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Successful enterprise resource planning implementation: taxonomy of critical factors

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Abstract

Purpose – The purpose of this paper is to investigate the current literature base of critical success factors (CSFs) of enterprise resource planning (ERP) implementations, provide a systematic compilation of CSFs, and present a new comprehensive taxonomy of CSFs for ERP system implementation.

Design/methodology/approach – This paper compiles literature that highlighted possible references to CSFs for ERP implementation projects. Given that the purpose of this paper is to achieve a depth of understanding of the various CSFs already identified by other researchers, "content analysis" is used. Four stages of content analysis are adopted to collect and analyse the literature, i.e. data collection, open coding, axial coding, and selective coding.

Findings – By analyzing all CFSs mentioned in literature during the last ten years (1999-2008), taxonomy of ERP CSFs implementation was formulated. In total 17 CSFs were identified, which is then categorized into five main categories.

Research limitations/implications – Literature is collected from selected databases and journals from 1999 to 2008.

Practical implications – This paper is significant because taxonomy helps us organize the knowledge. Taxonomy can help the researchers to make their search easier by assigning CSFs to a category and defining relationships between those categories.

Originality/value – The output of this paper will help future researchers to increase identification of related studies in the literature review phase of their work.

Keywords Manufacturing resource planning, Critical success factors

Paper type Literature review

1. Introduction

An enterprise resource planning (ERP) system is typically defined as a packaged business software system that facilitates a corporation to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a total integrated solution for the organization's information-processing requests, through a process-oriented view consistent across the company (Nah *et al.*, 2001). Many benefits have been mentioned by researchers and practitioners. ERP systems can potentially allow a company to manage its business better with potential benefits of improved process flow, better data analysis, higher quality data for decision making, reduced inventories, improved coordination throughout the supply chain, and better customer service (Gattiker and Goodhue, 2005). ERP is arguably the single biggest information technology (IT) investment an organization can make (Teltumbde, 2000). Mabert *et al.* (2001) put the total implementation cost at "tens of millions" of dollars for a

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medium-sized company and US$300-500 million for large international corporations. In spite of the many benefits, the adoption of ERP has not been without problem. A Standish Group report on ERP implementation projects reveals that these projects were, on average, 178 percent over budget, took 2.5 times as long as intended and delivered only 30 percent of the promised benefit (Zhang *et al.*, 2005). Given the high-expenses and low-success rate, causes of these problems or failures need to be understood and solutions leading to success need to be found (Calisir and Calisir, 2004).

Many studies have been conducted during the last ten years (1999-2008) to identify the factors affecting the ERP implementation success and failure. Rockhart (1979) was one of the first researchers to study critical success factors (CSF) of IT implementations. Early sponsors of this approach, as applied particularly to ERP, were Bingi *et al.* (1999), Holland and Light (1999) and Parr *et al.* (1999). The CSF approach is not only attractive to researchers but resonates with managers – it is reachable and vigorous, and it facilitates the identification and prioritization of factors that could influence implementation success (Brown and He, 2007). Since 1999, many information system (IS) researchers have used CSFs increasingly to study ERP system implementations. Amoako-Gyampah (2007) believed that although adoption and implementation of ERP systems has been studied, additional research and insights are needed. On the other hand, while the CSFs for the implementation of ERP systems have been discussed and analyzed, there have been many inconsistent and inconclusive findings (Law and Ngai, 2007). Dawson and Owens (2008) claimed that there are many differences between the CSFs that the authors define. They found that it is often the case that authors use different terminology to refer to the same CSF, and even encompass one CSF into what another author defines as two CSFs. According to Larsen (2003), the IS research area has rapidly expanded during the past three decades. Research is currently so fragmented that not even the most thorough researchers are able to fully draw on previous findings.

Few taxonomies have been presented in literature relating to CSFs of ERP implementation. The existing taxonomies have two main issues. First, the existing taxonomies are not current. The works of Holland and Light (1999), Esteves and Pastor (2000), Al-Mashari *et al.* (2003) and Somers and Nelson (2004) are the main taxonomies that have been presented so far. The research on ERP implementation has been increased in recent years (Pairat and Jungthirapanich, 2005). Moreover, product life cycles have become very short, and technology is changing rapidly. So, new success factors may be arising (Amoako-Gyampah, 2007). Consequently, it is needed to update the prior taxonomy based on the findings of fresh researches. Second, prior taxonomies have presented diverse categories of CSFs, i.e. "strategic and tactical" (Holland and Light, 1999), "organizational and technological" (Esteves and Pastor, 2000), and "ERP project life cycle" (Al-Mashari *et al.*, 2003; Somers and Nelson, 2004). Consequently, there is a need to consolidate prior research and present a holistic and bigger picture of CSFs for the ERP implementation projects.

