimum customization
5. Legacy systems support (LSS)	Legacy systems
6. ERP fit with the organization (EFO)	ERP package selection Alignment of ERP with business requirement
7. Local vendors partnership (LVP)	Software vendor; partnership with local vendors
8. Detailed cost (DC)	Cost of ERP implementation
9. Business process re-engineering (BPR)	Business process re-engineering; country specific business process; consultants expertise
10. Quality management (QM)	Data integration; data accuracy; quality management
11. Risk management (RM)	Risk management
12. Detailed data migration plan (DMP)	Data migration plan
13. Measurable goals (MG)	Comprehensiveness of implementation strategy; clear and measurable goals; co-ordinated analysis
14. Small internal team of best employees (STBE)	Cross-functional employees in the team; best people in the team; multi functional project team; ERP teamwork; multi functional project team; small internal team
15. Open and transparent communication (OTC)	Interdepartmental communication; open information and communication policy
16. Base point analysis (BPA)	Process discipline; benchmarking
17. Morale maintenance (MM)	Morale of the implementation team; celebrating small wins
18. Contingency plans (CP)	Co-ordinated analysis; contingency plans
19. ERP success documentation (ESD)	Document ERP success
20. User feedback usage (UFU)	User feedback Harmonized modeling optimization opportunities
21. Max. Potential usage (MPU)	Effective use of ERP
22. Results measurement (RM)	Results measurement Focussed performance measures Performance evaluation Post-implementation audit

Table II.
Consolidation of ERP implementation CSF

organizational characteristics at the start time of the project (is it ready? what is its IT maturity level? resources?, etc.); second, business requirements which imply that the decision to implement an ERP is taken. This involves management, strategy, and finance; third, technical solution which means that the organization believes that it has identified its requirements, they are accurate, and they are looking to find the right technical solution (entails servers, IT support, in-house/out-source/off-the-shelf); fourth, implementation, which covers the execution of the ERP solution and is primarily about project management; and fifth, post-implementation which engages all stakeholders to sustain the conversion of the solution from a project into operations.

In order to achieve our goal of consolidating all those CSF into a meaningful set, we utilize the four categories namely, organizational state; business requirements; technical solutions; project implementation; and post-implementation usage. In step 2 of the classification process described above we distinguish the factors according to

Category 1 Organizational state	Category 2 Business requirements	Category 3 Technical solutions	Category 4 Project implementation	Category 5 Post-implementation usage
1. Cultural change readiness (CCR)	3. Knowledge capacity production network (KCPN)	9. Business process re-engineering (BPR)	13. Measurable goals (MG)	19. ERP success documentation (ESD)
2. Top management support and commitment (TMSC)	4. Minimum customization (MC)	10. Quality management (QM)	14. Small internal team of best employees (STBE)	20. User feedback usage (UFU)
	5. Legacy systems support (LSC)	11. Risk management (RM)	15. Open and transparent communication (OTC)	21. Maximum potential usage (MPU)
	6. ERP fit with the organization (EFO)	12. Detailed data migration plan (DMP)	16. Base point analysis (BPA)	22. Results measurement (RM)
	7. Local vendors partnership (LVP)		17. Morale maintenance (MM)	
	8. Detailed cost (DC)		18. Contingency Plan (CP)	

Table III.
Final ERP implementation success factors as a function of stages

their meaning. As mentioned earlier success factors that were similar in meaning were put together in one category. The decision for two or more factors to have similar meaning was based on the word itself as well as the intention and description of it in the article that it is being used in. To that effect, we stress that this task was not a trivial one because it entailed great synthesis effort. Finally, Soja (2006) presented the lessons from practice regarding the success factors in ERP systems implementation. This represents a study done about a decade ago and that is closest to our work presented in this paper. Our study is very different as it is qualitative while Soja (2006) is empirical. Conceptually, both articles are very different as Soja (2006) study is IT focussed and treats the ERP implementation as a project. Our study herein, does not make assumptions and aggregates and consolidates published case studies' results. The outcome of our study is also very different from Soja (2006) where most of the CSFs (around 70 percent) are not IT-related and more organization and strategic related. Our study therefore provides a significant contribution in expanding and extending the body of knowledge on ERP implementation.

