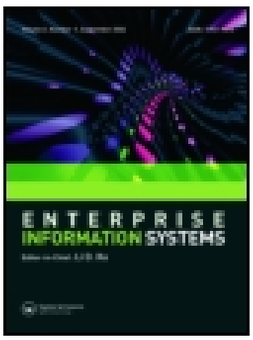

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A multi-dimensional model of Enterprise Resource Planning critical success factors

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ABSTRACT

Recent literature on ERP implementation Critical Success Factors has focused on how different factors characterizing the context of the implementing firm, such size or culture, affect the relative importance of CSFs. Based on a systematic analysis of recent literature, this paper proposes a comprehensive model of contextual factors affecting the importance of ERP implementation CSFs. The proposed model answers the call for research on CSF to focus more on context determining CSF effectiveness. It also helps practitioners to identify important success factors in ERP implementations, calling for more research about specific contextual factors and CSFs in determining ERP implementation success.

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1. Introduction

An Enterprise Resource Planning system (ERP) system can be simply understood as a company-wide information system connecting all important functions of a company, such as marketing, sales, finance, and logistics (Shehab et al. 2004). This type of integrated and comprehensive system has the potential to bring a series of benefits to firms, such as quick reaction to changes (Velcu 2007), reduced inventory (Gupta 2000) and easier communication between business units (Mraz 2000). Naturally, implementation of ERP systems or replacement of legacy systems with ERP has become the norm across companies seeking to improve their productivity and competitiveness. However, the implementation of an ERP system is a risky procedure that can prove to be very challenging (Sumner 2000). In an ERP implementation project, companies deal with an investment of probably millions of dollars and a lengthy process entailing time and efforts from practically all departments, which must collaborate to make the implementation project a success. Because of the high number of people and groups involved, and the high number and complexity of tasks, ERP implementations are often tackled using system engineering methodologies normally considered for large engineering endeavours (Leu and Lee 2017).

The importance and size of ERP projects have entailed a great deal of research about how to mitigate the risks of ERP system implementations. This includes research focusing

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on ERP selection, whereby the objective is to develop models to assist decision-makers in choosing an ERP offer on the market most fit to a given organisational context using, for instance, fuzzy cognitive maps (Salmeron and Lopez 2011), fuzzy analytic network processes (Chang et al. 2015) or analytical hierarchy processes (Ayağ and Özdemİr 2007). Another stream of research about ERP implementation concerns the in-depth analysis of case studies of companies that have gone through ERP implementations to pinpoint the most important aspects that are strongly related with implementation success or failure. These are called by various names: critical success factors, critical failure factors, drivers of success, key success factors or key implementation factors.

There is a large amount of literature about ERP critical success and failure factors. Most recently, research about CSFs of ERP has increasingly started to consider how contextual variables shape the relative importance of different success factors. Scholars, for instance, have become aware that differences in firm size have a direct influence on what the resultant CSFs are. In other words, context, as represented by the nature of a firm in which an ERP is implemented, can greatly influence the importance of CSFs, e.g. what really matters more in a small firm during ERP implementation may have little or no significance for a larger firm (Leyh 2014, Ahmad & Pinedo Cuenca, 2013). Further studies have focused on the nationality of the firm. This has resulted in a large number of papers on ERP implementing organisations within a specific country, such as India (Basu et al. 2013, Veena 2013), Poland (Trąbka 2013) (Ziemba and Kolasa 2015), or China (Sun et al. 2015). The results of these studies have given rise to a new stream of research, which aims at understanding why the findings are often not the same across different countries. Other literature has focused on understanding how the type of industry of a firm influences CSFs or how CSFs relative importance changes in respect of the state of the economy or the culture of the country where the firm is in (Dezdar and Ainin 2012).

While the literature has highlighted that the relative importance of CSFs of ERP implementations may change with different contextual variables, the research results available in this area are still patchy. Research has shown to either focus on one specific contextual factor, e.g. the nationality of the firm, or, in many other cases, contextual factors and their importance are reported only marginally while discussing the practical and theoretical implications of the results obtained. In other words, the research question answered by this paper is 'What are the contextual dimensions influencing the relative importance of ERP implementation CSFs?'. This question is answered by providing a comprehensive model of ERP implementation CSFs, which includes contextual dimensions influencing their relative importance and an analysis of how these contextual dimensions influence the ERP implementation success factors is currently lacking.