The purpose of this study is to investigate the current literature base of CSFs of ERP implementations, provide a systematic compilation of CSFs, and present a new comprehensive taxonomy of CSFs for ERP system implementations. This study is significant because taxonomy helps us organize our knowledge (Sravanapudi, 2004). A taxonomy can help researchers make their search easier by assigning CSFs to a category and defining relationships between those categories (Samler and Lewellen, 2004). As Larsen (2003) asserted, the output of this research will help future researchers

increase identification of related studies in the literature review phase of their work. In addition, journal editors and reviewers need taxonomy to examine the extent to which a submitted article has conducted an inclusive review of available research.

In the following sections, the research methodology chosen to prepare the compilation will be explained. Journals and databases will be searched using key terms identified in a preliminary literature review. Succeeding rounds of articles will be reviewed for the compilation. CSF constructs will then be identified using content analysis methodology and an inductive coding technique. A frequency analysis of CSF will be done to identify the importance of each CSF. A comparative analysis between findings of this research and three prior researches will be conducted as well. After that, a new taxonomy of CSFs will be developed and presented. Finally, conclusions and some implications for future research will be offered.

2. Research methodology

This study provides a comprehensive review of possible references to CSFs of ERP implementation projects. Given that the purpose of this study is to achieve a depth of understanding of the various CSFs already identified by other researchers, "content analysis" is a proper analysis approach. Harris and Attour (2003) claimed that content analysis is a suitable method when the phenomenon to be observed is communication (statement, message, and contact), rather than behaviour or physical objects. Patton (1990) declared that content analysis is the process of "identifying, coding and categorizing" the primary pattern in the data.

Cavana *et al.* (2001) suggested a method for conducting "content analysis" using the "constant comparative method." Content analysis can be accomplished by the researcher with a "manual decision support system." When using a manual decision support system, the researcher highlights each theme as it occurs in the raw data being perused. Each highlighted theme is given a "theme code" and the theme code name is written in a "data index," so that a record of the list of themes is kept. This method was developed to analyze the huge amount of published articles. In this study, we adopted the following steps for content analysis.

2.1 Data collection

This stage includes deciding whether to look for a single word, or a set of words or phrases. Berg (2004) stated that the first step of content analysis is to determine at what level the sample will be selected and what units of analysis will be counted. Malhotra (2007) believed that the unit of analysis may be words (different words or types of words in the message), characters (individual or objects), themes (propositions), or topics (subject of the message). The data-collection phase involves a comprehensive search of many databases and journals that are categorized as belonging to the business/IS field. The procedure of data collection will be described in Section 3.1.

2.2 Open coding

Neuman (1997) describes open coding as the first pass through the raw data when the researcher places themes and allocates primary codes or labels in a first attempt to compress the mass of data categories. This stage of the coding process involves determining whether to code for a specific pre-determined set of themes or to permit for a more interactive coding approach. The first pass allows the researcher to open up the

articles and investigate CSFs. In this part of the analysis, emphasis is placed on the words themselves and not on the meaning of the words.

2.3 Axial coding

As Neuman (1997) states, the second reading of raw data (articles) is for axial coding. In this stage, the researchers work around the central axis of the themes until the themes become clear. So, additional or new themes may emerge during this pass. During this step, it is necessary to decide whether themes are to be coded exactly as they appeared, or if they could be recorded in some changed or collapsed form. In short, this stage refers to the level of generalization of terms.

2.4 Selective coding

Selective coding occurs during the third reading of raw data (Neuman, 1997). The researcher first looks selectively for facts that illustrated or justified themes and then makes a comparison and identifies contrasts between subthemes and themes. Mapping allows the researcher to investigate relationships across categories.

