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Purpose: The authors examine the literature on Enterprise Resource Planning (ERP) to establish whether the Critical Success Factors (CSFs) for achieving stages of an ERP project have been empirically shown to be 'critical'.

Methodology: The authors used a systematic approach to review 627 refereed papers published between 1998 and 2010 on ERP, from which 236 papers related to CSFs on ERP were selected for analysis. The authors employed procedures from qualitative and interpretive research methods, to analyse and interpret the material using five-step procedure of gathering, categorising, coding, analysing and comparing the data.

Findings: Prior studies have identified a large number of CSFs for ERP implementation success or improved performance outcomes. The authors have shown that a limited number of CSFs have been empirically investigated for their role in, and effect on, implementation success or post-implementation performance outcomes. While reporting the factors that have some evidence to support them, the authors question the utility of the general concept of CSFs.

Research implications: The authors' findings question the validity of many of the claimed CSFs and the utility of the general body of literature on CSFs. The authors caution researchers who may plan to use claimed CSFs for ERP in their research to carefully examine the veracity of the claim before proceeding.

Practical implications: The findings can help managers to focus their attention, priorities, resources and leadership on managing the CSFs that have been established to be critical for achieving ERP project implementation and/or performance outcomes.

Originality/value: The results provide new insights into the usefulness of CSFs and indicate that merely identifying possible CSFs is not sufficient to help with ERP success. Further

investigation is required to establish the criticalness of proposed CSFs before managerial time is devoted to them.

Keywords:

Enterprise resource planning (ERP), critical success factors (CSFs), antecedents, content analysis, qualitative interpretive analysis, implementation success, organizational performance

1. Introduction

The birth of the concept of Critical Success Factors (CSFs) in the 1960s can be said to have introduced a new organisational approach for helping to achieve performance goals and competitiveness.

The CSFs concept promised a systematic way of identifying the key areas, or signposts, that require the constant and careful attention of management in order to achieve performance goals. CSFs are defined as ‘the limited number of areas in which results, if they are satisfactory, will ensure competitive performance for the organisation’ (Rockart, 1978, p. 12). These are “the few key areas where ‘things must go right’ for the business to flourish and for the manager’s goals to be attained” (Bullen and Rockart, 1981, p. 7). The CSFs concept implies a link between achievements or satisfactory results in identified, limited areas of activity and the gaining of desired performance outcomes (Rockart, 1978).

The potential application and usefulness of the CSFs concept generated considerable interest in industry, as CSFs seemed to be an aid to management to strategise, plan, manage, monitor and achieve organisational goals (Bullen and Rockart, 1981). Given the apparent relevance for industry, researchers saw the need to identify CSFs to help solve practice-oriented problems, which resulted in the growth of scholarly publications on CSFs over the past four decades (e.g. Dezdar and Sulaiman, 2009; Karuppusami and Gandhinathan, 2006; Khan *et al.*, 2009).

The CSFs concept also gained wider acceptance in the information systems domain and, in particular, in the context of enterprise resource planning (ERP) systems (Finney and Corbett, 2007; Ifinedo *et al.*, 2010). Organisations implementing ERP systems had higher stakes in achieving successful implementation outcomes, as these systems were heralded as a breakthrough innovation to solve the Y2K problem and to provide an integrated business solution in order to achieve operational efficiencies and improved business management

(Kumar *et al.*, 2003). However, the attempted implementation of ERP systems has been accompanied by high rates of failure and implementation difficulties (Kanaracus, 2012; Ngai *et al.*, 2008). Identifying CSFs became a popular research agenda to help improve the chances of implementation success, leading to the identification of a large number of seemingly relevant CSFs for the successful adoption, implementation and use of ERP systems (Ifinedo *et al.*, 2010). However, many research contributions concentrated on identifying CSFs for gaining success in the implementation stage of ERP projects (Nah *et al.*, 2011).

Despite the existence of a large body of identified CSFs that are claimed to help avoid ERP project failures, such projects have continued to experience failures and implementation difficulties (Liu and Seddon, 2009; Authors, 2013). A number of authors have therefore raised concerns on the usefulness of identified CSFs and the contributions made by the identified CSFs to the achievement of success and/or performance improvements (Sammon and Adam, 2007; Robey *et al.*, 2002). El Sawah *et al.* (2008) echo these sentiments and emphasised that our current understanding of the role of CSFs in success is inadequate. This calls into question whether factors that are identified as CSFs for achieving successful outcomes and performance improvements are 'critical' in doing so, at least in the ERP context. Do they meet an objective test for this?

Conceptually, the criticalness of a factor can only be established when it is empirically shown that it influences the performance of firms or helps to achieve a desired successful outcome—for example, in the case of ERP projects, the success of a particular stage or phase of the ERP project (e.g. adoption or implementation) (Bullen and Rockart, 1981; Salazar and Sawyer 2006). Proposing a factor as a CSF is not helpful to industry unless it has been empirically established that it is critical to the success of a desired outcome (King and Burgess, 2006). This paper argues that gaining an evidence-based understanding of the role of CSFs in leading to

successful project or performance outcomes is vital to aid the management of projects and give direction to the continuing research on identifying CSFs.