From a theoretical standpoint, the need for the proposed model is dictated by contingency theory. The existing literature clearly highlights that successful ERP implementation can be driven by different factors in different contexts. This is consistent with one of the main tenet of contingency theory, which has been applied in information systems literature for more than 30 years (Donaldson 2001). According to contingency theory, the optimal way to manage information systems within an organisation strongly depends on firm-specific factors (Weill and Olson 1989). Under this theoretical lens, this paper fills a gap in the literature by identifying in a comprehensive way the contextual variables that are more likely to influence the success factors of ERP implementations.

We propose a multi-dimensional model of ERP critical success factors. Specifically, through a thorough, large-scale review and coding of recently published work on CSFs of ERP implementations, this paper identifies a set of contextual dimensions that have shown to have a clear influence on the relative importance of ERP implementation CSFs. Then, for each identified dimension, the paper discusses the relative frequency of identification of CSFs in case studies having a different value of particular context dimensions, and what are the practical implications of it. The proposed model is then evaluated ex-post by revisiting existing case studies to show how the CSFs highlighted in them are predicted by the proposed model. Second, to evaluate the practical relevance of our work, the proposed model has been also qualitatively evaluated by three experts in ERP system implementations, who have highlighted different strengths and weaknesses.

The paper is organised as follows. Section 2 gives an overview of related work on ERP implementation CSFs. Section 3 presents the methodology. The model is presented in Section 4, while Section 5 reports the results from the model evaluation and provides a critical discussion of the value of the model.

2. Background and related work

The idea of critical success factors has been originally introduced by Daniel (1961) and made popular years later by Rockart and Forster (1989), who have refined the definition into 'key areas where "things must go right" for the business to flourish and for the manager's goals to be attained.' CSFs can be classified based on their source, e.g. industry CSFs, competitive position or peer CSFs, environmental CSFs, temporal CSFs, management CSFs, or by their positioning in respect of the implementing firm, e.g. internal, external, monitoring, adapting.

Critical success factors have ever since been applied to all enterprise systems. Regarding Business Intelligence (BI) systems, the literature stresses that those organisations addressing the CSFs from a business rather than technical orientation are more likely to achieve better results (Yeoh and Koronios 2010). The literature has also documented BI-specific critical success factors that industry partners, vendors or users have identified (Hawking and Sellitto 2010) and proposed a framework of CSFs specific to BI systems (Yeoh and Koronios 2010).

As for Customer Relationship Management (CRM) Systems, strategic issues in the identification of CSFs have been identified through case studies (Bull 2003). CSFs for this type of systems have been identified for different phases of the system life cycle, such as adoption or implementation (Hung et al. 2010). CSFs for CRM systems can be organised into organisational factors (e.g. champion, management support, resource), process factors (e.g. CRM strategy and CRM process), technological factors (e.g. complexity, compatibility, source systems, channel integration) and project factors (e.g. user participation and project team skills) (Kim, Lee, and Pan 2002). Models of CSFs for CRM Systems have also been developed by derivation from CSFs of ERP system implementation (Vinhas Da Silva and Rahimi 2007). Wong (2005) has proposed a model in which CSFs for CRM systems are distinguished based on the size of the firm, i.e. small, medium or large.

A considerable amount of research has been conducted into the identification of CSFs for ERP implementations (Holland and Light 1999) (Sumner 1999) and IT implementation

projects (Reel 1999). CSFs in these cases typically include top management support, end-user training and education, vendor partnership, vendor support, relations, interdepartmental collaboration, change management, communication, project team competence and composition. A ranking of different CSFs for ERP implementation by managers of organisations with hands-on experience in ERP implementations is proposed by Somers and Nelson (2001). Another body of research in this area revolves around interdependences among the CSFs, such as in the work of Akkermans and van Helden (2002).

Previous studies have tried to find similarities and differences across particular dimensions of CSFs. Shaul and Tauber (2013), for instance, have performed a literature review of a decade of research about CSFs of ERP, in which they present a comprehensive taxonomy of CSFs, mapping also these to different dimensions and facets of ERP system implementation. In their study, the authors have considered the following taxonomy dimensions: strategic v. technical, organisation v. end-user, cultural v. technological, global v. local, life cycle v. specific case. However, an analysis of the relative importance of different CSFs in different dimensions is lacking. Tobie, Etoundi, and Zoa (2016) have identified a number of contextual factors affecting ERP implementations specific to African countries, which reinforces the recent tendency of literature to focus more explicitly on the importance of context in ERP implementations.

3. Research methods

Given the large amount of literature already published about ERP implementation CSFs, we decided to proceed inductively starting with the analysis of existing literature. Also, because existing case studies are by nature qualitative and available in different formats and level of details, qualitative methods have been considered much more suitable than quantitative ones to perform this research. Overall, this paper adopts a qualitative research paradigm through a combination of grounded theory for analysing the results of a literature review, to qualitative interviews and case study analysis for the evaluation of identified contextual variables (Venkatesh, Brown, and Bala 2013). The steps of the methodology adopted by this paper are represented in Table 1.