3. ERP CSFs content analysis

3.1 Data collection

For the current research, the unit of analysis or level of analysis involves "research studies." As mentioned already, the raw data consists of published articles in the literature about CSFs involving ERP implementation projects. The data collection phase consists of an extensive search of many databases which are available to researcher. These databases consist of hundreds of journals that are categorized as belonging to the business/IS field:

- Scopus™.
- SpringerLink.
- IEEE Xplore™.
- ScienceDirect®.
- Wiley InterScience.
- Emerald Intelligence.
- ABI/INFORM @ProQuest®.
- Business Source Premier @EBSCOhost.
- Association for Computing Machinery (ACM) Digital Library.

Webster and Watson (2002) suggested that "while journal databases accelerate identification of relevant articles, scanning a journal's table of contents is a useful way to pinpoint others not caught by your keyword sieve." Accordingly, the data-collection phase of the literature review involved an exhaustive search of many of the more well-known IS journals including, but not restricted to, those outlined below:

- *MIS Quarterly*.
- *Information Systems Research*.
- *Communications of the ACM*.
- *Management Science*.
- *Journal of MIS*.

- *Decision Sciences*.
- *IEEE Transactions*.
- *European Journal of Information Systems*.
- *Information & Management*.
- *Business Process Management Journal*.
- *International Journal of Production Economics*.
- *Journal of Computer Information Systems*.
- *Industrial Management & Data Systems*.
- *European Journal of Operational Research*.

Keywords chosen for this search were, in fact, selected from the keywords supplied by the authors of some of the most cited articles (Holland and Light, 1999; Nah *et al.*, 2001; Akkermans and van Helden, 2002; Al-Mashari *et al.*, 2003; Somers and Nelson, 2001) recognized in a preliminary literature review. As well, because of the exclusivity of an ERP system, the focus was only on ERP and not other kinds of IS systems (Management Information Systems (MIS), Material Requirements Planning (MRP), Supply Chain Management (SCM), etc.). The keywords were searched in the fields of "article title, abstract and keywords." Finally, the searches were limited to only those articles that were published in the last ten years, i.e. between 1999 and 2008.

Articles were selected from the search results that had used the search terms (keywords) outlined in Table I. Since different authors may have utilized diverse terms in their research, we decided to define some alternative keywords for each main keyword. These alternative keywords consisted of some "acronyms, synonyms, and antonyms." For example, for the keyword "Critical Success Factor" we used "CSF" as an acronym, and for keyword "Success" we employed "Failure" as an antonym. Using this technique facilitated us to achieve the greatest coverage of the relevant articles while decreasing the likelihood of ignoring some important articles. Based on the conditions between keywords, several combinations of the keywords have been utilized. For instance:

- CSF (and) ERP (and) implementation.
- Critical factor (and) ERP system (and) success.
- Critical success factor (and) Enterprise resource planning.

The selection of the article for inclusion in the compilation was dependent upon the researcher's decision after reading the article title and abstract. If it was determined

Main keywords	First alternative	Second alternative	Third alternative	Fourth alternative
Critical success factor	CSF	Success factor	Critical factor	Risk factor
Enterprise resource planning	ERP	ERP system	ERP software	Enterprise system
Implementation	Adoption	Adaptation	Assimilation	Project
Success	Performance	Effectiveness	Difficulties	Failure

Table I.
Keywords used for search

that the article probably contained information that would be indicative of ERP implementation success factors, then the article was chosen for further analysis. First, 117 articles were downloaded based on their titles and abstracts. Finally, 95 articles were selected based on the aforementioned criteria. Articles were printed and assigned a source code. The source codes were chosen as unique, logical, and efficient for frequent use in content analysis.

3.2 Open coding

All 95 articles were read in detail, one by one. While this step takes only one sentence to express, it is the major and most time-consuming part of the analysis. The first phase allowed us to open up the articles and explore CSFs. In this part of the analysis, emphasis was placed on the words themselves not on the meaning of the words. As we read through articles, CSFs emerged. After we found the first CSF, we kept reading until the second CSF was recognized. We compared this second CSF with the first CSF identified to ensure that the two were different, and then continued reading until an evident third CSF was identified. This third CSF was compared with the first and second CSFs. So, the process of constant comparative analysis continued – each newly identified CSF compared with previously identified CSFs to ensure that the new CSF does indeed add more understanding about the phenomenon under investigation. This process is called "constant comparative analysis" (Cavana *et al.*, 2001). As we read through articles, the constant comparative procedure was employed and finally a list of CSFs and a brief description of them was prepared on a separate sheet in Microsoft Excel program. We added to this list as we discovered new CSF. This provided a "CSF index." Using constant comparative analysis, a primary list of 41 CSFs were identified.