The authors' conjecture is that little knowledge exists that establishes whether claimed CSFs achieve the desired objectives in ERP projects. Salazar and Sawyer (2006, p. 110) call for a deeper inquest into the role of CSFs and underline the need for objectivity in understanding why the identified factors are critical to success. Other authors (e.g., El Sawah et al. 2008; Robey et al., 2002) agree and advocate further research to examine whether CSFs for ERP are critical to achieving success. With the aim of addressing this gap in knowledge, the authors conduct a systematic and comprehensive review of the ERP literature to examine the criticalness of the claimed CSFs. Therefore, the research question is:

Are all CSFs that are claimed to be critical for achieving certain ERP system objectives actually critical?

The main contribution of this study is to provide evidence for whether the claimed CSFs in the ERP literature have been empirically established as CSFs. The study highlights the importance of empirically establishing CSFs as 'critical' rather than just identifying them as candidates for being CSFs. While the scope of our research is limited to CSFs in an ERP context, the authors believe that the significance and implications of this research's findings should be viewed in a wider context because the identification of CSFs has remained a very popular research stream across various disciplines, including management, marketing, commerce, organisational behaviour and information systems. Thus, by providing preliminary evidence in the context of CSFs to ERP, this study also makes a significant contribution by setting the groundwork for the review of the criticalness of CSFs in other disciplinary contexts. Such an understanding can enhance the conceptual and practical utility of the CSFs concept. In addition, this study's findings can help to improve the quality of the research output on CSFs and knowledge transfer to industry.

The rest of the paper presents a brief review of the concept of CSFs, followed by the research methodology and data analysis. Finally, the findings, conclusions, contributions and limitations of the study are discussed.

2. Background

CSFs are identified to assist managers to affect the outcome of an effort by proactively taking necessary actions in the areas that have a bearing on the outcome (Boynton and Zmud, 1984). Accordingly, a large number of CSFs have been identified for ERP projects to help managers achieve successful implementation outcomes and reap the benefits of the investments made in these systems (Authors *et al.*, 2013). A brief list of some of the identified CSFs, grouped by their context, is given in Table 1, which is similar to the lists found in Al-Mashari *et al.* (2003), Finney and Corbett (2007), and Ngai *et al.* (2008).

Table 1. Brief list of identified CSFs in an ERP context

CSFs Identified	Some References
Organisation-related	
1. Organisation culture and political structure	Ngai <i>et al.</i> (2008)
2. Top management support	Žabjek <i>et al.</i> (2009)
3. Change management	Cheng <i>et al.</i> (2006)
4. Cooperation	Ngai <i>et al.</i> (2008)
5. Change agents and leadership	Motwani <i>et al.</i> (2005)
6. Cross-functional cooperation	Motwani <i>et al.</i> (2005)
7. Management readiness for change	Motwani <i>et al.</i> (2005)
8. Scope for change	Motwani <i>et al.</i> (2005)
9. Management of change	Motwani <i>et al.</i> (2005)
10. Presence of champion	Bradley (2008)
11. Business plan/vision/goals/justification	Ngai <i>et al.</i> (2008)
12. Project justification based on cost and economic scale	Ngai <i>et al.</i> (2008)
13. Retrain IT workforce in new skills	Ngai <i>et al.</i> (2008)
14. Employee moral	Ngai <i>et al.</i> (2008)
Technological/ERP-related	
1. Customisation of ERP	Al-Mashari <i>et al.</i> (2003)
2. Technological complexity	Chang <i>et al.</i> (2008)
3. Compatibility	Chang <i>et al.</i> (2008)
4. Legacy systems	Al-Mashari <i>et al.</i> (2003)
5. Data analysis and conversion	Somers and Nelson (2004)
6. Data accuracy	Ngai <i>et al.</i> (2008)
Project-related	
1. Project management	Zhang <i>et al.</i> (2003)

CSFs Identified	Some References
2. Training and education	An-ru <i>et al.</i> (2009)
3. System integration	Al-Mashari <i>et al.</i> (2003)
4. Business process re-engineering	Ettlie <i>et al.</i> (2005)
5. Full time project manager	Bradley (2008)
6. Communication	Al-Mashari <i>et al.</i> (2003)
7. Minimal customisation	Ngai <i>et al.</i> (2008)
8. Implementation strategy and methodology	Ngai <i>et al.</i> (2008)
9. Teamwork and team composition	Ngai <i>et al.</i> (2008)
10. Project team competence	Ngai <i>et al.</i> (2008)
11. Steering committee	Somers and Nelson (2004)
12. ERP selection	Ngai <i>et al.</i> (2008)
Individual-related	
1. Perceived usefulness	Amoako-Gyampah and Salam (2004)
2. Ease of use	Amoako-Gyampah and Salam (2004)
3. Attitude towards ERP system	Amoako-Gyampah and Salam (2004)
4. Shared belief in the benefit of the system	Amoako-Gyampah and Salam (2004)
5. Social factors	Chang <i>et al.</i> (2008)
6. Facilitating conditions	Chang <i>et al.</i> (2008)
7. Near-term consequences	Chang <i>et al.</i> (2008)
8. Long-term consequences	Chang <i>et al.</i> (2008)
9. Affect (feeling of joy or displeasure with a particular act)	Chang <i>et al.</i> (2008)
10. Users' absorptive capacity	Park <i>et al.</i> (2007)
11. Usage performance	Park <i>et al.</i> (2007)
12. User satisfaction	Bradford and Florin (2003)
13. Learning capacity	Motwani <i>et al.</i> (2005)
14. User involvement	Ngai <i>et al.</i> (2008)