3.1. Data collection

With the aid of Google Scholar, a comprehensive literature review of articles has been performed in three rounds. The first round uses 'ERP critical success factors' as keyword, considering all the words, anywhere in the article, for works published from 2012 to the first quarter of 2019. Similarly, the second round uses the keyword 'ERP failure factors'. The third round uses 'ERP Project Evaluation' as keyword. These keywords have been selected based on the objectives of the present research. The timeframe of six years (2012-2019Q1) has been selected because it was considered sufficient to remain manageable. Moreover, it is deemed enough to obtain up to date information, since ERP technology has evolved over the years and, as such, it was presumed necessary to exclude older research.

Excluding duplicates lead to a total of 1825 academic articles. This list has been downsized further by excluding papers (i) not written in English, (ii) not clearly related to the subject, (iii) not including case studies with real world organisations. Moreover, to avoid duplication in the case of publication in two or more venues, when papers had the

Table 1. Research methodology.

Data collection	Data analysis	Evaluation
Google Scholar with 3 keywords and over the period (2012–2019Q1)	Create a common list of ERP implementation CSFs	Ex-post evaluation of the model against case studies in the literature
Filtering out duplicates and non-relevant articles	Scan papers to identify profiles (organisation, context variables, related CSFs	Qualitative evaluation of the model through discussion with a panel of 3 experts
Filtering out the papers that do not provide a list of CSFs	Identify context dimensions and their values (6 top-most frequent variables are retained)	
	Count relative frequency of CSFs per context variable value and generate model	

same title or clearly similar content based on abstract comparison, only the article with the most citations has been included, or the version that has been published by an academic journal. Finally, to account for relevance, we only considered papers with at least five citations. In the end, a total of 65 academic papers have been considered for the data analysis.

3.2. Data analysis

The paper identified by the literature has been analysed using a grounded theory approach (Urquhart, Lehmann, and Myers 2010). First, we have aimed at identifying the context variables that are relevant to the study of ERP implementation CSFs. Once these have been identified, the relative frequency of CSFs for all variables has been analysed. To achieve these objectives, the analysis of the resulting data has followed these steps:

Step 0. A preliminary step concerns identifying a standard list of ERP implementation CSFs. This has been necessary to compare the findings across different papers, in particular for counting the number of times that a given CSF has been considered in the literature. In other words, such a common list of ERP implementation CSFs contains the codes that we have used, in the next step, to classify the case studies identified by the literature review. The list has been initially populated using the CSFs considered by the following widely cited studies: Al-Mashari (2002), Holland and Light (1999), Somers and Nelson (2001). Then, a list of CSFs has been compiled for each paper identified in the literature search. These CSFs then have been compared to the initial list to either (i) match an identified CSF with one already in the initial list or (ii) extend the initial list with a new CSF if such a match was not found. Two or more CSFs have been considered the same if they had very similar wording, but different word. For example, 'Top management support and commitment' is considered the same as 'Top management commitment and support'. CSFs have been considered same also if they were evidently addressing the same aspects of the implementation. An example of this is the case of 'Vanilla ERP' and 'minimal customization'. Those CSFs that did not match any other CSFs in any other paper have been left standing alone. This procedure yielded a list of 63 CSFs.

Step 1. After compiling a list of CSFs, the next step has concerned the identification of case studies discussed in the papers identified by the literature search. Each paper, in fact,

may discuss ERP implementation CSFs found in one or more case studies, with each case study referring to a specific organisation. In this step, for each paper, we have extracted a list of organisations that were considered and, for each of them, a list of identified CSFs. We use the word *profile* to refer to the bundle of an organisation and its related CSFs. A profile ID number has been given to each identified profile. Each profile also has been coded to account for the context variables that it addresses, either implicitly or explicitly. Following a grounded theory approach, the list of contextual dimensions has been populated iteratively while analysing the case studies. To achieve internal validity, this classification of profiles has been conducted separately by each author. Once completed, conflicts in the classification provided by each author have been resolved in a discussion session.

Step 2. In this step, the profiles have been scanned to derive a list of context dimensions and their values to be considered in the proposed model. These context dimensions are the ones that are most frequently considered in the identified profiles. From a methodological point of view, we aimed to identify no more than 10 dimensions, in order to obtain a manageable set of dimensions. In practice, however, the frequency gap between the 6-th and 7-th most frequent contextual dimension turned out to be very wide. Therefore, we decided to focus our model on the 6 most frequent context dimensions only.