3.3 Axial coding

We reviewed and examined the list of 41 CSFs and their descriptions again. When needed, we referred to the related article for more details. In the literature, different categories have been used for defining CSFs. In fact, some of the CSFs were presented in the form of a super-CSF including some sub-CSFs. For example, while some researchers used "Change management culture and programme" as one CSF with several sub-CSFs (like change management plan, commitment to change, business process reengineering, organizational culture, user training, User involvement, etc.), others employed these sub-CSFs as separate CSFs. The same problem existed for other CSFs such as "business process reengineering and minimum customization," "consultants/suppliers support," and so on. Consequently, we decided to breakdown the more prominent CSFs to subparts to have a clearer CSFs meaning, thereby increasing the chance of further analysis in the next step. Therefore, new CSFs emerged in this phase. Finally, the initial list of 41 CSFs were re-categorised into 54 CSFs.

3.4 Selective coding

In this stage, we looked selectively for facts that illustrated or justified CSFs. Comparison between CSFs was made and contrasts and similarities between CSFs were identified. We mapped out all CSFs to investigate relationships across CSFs to build up the CSF classification. For categorizing the final CSFs, we utilized two criteria (Guba, 1978):

(1) *Internal homogeneity*. The extent to which one particular CSF holds together the other particular CSF in a meaningful way.

(2) *External heterogeneity*. The extent to which the differences between CSFs are bold and clear.

4. Identification of CSF

Based on these two criteria, we facilitated a "mutually exclusive and collectively exhaustive" list of CSF categories. Again, we reviewed and examined the CSFs and their descriptions. We referred to the main articles for more details as necessary. According to Guba's (1978) criteria, any CSFs that implied the same meaning (considering all synonyms, acronyms, and also antonym words for each CSF) were categorized under the same CSF. We considered "Related concepts," which are similar to the focal concept, and in some cases even identical other than by name. An example concerns the words "customization," "modification," and "localization," which have a similar meaning in the IS field and were placed within the same category. As another example, we classified a wide range of terms and phrases such as management support, like top management involvement, top management commitment, top management awareness, executive commitment, executive support, executive involvement, top management championship, lack of business management support, management participation, company wide commitment, company-wide support, dedicated resources, employee recognition and incentive, funds support, and so on, in one category, named, "Top Management Support." Also, we considered "Opposite concepts" that are similar or identical to the focal concept but inversely defined. For instance, "Ease of use" has an opposite concept by the name of "Complexity" in the literature. Finally, all 54 CSFs were re-arranged into 17 distinct broad categories of CSFs. The final compilation of CSFs for ERP implementation projects can be seen in the Appendix.

The actual analysis stage of CSFs involved reviewing the constructs in terms of frequency. By expanding the process to consider the frequency of CSFs, the researcher can gain a better understanding of the relative importance of the factors (Finney and Corbett, 2007). Table II shows the frequency of CSFs occurrence in the literature. As can be seen, five CSFs of "Top management support and commitment," "Project management and evaluation," "Business process reengineering and minimum customization," "ERP team composition, competence and compensation" and "Change management programme" are among the most frequent CSFs.

To show the stability (level of agreement between findings of prior studies), the CSFs were categorized into three parts, namely, "High, Medium, and Low." CSF with a "High" stability means that more than two thirds (66.66 percent) of prior research has recognized the CSF as critical. Two CSFs with the high stability in the literature consisted of "Top management support and commitment" and "Project management and evaluation." Also, CSFs with "Medium" stability means that more than one-third (33.33 percent) and less than two thirds (66.66 percent) of prior studies have identified the CSF as critical. Based on Table II, nine CSFs of "Business process reengineering and minimum customization," "ERP team composition, competence and compensation," "Change management programme," "User training and education," "Business plan and vision," "Enterprise-wide communication and cooperation," "Organizational culture," "Vendor support," and "Software analysis, testing and troubleshooting" are among the CSFs with medium level of agreement in prior researches. In addition, CSFs with "Low"