While CSFs were identified to help achieve successful outcomes of ERP projects, their role in influencing outcomes came under scrutiny when the problems and failures of ERP projects continued unabated. A number of researchers have raised questions regarding the actual utility of the identified CSFs (Rahmatian, 1999; Sammon and Adam, 2007; Yu, 2005). One of the concerns among researchers is the lack of an established process for the identification of CSFs. This may be limiting the effect of identified CSFs (Karuppusami and Gandhinathan, 2006; Somers and Nelson, 2001). The use of a variety of research methods and techniques for identifying CSFs may have led to a variety of descriptions of what constitutes a CSF and the

way it should be measured (e.g. Amoako-Gyampah and Salam, 2004; Bueno and Salmeron, 2008). Such a shortcoming means there is subjectivity in the identification process of CSFs, which results in a lack of objective measures to establish the 'criticalness' of the identified CSFs (Rahmatian, 1999).

Robey *et al.* (2002, p. 20) state that the lack of robust measures limits the establishment of the degree of usefulness of CSFs. They argue that the contributions of the CSF approach are of limited value and lack appropriate theoretical underpinning that can 'explain why the investigated project and business outcomes occur'. Other authors (e.g. King and Burgess, 2006, p. 59) concur and emphasise that 'providing a list of CSFs is only a partial aid to the practitioner struggling to understand the implications of their actions'.

Sammon and Adam's (2007, p. 224) words sum up the issue aptly when they say '... it is therefore a surprising characteristic of ERP research that efforts have not been made to improve the significance of CSFs and their usefulness for ERP project implementations'. Therefore, various authors have highlighted the importance of seeking an understanding of the contributions and the role of CSFs in achievement of success and performance outcome (El Sawah *et al.* 2008; Salazar and Sawyer, 2006).

In light of the forgoing discussion, this paper advocates that the CSF approach demands that not only the areas needing attention be explicitly defined, but also that the success achieved in the defined areas is measured in order to confirm the criticalness of the CSF. Given the large body of research literature on CSFs for ERP, this paper uses the ERP literature to generate an understanding of how objectively CSFs are established as CSFs. This is very important, not only in the context of the criticism of the CSFs-based literature (as discussed above), but also to help build knowledge and provide direction to future CSFs-based studies.

3. The methodology used in this study

This paper aims to establish if the CSFs that have been claimed to be critical to ERP success in the literature on ERP systems have been empirically demonstrated to be critical. The authors will seek and assemble any evidence that supports the claim that a particular factor is critical for achieving success in a nominated stage of ERP and / or performance outcome. Consistent with prior studies and the qualitative content analysis procedure described therein (Corbin and Strauss, 1990; Dezdar and Sulaiman, 2009; Esteves and Pastor, 2001), the authors used a five-step process of gathering, ordering/classifying, coding, analysing and comparing the data. The data to which this process was applied was comprised of an extensive set of published papers on ERP.

3.1 *The data sample frame*

The authors selected the sample frame for our research based upon the following:

1. ERP literature was the main source of data, as we the authors aimed to utilise the large number of CSFs studies that have been published in the ERP literature.
2. The authors chose studies that were published during 1998–2010 so as to achieve a reasonably contemporary finding for the research question. This 12-year period was particularly useful as it included a large number of publications on CSFs for ERP (see Table 5).
3. The population from which data would be collected would include only peer-reviewed articles.

3.2 *Data collection Phase*

In this phase, the authors carried out a thorough search of articles in five databases, including EbscoHost, Emerald management xtra, IEEE Xplore, ScienceDirect and Google Scholar.

The authors used multiple combinations of terms (Table 2) to search the literature to collect as many relevant articles as possible. This produced copious papers on the subject matter, but it is possible that some relevant papers were not picked up due to the search engine logic at the time of the search. Given that many papers refer to, and use, material from other papers, there is a strong likelihood that key points and findings in those that may have been omitted are nevertheless covered in the papers that were used.

Table 2. Keyword combinations used for database search

Critical Success Factors + Enterprise Resource Planning + Performance
CSFs + ERP + Performance
Antecedents + ERP + Performance
Critical Factors + Enterprise Resource Planning + Performance
Critical Factors + Enterprise
Antecedents + Performance/Success
Critical Success Factors + Enterprise Resource Planning + Success
CSFs + ERP + Success
Antecedents + ERP + Success
Critical Factors + Enterprise Systems + Performance
Factors + Enterprise Resource Planning + Performance
CSFs + ERP + Organisational Performance

In the next step, the articles were confirmed as being peer-reviewed, mainly by using the Ulrichsweb.com website wherever possible or checking whether they had been published in peer-reviewed conferences. While it is recognised that various sources could be used to establish whether a journal is peer-reviewed, Ulrichsweb.com is a widely accepted reference database and an 'authoritative source of bibliographic and publisher information', and so it was preferred.