Step 3. In this step, the relative frequency of individual CSFs is calculated for each identified context dimension and value. The result of this phase is the model that is presented and discussed in depth in Section 4.

3.3. Evaluation

As mentioned in Section 1, the model obtained in the data analysis phase has been evaluated qualitatively in two ways. First, case studies existing in the literature have been revisited to show that the model obtained could predict the ERP implementation CSFs. Second, the model has been discussed with a panel of three ERP experts to collect their feedback about usefulness, usability limitations and possible improvements. The model has been provided to the experts in the form of a decision support tool. Based on the findings described in Section 4, the decision support tool involves a set of questions to identify context values for a specific company and, based on the answers given, the tool shows the CSFs that are most likely relevant in the considered scenario. We first have provided this decision support tool to the experts. One week after, we have followed up with a telephone qualitative interview. These lasted on average 45 minutes.

4. Results

In this section, we first describe the identified context dimensions and values. Then, we present and discuss in depth the relative frequency of ERP implementation CSFs for each context dimension value.

4.1. Identification of context dimensions

The model proposed in this study uses the data collected from the literature review to determine the similarities or patterns of commonality among them. The following six most frequent contextual dimensions are considered. Each dimension can assume two possible values in a given context:

- Size (assuming values: large, small),
- Economic status of the firm's residence country (developed, developing),
- Culture (with subdimensions Masculinity, Uncertainty avoidance, Power distance and Individualism, each of which can assume the values low or high),
- Sector (public, private),
- Type (manufacturing, services).

The following sub-sections cover the particulars of each dimension of the model.

Regarding dimensions of culture, the tables displayed in the next sections show the 15 most frequent CSFs for each value of a dimension. For the other dimensions, the tables show the CSFs for which the frequency differences between values of each dimensions are equal to or higher than 10%.

4.2. CSF frequency analysis and discussion

4.2.1. Culture

The impact of culture on organisations is a topic widely covered in the literature. For the purpose of this study, the Hofstede (Hofstede, Hofstede, and Minkov 2005) dimensions of culture have been selected to typify countries or regions into different groups, since these are widely used in IS research. According to Hofstede, different countries score a particular number (index) comprised between 0 and 100 on different cultural dimensions, such as masculinity, individualism, uncertainty avoidance and power distance.

Each of these dimensions has different cultural characteristics that are reflected in different behaviours or preferences. For instance, *masculinity* stands for a preference in society for achievement, heroism, assertiveness, and material success, whereas a *feminine* (i.e. low masculinity) culture displays a preference for relationships, modesty and caring for all members.

Using the results of cross-cultural research by Hofstede, the profiles identified by the literature analysis have been sorted by country, using the score 50 as discriminant between high and low scoring countries for all dimensions. For example, Malaysia is a country with a very high index of distance power (100), whereas Sweden has a low power distance index of 31.

The profiles then have been classified, based on the country in which a case study occurred, either as high or low scoring for each dimension. Finally, the relative frequency of each CSF has been calculated based for each dimension and possible value (high or low). Below, the results of obtained are discussed.

4.2.2. Index of masculinity (Table 2)

Masculinity is defined as a preference in society for achievement, heroism, assertiveness and material rewards for success. Its counterpart (feminine culture) represents a preference for cooperation, modesty, caring for the weak and quality of life.

In feminine culture organisations, there tends to be equality among employees, while in masculine cultures there is usually more inequality, either by gender or among different levels of an organisation. These traits are reflected in the relative frequencies of CSF for ERP implementation displayed in Table 2. In feminine culture organisations, in fact, top scoring CSFs are 'User training' and 'End user involvement', which typically promote a sentiment of equality in the organisation, mainly striving to reach consensus from end-users about the configuration and usage of the system. Moreover, these rankings can be explained by considering that feminine cultures consider that equality among peers is extremely important and one of the ways of attaining it is through training. Previous research has demonstrated that employees from feminine cultures are prone to prefer non-financial rewards such as time-off for training (Andersson and Ericsson 2008).

One peculiar aspect in Table 2 is the absence of a 'Project champion' as a CSF in the rankings of masculine cultures, which can be explained in two ways. First, masculine cultures are more competitive by nature and the presence of a leader would be natural, making it a not particularly critical success factor. Second, according to Bjerke (2000), among the typical characteristics of strongly masculine organisations is that power is often centralised, which again confirms that the likelihood of having a natural project champion or project leader is very high in any situation.