5. Theoretical and practical implications

From a theoretical point of view, this paper adds value to the existing ERP body of knowledge. The new distribution of the stages of the ERP implementation provides an avenue to relate it to the existing stages of the implementation process and find out correlations between them. The distinct success factors provide a starting point to develop a framework of success factors throughout an ERP implementation process. One of our intentions of this paper is to provide an updated list of case studies relevant to ERP implementation, while at the same time encourage and in fact call for more case studies – it is very important that more practitioners collaborate with researchers to report on their experiences to ERP implementation.

This paper also impacts researchers by providing them with the contexts of the case studies. With this information aggregated in one place, researchers can identify their focus of study based on contexts which have or have not been explored. We also argue in this paper that the total numbers of distinct factors that are needed for a successful ERP implementation are 22, as given in Table III. These factors are the constructs that can be utilized in practice to analyze needs, design, implement, monitor, control and assess their ERP initiative. The consolidation of the CSFs into the practical implementation stages are accurately representative of the industrys' behavior and produces in a clearer picture on the collective trials done. Organizations can concentrate on exploring those factors that can result in the most successful scenario for their context.

The CSFs identified in this paper by studying more than 37 relevant case studies in different contexts outline different factors which are created by the combination of scattered factors present in the literature. From a practical perspective, this would provide a complete understanding of the CSFs present in the literature. Also, because the factors have been compiled using the case studies, these factors are a result of practical experiences of the industry. Practitioners can use these factors to relate to their industry and only concentrate of these factors which are most prevalent in the industry. The paper also helps managers to understand the factors required at the various stages of the ERP implementation. The stages defined are closest to the actual stages during the ERP implementation process and so the factors can be related to them directly without overlap or confusion. So, the paper presents a very practical and industry oriented framework to ensure the success of an ERP implementation.

6. Limitations

The research in this paper is not without limitations. First, the case studies are not all structured in the same way. If they were then comparison would have been straight forward; however, since they are not, different data, sections, content breadth and depth have been reported. As such, comparison of these articles are complex and may include researcher's bias for comprehension and interpretation. Second, and in the same vein, the synthesis stage also entails the same level of uncertainty of interpretation of meaning. Finally, the results of this research are limited to reported cases and does not include research work on ERP implementation models and frameworks.

7. Conclusions and future research

In this paper we focussed on the identification of a consolidated CSF set for a successful ERP implementation using case studies in different contexts alone. There have been articles which also mention the CSFs according to the stages of ERP implementation (Somers and Nelson, 2001; Bharathi and Parikh, 2012); however, literature shows that these stages are not understood in the same way by industry. There is a need to not only condense these factors but also be as specific as possible to eliminate overlap, redundancies, and multiple meanings across the factors and to simplify them by assigning them to industry agreed upon stages. A total of 37 related case studies were selected; a total of 64 CSFs were extracted which were condensed to 22 unique ones.

To provide clarity about the duration of their usage and importance, these CSF's were divided into five categories based on their occurrence in the ERP implementation stages. The five categories were organizational state, business requirements, technical solutions, project implementation and post-implementation usage. Once the CSFs were consolidated, it became clear that there some stages do not have enough factors to

appropriately represent the conceptual stages. For example, the first stage which is the organizational state has the least CSF (two only) which are abstract in nature and make their use rather limited. This is a great opportunity for future research. The research could also focus on the possible correlation between the CSFs and particular contexts. This paper opens the possibility to view the ERP implementation life cycle and the related CSFs from another consolidated point of view which also focusses on the factors related to change management that are applicable throughout the ERP implementation process. Change management can be considered as a dimension for all the CSFs found herein.

Another important extension to this research, is to use the 22 CSFs to develop a post-implementation assessment instrument with the appropriate scales to measure them – hence the confirmation of these factors quantitatively. This paper sheds light on the possible distinction of factors related to each implementation stage. Empirical studies can focus on the combined factors and validate the relationship between these factors and the stages in which they occur. Some of the factors might move to other stages which could be validated through empirical studies. Last but not least, more case studies could be studied in contexts which were not found in the research literature of ERP implementation to figure out if there are other factors which could be present in particular contexts and what are the parameters which make these factors differ than the factors described above in the paper. This paper opens up a new direction which could be prominent in deciding the route of further research in ERP literature.

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