3.3 Data classification phase

In this phase, all articles were reviewed for relevance and inclusion for analysis purposes. The search of four databases and some peer-reviewed conferences yielded 627 publications. Of these, 387 did not relate to CSFs and were excluded, resulting in a total usable sample of 240 CSFs-related papers for data analysis. The excluded 387 ERP-related, but not entirely CSFs-related, papers covered various aspects of research on ERP including adoption, benefits, implementation management and the history of ERP, which did not fit the objectives of this study. The papers were then classified according to database, journal and year (see Tables 3–5). Given the objectives of the study, which focused on CSFs, four studies that specifically investigated critical failure factors (CFFs) were eliminated from further analysis. This left 236 studies. In the database search process, no restrictions were placed on subject or field of

journal surveyed. This approach is consistent with prior research (Moon, 2007) and, more importantly, it facilitates comprehensiveness of the review.

Due to manuscript limitations, the authors do not list all 236 papers that were reviewed for the study in the references, but they can be provided upon request.

Table 3. Database classification of (236) CSFs-related publications

Database Name	Refereed Publications (1998–2010)
EbscoHost research databases	52
Emerald management xtra	56
IEEE Xplore	46
ScienceDirect	54
Conferences and others e.g. working papers (Google Scholar)	28

Table 4. Journal classification of (236) CSFs-related publications

Journal Name	Refereed Publications (1998–2010)
Advances in Engineering Software	1
Business Process Management Journal	22
Business Strategy Series	1
Computers in Human Behaviour	4
Computers in Industry	4
Contemporary Management Research	1
Decision Sciences	2
Decision Support Systems	4
Economics and Management	2
Electronic markets	1
Enterprise Information Systems	3
European Journal of Information Systems	4
European Journal of Operational Research	3
Human Factors and Ergonomics in Manufacturing	1
IEEE published papers	45
Industrial Management & Data Systems	11
Informatica Economica	1
Information & Management	13
Information & Software Technology	1
Information Systems Journal	2
Information Systems Management	1
Information Technology for Development	1
Information Technology and People	1
Interacting with Computers	1
International Journal of Accounting Information Systems	2
International Journal of Advanced Manufacturing Technology	1
International Journal of Benchmarking	1
International Journal of Business and Management	1
International Journal of Business Information Systems	2
International Journal of Business and System Research	1
International Journal of Computer Science and Network Security	1
Interdisciplinary Journal of Contemporary Research in Business	1
International Journal of Engineering and Technology	1

Journal Name	Refereed Publications (1998–2010)
International Journal of Human–Computer Interaction	2
International Journal of Information Management	2
International Journal of Management and Enterprise Development	2
International Journal of Operations & Production Management	5
International Journal of Production Economics	7
International Journal of Production Research	3
International Journal of Project Management	3
International Journal Of Qualitative Market Research	1
Journal of Academy of Business and Economics	1
Journal of American Academy of Business	1
Journal of Business Economics and Management	1
Journal of Change Management	1
Journal of Computer Information Systems	4
Journal of Computing in Civil Engineering	1
Journal of Database Management	1
Journal of Enterprise Information Management	11
Journal of High Technology Management Research	2
Journal of Information Technology	2
Journal of Management in Medicine	1
Journal of Management Information Systems	2
Journal of Manufacturing Technology Management	2
Journal of Marketing & Communication	1
Journal of Strategic Information Systems	2
Journal of Systems and Software	1
Knowledge and Process Management	1
Knowledge Based Systems	1
Management Research News	1
Total Quality Management	1
Conferences, and miscellaneous papers	32

Table 5. Year classification of (236) CSF-related refereed publications

Year	No. of Publications	Some References
1998	0	
1999	3	Bingi <i>et al.</i> (1999)
2000	7	Parr and Shanks (2000)
2001	10	Nah <i>et al.</i> (2001)
2002	13	Hong and Kim (2002); Petroni (2002)
2003	12	Al-Mashari <i>et al.</i> (2003); Zhang <i>et al.</i> (2003)
2004	21	Xu and Cybulski (2004); Somers and Nelson (2004)
2005	21	Ettlie <i>et al.</i> (2005); Motwani <i>et al.</i> (2005)
2006	23	Peslak (2006); Cheng <i>et al.</i> (2006)
2007	26	Chien <i>et al.</i> (2007); Law and Ngai (2007b)
2008	35	Bernroider (2008); Ngai <i>et al.</i> (2008)
2009	36	An-ru <i>et al.</i> (2009); Žabjek <i>et al.</i> (2009)
2010	29	Velcu (2010); Zhu <i>et al.</i> (2010)

3.4 Data analysis phase

In order to systematically examine the extensive papers that were assembled, the authors needed to categorise them. To do this, the papers needed to be appropriately coded. Pandit (1996) recommends three types of coding for data analysis purposes: open coding, axial coding and selective coding. The authors used these coding methods to analyse the assembled literature as discussed below.