Finally, the high rankings of 'Project team competence and composition' and 'Project management' in masculine cultures may be related with the emphasis put by this type of cultures on performance, whereas the high ranking of 'Organizational culture' on feminine cultures and the presence of 'Partnership with vendor' relates with the emphasis that feminine cultures put on building and fostering relationships within an organisation.

Table 2. Masculine versus feminine cultures – CSF relative frequencies.

Rank	CSFs for Masculine Cultures	Relative frequency	CSFs for Feminine Cultures	Relative frequency
1	Top management support and commitment	82%	User training and education	64%
2	Project team competence and composition	61%	Top management support and commitment	61%
3	Project management	57%	End user involvement	55%
4	Change management	55%	Project team competence and composition	55%
5	User training and education	52%	Clear goals and objectives	52%
6	Communication	51%	Project management	45%
7	BPR and minimal customisation	45%	Communication	45%
8	Clear goals and objectives	42%	Careful package selection	42%
9	Vendor and or consultant support	36%	Vendor and or consultant support	39%
10	Organisational culture	34%	Organisational culture	36%
11	End-user involvement	34%	Change management	33%
12	Careful package selection	33%	Data accuracy, conversion	33%
13	Legacy system and infrastructure	31%	BPR and minimal customisation	33%
14	Implementation strategy	28%	Legacy system and infrastructure	30%
15	Resources availability (financial, human and technological)	27%	Project champion	27%

4.2.3. Index of individualism (Table 3)

Individualism explores the degree to which people in a society are integrated into groups. Individualistic societies have loose ties that often only relate individuals to their immediate family. Its counterpart, collectivism, describes a society in which tightly integrated relationships, such as extended families and others in-groups, are prominent.

Cultures with high index of individualism are more likely to display problems or difficulties related with teamwork. It is not surprising, therefore, that 'End user involvement' and 'Change management' score higher among individualistic cultures, since more involvement and cooperation of the entire organisation is necessary to facilitate teamwork. In the collectivistic cultures, following the group is the norm. Therefore, 'Change management' scores lower, since individuals are more likely to follow organisational policies and not to feel distressed by radical change, as long as it is managed at the organisational level. Both organisational culture and collectivism are related to cooperation in organisational settings, which explains its higher rank in individualist cultures. Notably, the presence of a champion is important for highly individualistic cultures where decisions are more likely to be made effectively if taken individually rather than collectively.

4.2.4. Index of uncertainty avoidance (Table 4)

The uncertainty avoidance index is defined as a society's tolerance for ambiguity, in which people embrace or avert an event of something unexpected, unknown, or away from the status quo. Societies that score a high degree in this index opt for stiff codes of behaviour, guidelines, laws. A lower degree in this index shows more acceptance of differing thoughts or ideas.

The effects of uncertainty avoidance can be observed based on the evident differences in ranks of the following CSF: 'Clear goals and objectives' 'User training and education', 'Communication', 'End user involvement' and 'Monitoring and feedback'. Employees in cultures with high uncertainty avoidance tendencies require a better upfront understanding of the process of ERP implementation, and also require to being reassured about the steps being taken. Conversely, low uncertainty avoidance cultures are better equipped to deal with uncertain and changing requirements, which would explain why the same CSFs do not score high.

Table 3. Individualist versus collectivist cultures – CSF relative frequencies.

Rank	CSFs for Collectivist cultures	Relative frequency	CSFs for Individualistic cultures	Relative frequency
1	Top management support and commitment	72%	Top management support and commitment	81%
2	User training and education	57%	Project management	69%
3	Project team competence and composition	57%	Project team competence and composition	61%
4	Change management	54%	User training and education	56%
5	BPR and minimal customisation	46%	Communication	56%
6	Clear goals and objectives	45%	End user involvement	53%
7	Communication	45%	Clear goals and objectives	44%
8	Project management	43%	Vendor and or consultant support	44%
9	Careful package selection	40%	Organisational culture	39%
10	End user involvement	35%	Project champion	39%
11	Organisational culture	34%	Change management	36%
12	Legacy system and infrastructure	32%	Partnership with vendor	36%
13	Vendor and or consultant support	32%	Resources availability (financial, human and technological)	31%
14	Data accuracy, conversion	29%	BPR and minimal customisation	31%
15	Implementation strategy	25%	Legacy system and infrastructure	28%

Table 4. Low versus high uncertainty avoidance cultures – CSF relative frequencies.