No.	Code	CSFs	Frequency (out of 95 articles)	Frequency (%)
1	MSC	Top management support and commitment	68	72
2	PME	Project management and evaluation	66	70
3	BPR	Business process reengineering and minimum customization	59	62
4	TCC	ERP team composition, competence and compensation	53	56
5	CMP	Change management programme	48	51
6	UTE	User training and education	45	47
7	BPV	Business plan and vision	43	45
8	ECC	Enterprise-wide communication and cooperation	39	41
9	ORC	Organizational culture	37	39
10	VES	Vendor support	36	38
11	STT	Software analysis, testing and troubleshooting	32	34
12	PRC	Project champion	30	32
13	CSS	Careful selection of ERP software	28	30
14	USC	Use of consultant	25	26
15	BLS	Appropriate business and IT legacy systems	24	25
16	SYQ	System quality	24	25
17	USI	User involvement	22	23

Table II.
Frequency analysis of CSFs for ERP implementation used in the literature (1999-2008)

stability means that less than one third (33.33 percent) of prior researchers has mentioned the CSF as critical. Six CSFs with the low stability in the literature consisted of "Project champion," "Careful selection of ERP software," "Use of consultant," "Appropriate business and IT legacy systems," "System quality," and "User involvement."

4.1 Comparative analysis

An important step in examining a new taxonomy is comparing it with previously developed taxonomies (Larsen, 2003). A comparative analysis was prepared between findings of this research and findings of three prominent articles in the field of ERP implementation success. Two of the articles have been the most cited articles (Nah *et al.*, 2001; Somers and Nelson, 2001), and the third article was a recent compilation study, which was done by Finney and Corbett (2007). The comparative analysis can be viewed in Table III. As can be seen, 12 out of 17 CSFs from our findings are in the range of other researchers' findings. It shows more than 70 percent harmony between our findings and prior findings.

However, there are some differences between our finding and prior findings. "System quality" and "User involvement" are two main differences which have not been mentioned in other three studies. Prior researchers have employed different approaches to identify and classify CSFs and the studies have been fragmented in different areas. Dawson and Owens (2008) claimed that there are many differences between the CSFs that the authors define. The differences may have occurred because of the varying aims of the research and the research methods. They found that it is often the case that authors use different terminology to refer to the same CSF, and even encompass one CSF into what another author defines as two CSFs. In addition, Law and Ngai (2007) stated that while the CSFs for the implementation and use of ERP

No.	CSFs	Nah *et al.* (2001)	Somers and Nelson (2004)	Finney and Corbett (2007)	Range	Result
1	Top management support and commitment	3	1	1	1-3	+
2	Project management and evaluation	6	5	6	5-6	–
3	Business process reengineering and minimum customization	5	16	3	3-16	+
4	ERP team composition, competence, and compensation	1	2	5	1-5	+
5	Change management programme	2	7	2	2-7	+
6	User training and education	2	14	4	2-14	+
7	Business plan and vision	4	4	8	4-8	+
8	Enterprise-wide communication and cooperation	8	3	11	3-11	+
9	Organizational culture	2	–	13	2-13	+
10	Vendor support	–	9	–	9	+
11	Software analysis, testing, and troubleshooting	9	11	3	3-11	+
12	Project champion	10	8	10	8-10	–
13	Careful selection of ERP software	–	10	15	10-15	+
14	Use of consultant	–	22	7	7-22	+
15	Appropriate business and IT legacy systems	11	–	12	11-12	–
16	System quality	–	–	–	–	–
17	User involvement	–	–	–	–	–

Table III.
Comparative analysis of CSFs ranking with three other studies

systems have been discussed and analyzed, there have been many inconsistent and inconclusive findings. Furthermore, the scope of these researches was totally different. For example, while our research consisted of 95 articles published from 1999 to 2008, the work of Finney and Corbett (2007) was composed of 45 articles and the research of Nah *et al.* (2001) consisted of ten articles published from 1998 to 2000. Consequently, based on the differences in aim, scope and methodology of studies and using different terminology for referring to the same CSF, such differences in findings of studies are reasonable.