3.4.1 Open coding

The open coding process allows the development of concepts, categories and properties. Initially, the authors read the abstract, aim/purpose, research question and the findings for each identified paper. The intent was to establish the context and the concept or theme of the paper in order to form labels and broad categories for the classification of the literature. Reading the papers resulted in the identification of three major themes (Table 6). The authors started grouping the papers along these themes at this stage of the coding process. Each time a paper was read, the authors compared it against the set themes to ensure that the papers were carefully labelled based on the comparative process. The authors often re-visited the papers to re-check and compare their labelling and categorisation. The papers were grouped in line with

the themes (Table 6) in the endnote software to make the initial coding process easy and effectively manageable.

Table 6. Major themes-based classification of CSFs-related publications

Themes Identified in 236 CSF-related Papers	Refereed Publications (1998–2010)
Identification of CSFs	154
Management of CSFs	22
Effect of CSFs on implementation success or performance outcomes	60

3.4.2 Axial coding

Axial coding is a more directed, purposeful examination of the data to help make sure that the important aspects have been identified. The above phase focussed upon identifying the main categories or themes apparent in the data. In this phase the authors sought to confirm that the initial themes seemed accurate and, secondly to gain some appreciation of how these themes might be related. For example, initially the studies by Ehie and Madsen (2005) and Young and Jordan (2008) were classified under ‘identification of CSFs’ and ‘management of CSFs’ themes respectively in the open coding cycle. However, a further review of the paper in the axial coding cycle resulted in the same studies in being re-categorised under the ‘effect of CSFs on implementation success or performance outcome’ category. The re-categorisation in this cycle led to re-classification of total number of studies under each theme with a particular as shown in Table 7.

Table 7. Major focus based re-classification of CSFs-related publications

Focus of Papers	Refereed Publications (1998–2010)
Identified CSFs to ERP across various stages	141
Discussed how organisations should manage CSFs	18
Investigated influence of CSFs to ERP implementation success and post-implementation performance outcomes	77

In this coding cycle, the authors also analysed the conditions, contexts or circumstances associated with a theme and what might be the effects on the key ERP issues of concern to this

research. So, the authors initially re-read the articles thoroughly to establish whether there was testing of the relationship of CSFs to a particular stage or phase in the ERP deployment process or testing of the relationship of CSFs to post-implementation performance improvements. The authors then recorded the information about CSFs that have been tested for their relationship to the success of a particular stage and/or the ERP performance outcome.

The authors coded 'project success' as the completion of an ER project on time, within budget and as per stakeholders' expectations. The authors coded post-implementation performance outcomes as performance improvements in financial, operational and strategic dimensions. The analysis resulted in further re-categorisation of the data as shown in Table 8.

Table 8. Re-classification of publications based on testing of CSFs relationship to implementation success and / or performance impact

Re-categorisation of 77 studies	Refereed Publications (1998–2010)
Studies that investigated factors for their association with implementation/ Project success	52
Studies that investigated factors for their association with performance	17
Studies that investigated a theoretical framework/proposition for the relationships between CSFs and the implementation success/performance	8

3.4.3 Selective coding

This coding cycle involved further examination of the segmented data to build an overall approach for when a factor could be called as CSFs. To do this, the authors examined how the dependent variables of project success and post-implementation performance outcomes were measured (Table 11 shows the results of such analysis). In the relevant papers, the authors examined also the terms used for project success and post-implementation performance outcomes to see whether a clear conceptual differentiation had been made between these two dependent variables.

3.5 Literature comparison phase

In this phase, the authors compared the results of this study with those that have also included a literature review of ERP studies. The authors found similarities in the way the literature was coded and/or categorised as in section 3.4 (see Esteves and Pastor, 2004). However, the authors were not able to find a study that went further to establish whether the CSFs are linked to project success and post-implementation performance improvements.

4. Analysis and findings

From the 236 CSFs-related papers, the authors established that 141 were only concerned with the identification of possible CSFs for ERP implementation and 18 discussed management issues of CSFs (Table 7). The remaining 77 studies were investigated to establish how many CSFs had tested for their empirical relationship to a particular stage of the ERP deployment process—for example, an implementation success or a performance improvement outcome (Table 8). This showed that the papers were primarily concerned with either:

- a) an investigation of a direct relationship between CSFs and the implementation success or performance outcome (see section 4.1 and 4.2 showing 69 studies); or
- b) a theoretical framework/proposition for testing the relationships between CSFs and the implementation success/performance outcome—for example, Authors (2008), Authors (2009), Bhatti (2006), Gable *et al.* (2003), Ke and Wei (2008), King and Burgess (2006), Saini *et al.* (2010), Westerveld (2003).

The authors then examined the studies identified in (a) above.

4.1 Studies that found empirical evidence of CSFs for ERP implementation success

The analysis showed that some factors had been tested for their relationship with ERP implementation success, and these are listed in Table 9.