Rank	CSFs for High Uncertainty Avoidance	Relative frequency	CSFs for Low Uncertainty Avoidance	Relative frequency
1	Top management support and commitment	71%	Top management support and commitment	81%
2	User training and education	60%	Project management	62%
3	Project team competence and composition	59%	Project team competence and composition	60%
4	Communication	53%	User training and education	50%
5	Clear goals and objectives	52%	Change management	45%
6	Change management	50%	Communication	43%
7	End user involvement	48%	Vendor and or consultant support	38%
8	Project management	47%	Resources availability (financial, human and technological)	38%
9	BPR and minimal customisation	43%	BPR and minimal customisation	38%
10	Organisational culture	36%	Clear goals and objectives	36%
11	Careful package selection	36%	Careful package selection	36%
12	Vendor and or consultant support	36%	Organisational culture	33%
13	Legacy system and infrastructure	31%	Legacy system and infrastructure	31%
14	Monitoring and feedback	28%	End user involvement	31%
15	Implementation strategy	28%	Data accuracy, conversion	29%

4.2.5. Index of power distance (Table 5)

The power distance index is defined as the extent to which the less powerful members of organisations and institutions (like the family) accept and expect that power is distributed unequally. A higher degree of this index indicates that hierarchy is clearly established and executed in society, without doubt or reason. A lower degree of the index signifies that people question authority and attempt to distribute power.

The effects of power distance are likely to explain the difference in relative rankings of the following CSFs: 'Interdepartmental cooperation', 'Vendor and or consultant support', 'Use of a steering committee', 'Project champion', and 'End user involvement'. In low power distance cultures, there exists a preference for consultation, whereby subordinates

Table 5. High versus low power distance cultures.

Rank	CSFs for High Power Distance	Relative frequency	CSFs for Low Power Distance	Relative frequency
1	Top management support and commitment	75%	Top management support and commitment	72%
2	Project team competence and composition	62%	Project management	59%
3	User training and education	55%	User training and education	52%
4	Communication	49%	Project team competence and composition	52%
5	Change management	49%	Communication	45%
6	Clear goals and objectives	48%	End user involvement	41%
7	Project management	48%	Project champion	41%
8	BPR and minimal customisation	42%	Change management	41%
9	End user involvement	40%	Clear goals and objectives	38%
10	Organisational culture	38%	Careful package selection	38%
11	Careful package selection	37%	Data accuracy, conversion	38%
12	Vendor and or consultant support	37%	Vendor and or consultant support	34%
13	Legacy system and infrastructure	30%	Organisational culture	31%
14	Implementation strategy	26%	Legacy system and infrastructure	31%
15	Data accuracy, conversion	26%	Resources availability (financial, human and technological)	31%

can more easily approach their superiors with their ideas and contradict them if they think it is necessary. Discussion is managed in more friendly terms and then can reach a satisfactory conclusion. Leaders from this type of cultures expect to be challenged and to receive contributions from subordinates. As a result of these cultural traits, low power distance countries tend to privilege CSFs that promote equality and opportunities for cooperation, in which opinions can be exchanged.

4.2.6. Economic status: developing vs developed countries (Table 6)

The United Nations yearly develop the World Economic Situation and Prospects (WESP) report, which collects statistical information about trends in various dimensions of the world economy. This report serves to group countries into categories of developed and developing countries. The composition of these groupings is intended to reflect basic economic country conditions (United Nations 2018).

In the developing economies, factors related with computer culture, IT maturity, and infrastructure take on greater importance as reflected by the higher importance of 'Software development, testing and troubleshooting'. This is also reflected in the prominence of the 'User training and education' CSF for developing economies. In developing countries, in fact, ERP technology faces additional challenges related with economic and basic infrastructure lagging. Additionally, 'Project management' stands also highly ranked for developed countries because firms with more experience in process management are more likely to succeed with ERP. Developed countries have more experience than developing nations in respect of ERP technology and that is how this factor shows a significant difference in rankings between developed and developing nations (Huang and Palvia 2001).

Interestingly, it appears that in the developed economies firms opt for having partnerships with vendors while this does not seem a critical aspect in developing economies. The use of steering committees is significantly present among the developed economies but not so for the developing ones. In general, these results indicate the wide experience that developed economies have with ERP implementation as they are early adopters of this type of systems.

Table 6. Developed versus developing economies.

CSFs List	Developing	Developed	Difference
Project management	54%	97%	44%
Interdepartmental cooperation	0%	40%	40%
Use of a steering committee	0%	24%	24%
Project champion	3%	26%	23%
ERP treated as a program rather than a project	0%	23%	23%
Change management	41%	19%	22%
User training and education	53%	75%	21%
Careful package selection	36%	56%	20%
Clear goals and objectives	38%	57%	20%
Partnership with vendor	15%	33%	18%
Vendor and or consultant support	59%	43%	16%
Public sector procedures and processes	0%	15%	15%
Resources availability (financial, human and technological)	10%	25%	15%
Software development, testing and troubleshooting	36%	25%	12%
End user involvement	40%	50%	10%

Table 7. Large versus small medium enterprises (SMEs).