5. Taxonomy of CSFs for ERP implementation

Samler and Lewellen (2004) stated that taxonomy can help make searches easier by assigning concepts to a category and defining relationships between those categories. Sravanapudi (2004) believed that taxonomies matter because they help us organize our knowledge. Of the many attributes of a good taxonomy, two of the most important qualities are:

(1) *Structure*. A logical and disciplined hierarchical structure of categories that make sense to the business. Good taxonomies are not too deep or too wide. They sum up the rigour of a knowledge worker and enable it to be reused without requiring the same discipline of the users.

(2) *Completness*. A good taxonomy contains all the terms used to describe the business, i.e. the "language of business." Consider a global automobile manufacturer. The term "hood" in the USA is equivalent to a "bonnet" in the UK. Documents that discuss the design of hood should also to be visible to a British engineer researching something about the bonnet for his design project.

By analyzing all the CFSs mentioned in the literature during the last ten years (1999-2008), a taxonomy of CSFs for ERP implementation is formulated. Kerimoglu *et al.* (2008) presented a model of three common categorization of an ERP project, consisted of "technology, organization, and user." This study included these categorisation as well as two other categories, i.e. "External Expertise" and "ERP Project," Further analysis was made and the categories were found to be representing two different environments, i.e. "ERP adopting organization" and "ERP system." We then re-categorised the five different categories to enhance the model. We then classified "Organization, ERP Project, and ERP User" under the "ERP adopting organization environment" and "ERP Technology, and External Expertise" as "ERP system" (Figure 1).

Also, since we were to classify the critical factors for success of ERP implementation projects, we linked all these 17 CSFs to ERP project success. Different measures have been employed by prior researchers for defining ERP project success. We adopted the model of Markus *et al.* (2000), which was recently used by Kamhawi (2007), for this taxonomy. Markus *et al.* (2000) distinguished between two types or dimensions of success for ERP systems implementation: project success

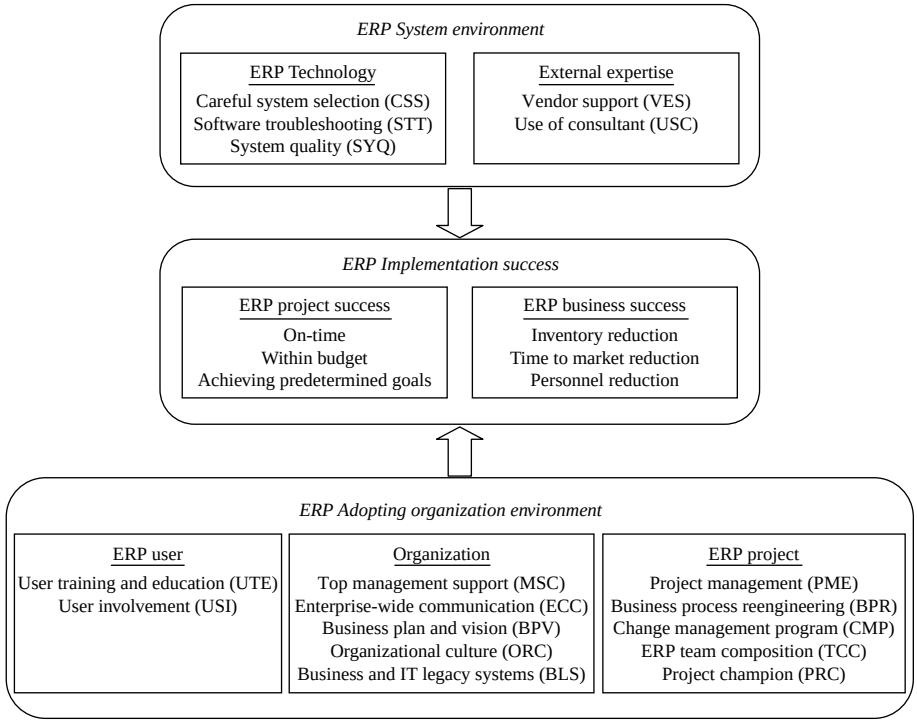

Figure 1.
ERP implementation: taxonomy of CSFs

metrics (in terms of meeting the project due dates, budgets, and scope and performance expected) and business value metrics (in terms of business improvements such as inventory reduction, cycle times reduction, time to market reduction, etc.).