Table 9. List of factors empirically tested for their influence on implementation success

Factors tested for their association with implementation/ Project success	Some References
1. Full-time project manager, training of personnel, presence of champion	Bradley (2008)
2. Top management support	An-ru <i>et al.</i> (2009); Ehie and Madsen (2005); El Sawah <i>et al.</i> (2008); Ifinedo (2008); Kansal (2007); Young and Jordan (2008); Žabjek <i>et al.</i> (2009); Zhang <i>et al.</i> (2003)
3. Training and education	An-ru <i>et al.</i> (2009); Lin <i>et al.</i> (2006); Sun <i>et al.</i> (2005); Xu and Cybulski (2004); Zhang <i>et al.</i> (2003)
4. Project management	Ehie and Madsen (2005); El Sawah <i>et al.</i> (2008); Ji and Min (2005); Kansal (2007); Zhang <i>et al.</i> (2003)
5. Business process re-engineering	Ettlie <i>et al.</i> (2005); Ji and Min (2005); Zhang <i>et al.</i> (2003)
6. Business process management	Žabjek <i>et al.</i> (2009)
7. Business process improvement	Law and Ngai (2007a, 2007b)
8. Change management	Ji and Min (2005); Cheng <i>et al.</i> (2006); Žabjek <i>et al.</i> (2009)
9. Full-time project leader, proven implementation plan, utilisation of cost-benefit analysis	Petroni (2002)
10. Project planning, organisational resistance and ease of use	Kamhawi (2009)
11. Leadership, external support	Ettlie <i>et al.</i> (2005); Ji and Min (2005)
12. Suitability of hardware and software, data accuracy	An-ru <i>et al.</i> (2009); Zhang <i>et al.</i> (2003)
13. Strategic planning, external expertise support, business vision, and project preparation	Cheng <i>et al.</i> (2006); Ifinedo (2008); Ji and Min, (2005); Shi and Lu (2009)
14. Clear goal and strategy, powerful implementation team	An-ru <i>et al.</i> (2009)
15. IT assets	Ifinedo and Nahar (2009)
16. Acquisition strategy	Ettlie <i>et al.</i> (2005)
17. Culture	El Sawah <i>et al.</i> (2008); Zhang <i>et al.</i> (2005)
18. Organisational fit of ERP	El Sawah <i>et al.</i> (2008); Holsapple <i>et al.</i> (2006); Hong and Kim (2002); Motwani <i>et al.</i> (2008)
19. Key user satisfaction, employee satisfaction	Almashaqba and Al-Jedaiah (2010); Wu and Wang (2007)
20. Group cohesion	Wang <i>et al.</i> (2006)
21. Feasibility and evaluation of ERP project, Consulting services, and Cost/budget issues	Ehie and Madsen (2005); Yang <i>et al.</i> (2006)
22. Balance of centrifugal and centripetal forces	Chein <i>et al.</i> (2007)
23. Software quality and Information quality	Fan and Fang (2006); Tsai <i>et al.</i> (2009)

Factors tested for their association with implementation/ Project success	Some References
24. Project team competence / experience, rewards, communication and change, multi-skilled team	Akkermans and van Helden (2002); Rothenberger <i>et al.</i> (2010); Wickramasinghe and Gunawardena (2010)
25. Knowledge management competence	Sedera and Gable (2010)
26. Information quality, system quality, service quality	Häkkinen and Hilmola (2008); Ifinedo and Nahar (2006); Ifinedo <i>et al.</i> (2010)
27. Internal support, function (functionality & fit with business)	Chung <i>et al.</i> (2008)
28. Task relevance, compatibility of ERP, higher educated users	Holsapple <i>et al.</i> (2006)
29. Dominance and promotion of high level management, establishment of implementation strategy, enhancing personnel cooperation, enhancing module capability and reducing costs	Lin <i>et al.</i> (2006)
30. IS resources, IS capabilities, executive support, business strategy	Ditkaew and Ussahawanitchakit (2010)
31. Project Manager, project Sponsor	Esteves and Pastor (2002)
32. Power issues	Yeh and OuYang (2010)
33. Management of data, link to business objectives, appropriate IS staff/technology	Poon and Wagner (2001)

Other studies (Amalnick *et al.*, 2010; Soja 2006) ranked CSFs based on their importance. The authors note that Yoon (2008) found evidence of organisational citizenship behaviours (OCBs) on the ERP system success variables of information quality, work efficiency and intention of IT innovation. Peslak (2006) found cost performance and time performance significantly influence financial executives' view of ERP project success. Others provided evidence that understanding staff and implementation risks (Chen *et al.*, 2009), planning and control risks (Tsai *et al.*, 2009b) and factors related to (Chen *et al.*, 2007) management, organization and technology is important for achieving successful implementation of ERP.

Overall, Table 9 shows that some factors have been tested for their influence on ERP implementation success and that studies have primarily focused on the ERP implementation stage alone, while a few others have examined the effects of CSFs on other stages e.g., Park *et al.* (2007), and Bradford and Florin's (2003).

4.2 Studies that have tested CSFs for their relationship to post-implementation

performance outcomes

The authors found that a second stream of papers has investigated the relationship of CSFs to the post-implementation performance outcome of ERP systems. These are presented in Table 10.