CSFs list	Large firms	Small firms	Difference
Careful package selection	15%	79%	63%
Communication	81%	20%	60%
Software development, testing and troubleshooting	4%	56%	52%
BPR and minimal customisation	19%	67%	48%
Project team competence and composition	43%	90%	47%
Vendor and or consultant support	56%	100%	44%
Monitoring and feedback	7%	51%	44%
Project management	81%	42%	38%
End user involvement	21%	59%	38%
Implementation strategy	11%	40%	29%
Data accuracy, conversion	14%	40%	27%
ERP treated as a program rather than a project	0%	25%	25%
Organisational culture	28%	53%	25%
Cloud-based data achieving	0%	27%	25%
Cloud based segregation of duties	0%	26%	25%
Compliance	3%	26%	23%
Use of a steering committee	6%	27%	21%
Interdepartmental cooperation	7%	27%	21%
Partnership with vendor	13%	27%	15%
User training and education	72%	59%	14%
Clear goals and objectives	43%	57%	13%
Proper reporting structure	0%	13%	13%
Legacy system and infrastructure	35%	25%	10%
Resources availability (financial, human and technological)	15%	25%	10%

4.2.7. Firm size: large firms vs SMEs (Table 7)

The differences between CSFs in large firms and SMEs are remarkable. First, 'Legacy systems and infrastructure' has a lower ranking for smaller firms, since they usually do not have them.

'Vendor support' and 'implementation strategy' score lower for large firms, since they tend to be more independent from vendors and often perform in-house ERP development. The opposite can be seen for SMEs, which usually acquire ready-made ERP systems, as reflected by the importance of the CSF 'Careful package selection' (63%), and the relative lower importance of 'Software development' and 'Testing and troubleshooting'.

Notably, the rankings of Table 7 are consistent with other studies comparing CSFs on the basis of firm size, such as (Aarabi et al. 2012) (Ahmad and Pinedo Cuenca 2013).

The results of Kurnia, Linden, and Huang (2019) recent work on CSFs of different classes of enterprise systems in SMEs are also consistent with ours. They identify system affordability and software customisation as SME-specific factors. These are consistent with the high ranking in Table 7 for SMEs of Careful package selection, in which affordability is an important decision criterion, and Vendor or consultant support, which is fundamental to exploit all possible system customisation options of an ERP system effectively.

4.2.8. Sector: public vs private organisations (Table 8)

The results of this comparison can be seen in Table 8 reporting percentages for 870 profiles of private companies and 241 profiles of public firms. The differences inside this dimension have to do with context, the distinctive environment pertaining to each of them makes the difference as seen in other studies, such as (Holland and Light 1999) and (Holland and Light 1999).

Table 8. Private versus public firms.

CSFs list	Public firms	Private firms	Difference
Vendor and or consultant support	0%	99%	98%
Monitoring and feedback	0%	66%	66%
Careful package selection	6%	71%	64%
User training and education	8%	69%	61%
Data accuracy, conversion	0%	57%	57%
Software development, testing and troubleshooting	0%	56%	56%
Project management	97%	42%	55%
Implementation strategy	1%	56%	55%
Change management	3%	43%	39%
Communication	62%	23%	39%
Project team competence and composition	68%	99%	31%
Interdepartmental cooperation	0%	27%	26%
Partnership with vendor	1%	27%	26%
Use of a steering committee	0%	26%	25%
ERP treated as a program rather than a project	0%	24%	24%
Resources availability (financial, human and technological)	0%	24%	24%
Compliance	0%	24%	24%
Cloud-based data achieving	0%	24%	24%
Cloud based segregation of duties	0%	24%	24%
Legacy system and infrastructure	7%	24%	17%
Organisational culture	37%	51%	14%
Proper reporting structure	0%	12%	12%
Rewards, Recognition & Retention	7%	18%	11%

Very interestingly, vendor and or consultant support was found in 99% of the private companies compared to 0% in the public sector.

As far as the most important CSFs are concerned, we have identified 'Project management and Communication' for the public sector and 'Careful package selection', 'Monitoring and feedback', 'Partnership with vendor', 'Project team competence and composition', 'Software development', 'Testing and troubleshooting' for private firms.