Earlier taxonomies have provided dissimilar classifications of CSFs. Holland and Light (1999) categorized ERP implementation CSFs into "strategic and tactical." Esteves and Pastor (2000) classified CSFs into "organizational and technological." Some of prior researchers categorized CSFs based on the "ERP project life cycle" (Al-Mashari *et al.*, 2003; Somers and Nelson, 2004). Therefore, it was needed to consolidate previous taxonomies and present a holistic and comprehensive picture of CSFs for the ERP implementation projects. This study categorized the ERP implementation CSFs into five main factors of an ERP implementation projects, i.e. "ERP software, ERP expertise, ERP user, ERP project, and ERP adopting organization" Because this kind of classification gives a chance to stakeholders (chief executive officer, chief information officer, vendor, etc.) of ERP implementation project to highlight the area in which problem may occur and evaluate ERP implementation success from five collective points of view.

6. Conclusion

Identifying factors leading to success or failure of ERP systems is of increasing importance (Haines and Goodhue, 2003). From a practical point of view, understanding the determinants of ERP implementation will be of benefit to both adopting companies and software vendors. Decision makers will be able to formulate better strategies to enhance ERP implementation, while vendors will build ERP products that satisfy their customers, and, therefore, they can make more profit. In this study, we reviewed the recent works, investigating CSFs in the ERP implementation projects. The different studies were analyzed from a CSF point of view to highlight critical factors and their importance for ERP projects success. Using comprehensive data collection, article reading, content analysis of constructs, frequency analysis of CSFs, and comparative analysis with prior researches, we classified all CSFs mentioned in literature in 17 broad categories and finally developed taxonomy of CSFs for ERP implementation.

Among the possible uses for the proposed taxonomy are the following. Researchers in the literature review stage can use the taxonomy to find out other associated concepts for each CSF. For example, a researcher may want to examine prior studies on the concept "Data analysis and conversion," but this particular researcher may not know that very related concepts have appeared under the titles of "Data migration," "Data acquisition," "Data fit," "Data management," and so on. In addition, practitioners may use the taxonomy to recognize the areas that may have to be considered in order to successfully implement the ERP system. Furthermore, journal editors and reviewers may use the taxonomy to make sure that submitting authors have been comprehensive in their approach. Finally, case study research on the taxonomy itself could be conducted by researchers in different countries to obtain a deep understanding of each of the categories and their characteristics within changeable organizational contexts.

There are some critical findings from the in-depth study of prior researches.

It is important to point out that ERP systems are different from other IT systems (Davenport, 2000) because ERP implementation includes technological, operational, managerial, strategic, and organizational related components (Markus and Tanis, 2000). ERP systems differ from traditional systems in many ways, such as scale, scope, complexity, organizational changes, project costs, and need for business process

re-engineering (Somers and Nelson, 2001). Therefore, an ERP implementation project is not merely a "computer project." It is strategic and must be approached as such. It should be noted that ERP systems are integrated applications with an impact on the entire organization.

The literature in ERP implementation has a heavy emphasis on companies in the developed countries from Europe and North America. Little work has been done on companies in developing countries. Research shows that ERP technology faces additional challenges and increasing dependencies in developing countries (Al-Mashari *et al.*, 2006). Al-Mashari and Zairi (2000) believe that many problems that have led to failure of IT adoption have occurred when trying to adopt Western-developed IT applications in organizations in developing regions. It seems that some CSFs have a different priority in different countries. While in our frequency analysis (Table II), "organizational culture" ranked in the middle, it might be a very high critical factor when adopting an ERP in a developing country. In future, other researchers could consider this important point to develop a taxonomy based on the CSFs relating to ERP projects in developing countries.

Furthermore, the aforementioned subject in the previous paragraph is significant about small and medium-sized enterprises (SMEs). According to Pairat and Jungthirapanich (2005), the ERP vendors are now trying to extend their market to companies in developing countries, SMEs. Dawson and Owens (2008) believe that, those conducting research on SMEs might compile a different set of CSFs to those conducting research on large originations. Therefore, it will also be valuable to prepare a taxonomy based on the CSFs relating to ERP projects in SMEs.

The taxonomy generated in this article is just the beginning. A next step for researchers in the field might be to collect supplementary data to expand this taxonomy. This study was conducted considering some limitations. Future research can be carried out based on expanding the time period constraint from the last ten years to last 20 years. In such case, some prior form of ERP, like MRPII could be included in the search items. In addition, further databases, journals and conference proceedings could be utilized to enlarge the number of articles in the data-collection phase. Finally, research on the taxonomy itself could be conducted by other researchers to obtain a deep understanding of each of the categories and their characteristics. An empirical study could be carried out in the future in order to validate the 17 broad categories of the CSFs, considering that some of the CSFs in a category might be related with other categories.