Table 10. List of factors tested for their association with performance outcome

Factors tested for association with Performance	Relationships & References
1. IT governance, organizational objective consensus, implementation quality and organizational readiness	Related to improved organizational performance (Bernroider, 2008; Bradford and Florin, 2003; Zhu <i>et al.</i> 2010)
2. System quality, service quality	Related to achieving post-implementation success (Chien and Tsaur, 2007)
3. Coordination improvement, task efficiency	Related to overall ERP benefits (Chou and Chang 2008)
4. Internal organization and external factors and their interaction between marketing and manufacturing	Related to improved performance (Hsu and Chen 2004)
5. Contingency factors	Related to ERP system performance (Hsu <i>et al.</i> , 2008)
6. Consistency between internal (user support, TMS, project manager leadership, team member competence) and external factors (vendor support, consultant competence)	Related to decision making and control, efficiency and profitability (Wang <i>et al.</i> 2008)
7. Internal process efficiency	Leads to leads to financial and customer benefits (Velcu, 2010)
8. Strategic intent to use ERP	Related to organizational performance (Law and Ngai 2007b)
9. Information quality, service quality	Related to organizational impact (Gorla <i>et al.</i> 2010)
10. Organizational vision, process re-engineering, deployment strategy, scope of ERP implemented	Related to achievement of cross-functionality within organization (El Amrani <i>et al.</i> 2006)
11. Integration, process optimisation, use of enterprise system data in decision making	Related to benefit realisation from enterprise systems (Davenport <i>et al.</i> 2004)
12. Type of ERP, extent of organizational change	Related to post-introduction outcomes (Federici 2009)
13. CEO commitment and involvement, professional management knowledge of MIS leaders, top- and middle-management commitment and involvement	Affects the effectiveness of ERP systems post-implementation (Yu 2005)
14. Business process, increased flexibility in decision making, simplified user (individual / group) working	Related to enterprise wide information systems performance (Kansal 2008).
15. System quality, ease of use, utilization	Related to individual performance (Kositanurit <i>et al.</i> , (2006)

In addition to the above, Liu and Seddon (2009) claimed that some project related factors affect the achievement of organizational benefits from enterprise systems use when implementation of the system leads to attainment of good function fit, overcoming organizational inertia, and delivery of a working system.

In summary, this paper finds that the number of studies empirically examining the role of CSFs on ERP performance improvements is limited. The authors also found that some CSFs (e.g. information quality) associated with ERP system implementation success are also associated with post-implementation performance improvement.

4.3 Measurement of Implementation Success and Performance Improvement

In order to establish empirically whether a CSF is associated with a particular outcome, such as implementation success or performance improvement, this study needs to use a clear, consistent definition of the outcome. From the assembled literature, the authors found that considerable variation exists in the ways that implementation success and output performance have been measured in various studies, as shown in Table 11.

Table 11. Measurement of Implementation success or Performance outcome in ERP context

Dependent Variable	Measurement of Success or Performance	Reference
ERP success	Net benefit (7 items) and financial benefit (2 items)	Bernroider (2008)
Implementation success	User satisfaction (1 item) and organisational performance (5 items)	Bradford and Florin (2003)
Project success	Completion on time, within budget and organisational effect	Bradley (2008)
Implementation success	Time, cost, system performance, users' attitude towards ERP, users' expectations, ERP fit (6 items)	Chien <i>et al.</i> (2007)
Implementation success	User satisfaction, individual effect, organisational impact, intended business performance improvement (4 items)	Zhang <i>et al.</i> (2005)
Implementation success	Faster information response time, increased interaction across enterprise, accelerated business response, improved order management and order cycle, lowered inventory levels (5 items)	Wang <i>et al.</i> (2006)
Implementation success	Budget, time, system performance, anticipated benefits materialised (4 items)	Hong and Kim (2002)
Implementation success	Implementation success index	El Sawah <i>et al.</i> (2008)
ERP system success	System quality, information quality, vendor/consultant quality, individual effect, work group impact, organisational effect (30 items)	Ifinedo and Nahar (2009)
Benefit of use, and net Value	Benefit of use (5 items), net value (5 items)	Chien and Tsaur (2007)
Organisational performance	Image, customer retention, sales growth rate, profitability, overall competitive position (5 items)	Law and Ngai (2007b)
Performance of ERP usage	User satisfaction, individual effect (2 items)	Park <i>et al.</i> (2007)
Decision making and control, efficiency and profitability	Effective decision making, effective decision process, control (3 items); enhance profitability, improved price/performance ration, improved work processes, increase cost savings, efficient operations (5 items)	Wang <i>et al.</i> (2008)
Overall benefit	Improvement in overall business performance, system success, positive effect on organisation (3 items)	Chou and Chang (2008)
Post-implementation success	Managerial and operational benefits (5 items)	Zhu <i>et al.</i> (2010)
Adoption performance	Proportion of project (\$) is done, position relative to other companies in industry on project outcome (2 items)	Ettlie <i>et al.</i> (2005)

5. Discussion and Conclusions

This is the first comprehensive study to question the validity and utility of the concept of CSFs. It has been done in the context of applying CSFs to the management of ERP projects.

In a large number of papers on ERP, many CSFs have been cited as being necessary for success in some aspect of an ERP project. However, very little research has been done to systematically assemble and establish the degree to which these proposed CSFs are associated with ERP project success.

Thus, this study embarked upon a mission to undertake this needed research. To do this, the authors established a thorough review of the ERP literature over the period 1998–2010. From this, papers were extracted that contained material relating to some aspect of CSFs. Within these papers, the authors carefully searched for evidence that claimed CSFs were associated with a positive outcome of some aspect of an ERP project. The analysis has drawn from studies that have investigated ERP issues across a wide range of industries and ERP types.

The authors found that most ERP papers that involved a CSFs aspect had studied either the implementation phase or project output evaluation. From these, the analysis found that only some CSFs in this ERP literature have empirical support that is associated with some form of positive outcome. More research studies are needed to establish the definitive role of CSFs on project outcome and / or post-implementation performance improvements.

Section 4.2 and 4.3 lists the CSFs for which there is evidence that they are associated with successful ERP Implementation or performance improvement. However, in many cases, the evidence that they are CSFs in this context rests upon the outcome of just one study in one particular set of circumstances. This limits the ability to make an empirical generalisation; that is, to provide confidence that this CSF will always lead to the desired outcome.

The study also found that *success* and *performance* are measured in diverse ways, leading to difficulties in the empirical validity of CSFs. This also contributes to the difficulty of using a common basis for establishing whether CSFs affect ERP implementation or performance. Thus,

this study cannot definitively establish the extent to which CSFs contribute to implementation outcome or performance improvement.

This study shows that there remain many proposed CSFs that need to be robustly empirically tested for their actual influence on some aspect of ERP success. This major program of work is not likely to be conducted because it is not an attractive project; it will not produce anything 'new', which is what many researchers strive for. Hence, many CSFs are unlikely to be able to be verified as *bona fide* CSFs. This study concludes that the concept may be de-emphasised, as it could give false hope to those endeavouring to manage or research ERP projects.

Based on this, the authors feel that the concept of CSFs for ERP projects should be carefully treated. As many factors have been termed CSFs, this gives a false sense of hope that if they are employed, then ERP project success will ensue. The authors feel that CSFs that are identified but not empirically tested for being CSFs should be carefully used, and the specific requirements of individual projects should be worked out and managed for their fulfilment without recourse to attention to certain additional CSFs due to their having been claimed in the literature as a necessary CSF.

The concept is widely cited and recommended for use in ERP projects, but it lacks empirical validation in many cases and should limit confidence in its usefulness. This study shows that much of the present body of knowledge on CSFs does not conform to the conceptualisation of CSFs.

The findings indicate that further research in the area of CSFs should focus on (a) the effect of CSFs, as in Table 7 and (b) individual themes, as identified in Table 1, which are built upon to establish reliable generalisations that can be acted upon with confidence. This work can then be the basis for theory building on the way that CSFs affect ERP project success.

6. Research Implications, Limitations and Future Direction

The results of the study make a number of significant academic and managerial contributions. Firstly, based on a systematic and large literature review, this study provides evidence that not all CSFs identified in the ERP literature are empirically established as CSFs, thus raising concerns regarding the utility of CSFs that have not been empirically established as such. Secondly, it shows which CSFs have been established as CSFs by being tested in the literature for their influence on ERP project success or post-implementation performance outcomes. Thirdly, it shows that CSFs research can be systematically categorised into three major classifications: identification, management and performance effect. Such a categorisation is expected to aid future investigations on the subject and add value to the utility of literature on ERP. Finally, the study shows that *success* and *performance* is measured in diverse ways, leading to difficulties in synthesis and the effective use of literature on ERP.

Managerially, the results of the study can provide direction and guidance on which CSFs are robust and empirically established as CSFs. Managers can then focus on a particular set of CSFs and direct their efforts to managing them to assist in ERP project success.

The study has some limitations. Firstly, while the authors found and reviewed a large number of research papers on ERP between 1998 and 2010, the possible presence of some further papers, in particular conference papers, that we have not included, cannot be discounted. Secondly, the analysis is limited to CSFs for ERP projects; it does not consider CSFs for other technological innovations, hence results cannot be generalised in an information systems context. Thirdly, as ERP project success and ERP performance outcomes have been measured in many different ways, it means that being able to measure the contribution of CSFs to these is difficult to accomplish in a consistent way. Finally, the analysis was limited to CSFs and did not include the few studies that identified critical failure factors (CFFs), although that did not affect the outcome of this study.

The results have opened up a number of future research opportunities. Further studies can be conducted to test whether others—those that have not been empirically established as yet, among the large number of identified CSFs—are actually CSFs. More work should be done to identify common and consistent measures for implementation success and performance outcomes in order to clearly establish when a factor should be termed a CSF. Future studies could also investigate the relationships between, and interactions among, CSFs that are empirically established as CSFs.

Further studies could also be done to take a more top-down approach by firstly classifying the CSFs into various categories such as temporal, environmental, managerial, peer, and industrial. The next step would be to review the impacts of the categorised CSFs on performance or success. Such a top-down approach to the investigation of CSFs could help in understanding: (a) categories in which factors have been empirically well established as CSFs, (b) categories which further require attention because factors therein are not well established as CSFs, (c) through comparisons and contrasts as to why CSFs in some categories are well established and not in others, and (d) the direction for further research on empirical validation of CSFs. The authors also propose that more studies are needed to investigate how to manage the identified CSFs and thus help managers in developing appropriate action plans.

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Note: We have not listed references of the 236 papers (due to manuscript word limitations), but have listed all 77 papers references which are directly related to the findings of this study.

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