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Appendix

CSFs	
1. Top management support and commitment	Top management/executive involvement; top management/executive commitment; top management/executive awareness; top management/executive participation; company-wide support; company wide commitment; dedicated resources; employee recognition and incentive; funds support
2. Project management and evaluation	Effective project management; project planning project schedule and plan; project scope; work time schedule; detailed schedule; project completion time; project cost; auditing and control; project management of consultants and suppliers
3. Business process reengineering and minimum customization	BPR; business process reengineering; business process change; business process improvement, optimization, and reengineering; alignment of the business with the new system; process adaptation level; process standards; business process skills; job redesign; worked with ERP functionality-maintained scope; minimum customization
4. ERP team composition, competence and compensation	Composition of project team member; balanced implementation team; project team: the best and brightest; project team empowerment; steering committee; project team competence; the domain knowledge of the ERP project team; teamwork participation; attitude of the ERP project team; professional personnel; constitution of project team; ERP team compensation
5. Change management program	Change management plan; managing changes; managing conflicts; argument for change; management of expectations; organizational resistance to change; change readiness; understanding changing requirements; change in business goals during the project; conflicts between user departments; reasonable expectation with definite target
6. User training and education	Training employee; education on new business processes; adequate training and instruction; training of project team and end-user; effective training; Hands-on training
7. Business plan and vision	Business plan-vision-goals-justification; vision statement and adequate business plan; feasibility-evaluation of ERP project; Effective strategic thinking and planning strategic; competitive pressure; clear goals and objectives; clear desired outcomes; strategic IT planning; link to business strategy; ERP strategy and implementation methodology; consensus on organizational objectives; clear ERP strategy-vision
8. Enterprise-wide communication and cooperation	Effective enterprise-wide communication; interdepartmental communication; interdepartmental collaboration; interdepartmental cooperation; open and honest communication among the stakeholders; cross-functional coordination; free flow of information in project team; communicating ERP benefits; communication with ERP project team
9. Organizational culture	Cultural and business change; cultural differences; cultural readiness; change culture; cultural fit; cultural issues; shared beliefs; centralization of decision making; commitment to

(*continued*)

Table AI.
Compilation of CSFs for ERP implementation project

CSFs	
	learning; national culture; trust; unfocused information-seeking; deal with organizational diversity; human resources commitment
10. Vendor support	Vendor-customer cooperation; Vendor-customer partnership; usage of vendor's tools; technical competence of supplier; effective communications with users; domain knowledge of supplier; implementation team members; connectedness with user department; effective communications with users; service of the supplier of ERP
11. Software analysis, testing and troubleshooting	System development; stabilization of ERP; adequate testing; data accuracy; data analysis and conversion; data management; data fit; data migration; accurate and prompt data acquisition; trouble shooting; tests and problem solutions; country-related functional requirement; technical issues
12. Project champion	Project manager; project leader expertise; strong and committed leadership; ERP project manager leadership
13. Careful selection of ERP Software	Adequate ERP selection; system selection process; suitability of software; package standards; completeness of software; selection of ERP vendor; ERP vendor quality; ERP vendor reputation; related experience of supplier; ERP supplier option and service; technical competence of supplier; domain knowledge of supplier
14. Use of consultant	Consultant-customer partnership; consultant involvement; consultant support; usage of consultant's tools; consultant selection; consulting services; technical competence of consultants; domain knowledge of consultant; consultant competence; consultant implementation team; connectedness with user department; effective communications with users
15. Appropriate business and IT legacy systems	Legacy systems and IT infrastructure; IT infrastructure-skills; pre-existing data and systems; suitability of hardware and software; technological context; technology or infrastructure in place; integration and communication between legacy system and ERP
16. System quality	System reliability; system integrity; system stability; compatibility of software; timeliness; ERP adaptation level; ERP software features; competency and flexibility of the ERP; ease of use; perceived complexity; user fit; fit between ERP and business process
17. User involvement	User participation; user support; feeling of user involvement; willingness to participate; employee cooperation; involving individuals and groups; key user involvement

Table AI.

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