These findings are confirmed by the literature (Hurbean 2008). The differences among these CSFs can be explained by the bureaucratic structure that persists in the public sector, which, while providing stability, consistency, and conformity with rules, can also represent a challenge when changes need to be implemented (Bannister 2001) (Daft and Armstrong 2012). Furthermore, the identified CSFs are consistent with typical weaknesses of public organisations. such as 'In-depth knowledge due to specialization' within the functional departments, slow response to internal or external environment changes, and slow decision-making due to hierarchy overload (Daft and Armstrong 2012).

These are very important and perhaps are responding to the most important barrier found in public organisations bureaucratic culture (Ebrahim and Irani 2005). Public organisations have more complicated and intricated processes, which can be hampered by weak inter-departmental communication and by the many legal and political requirements they have to deal with (Alves and Matos 2011).

4.2.9. Type: manufacturing vs services (Table 9)

The results of this comparison can be seen in Table 9 reporting percentages for 61 profiles of companies in manufacturing and 175 in services. The CSFs most frequent for service companies, such as 'Data Accuracy', 'BPR' and 'Change Management' can be explained by the fact that most of the available ERP software has primarily been developed for

Table 9. Manufacturing versus service-oriented firms.

CSFs List	Services	Manufacturing	Difference
Software development, testing and troubleshooting	89%	15%	74%
Monitoring and feedback	87%	21%	66%
Implementation strategy	90%	26%	64%
BPR and minimal customisation	90%	33%	57%
Project management	3%	61%	57%
Rewards, Recognition & Retention	88%	31%	57%
Vendor and or consultant support	87%	31%	56%
Change management	93%	39%	54%
End user involvement	91%	38%	54%
Organisational culture	3%	56%	52%
Data accuracy, conversion	89%	39%	49%
Careful package selection	4%	52%	48%
Communication	91%	44%	47%
Legacy system and infrastructure	5%	51%	46%
Top management support and commitment	94%	52%	42%
Organisation's structure	1%	34%	34%
external environment	1%	31%	31%
Project team competence and composition	92%	64%	28%
Clear goals and objectives	91%	64%	27%
Partnership with vendor	2%	30%	27%
Resources availability (financial, human and technological)	3%	30%	26%
User training and education	93%	67%	25%
Project champion	1%	26%	25%
Interdepartmental cooperation	1%	20%	19%
Use of a steering committee	1%	16%	15%

manufacturing firms. Therefore, manufacturing companies should focus more on implementing and customising correctly a package, rather than selecting the right one.

Conversely, the frequent CSFs for manufacturing firms, such as 'Careful package selection', 'Legacy systems' or 'Partnership with vendor' point towards the need for service firms to understand which ERP package and vendor is better suited for their needs, which is probably due to a higher variability in the offering of ERP services for manufacturing firms.

4.3. Evaluation

The evaluation of the proposed model relies on two different methods. First, case studies found in the literature have been revisited with the aim of verifying if the proposed model could predict which CSFs are highlighted in each case. The second evaluation method is a survey of expert opinion, to assess whether the model is understandable, accurate, and useful in practice.

4.3.1. Revisiting existing case studies

An evaluation of the model comparing against similar literature shall provide proof of whether the model is applicable to real case studies.

For example, a study by Cyrus and Nejad (2011) has identified the most influential Critical Success Factors (CSFs) from each dimension of Hofstede cultural dimensions based upon Iran's scores. According to their findings Iran's highest ranked dimension is Uncertainty Avoidance, which has a high influence on the CSFs 'Clear and defined goals and objectives', 'Organizational support' and 'Minimal customization'. This is consistent

with the findings of the model proposed in this paper, according to which members from cultures with high uncertainty avoidance strive to be more involved and supported during an implementation process to cope with the uncertainty typical of ERP projects.

Shanks et al. (2000) compare two case studies of ERP systems implementation, one in Australia and one in China, with the aim of explaining the differences between the Australian and Chinese cases based upon their culture. In their study, only the case in Australia is reported to have a project champion and change management as CSFs. These could be predicted by the proposed model, since 'change management' and 'project champion' are more important in countries where there is high uncertainty avoidance, high individualism, and low power distance, such as the case of Australia. From a cultural standpoint, China is the opposite of Australia, scoring low in individualism and uncertainty avoidance and high in power distance.

As far the type contextual dimension is concerned, Shanks et al. (2000) consider a Chinese company that manufactures elevators (ElevatorCo) and an Australian company (Oilco), that refines and sells oil. Most of the identified CSFs for both companies are clearly predicted by our model. According to our model, in fact, a manufacturing firm in China (a developing economy) should pay special attention to CSFs such as 'Top management support', 'External expertise', 'Project management', 'Data accuracy', and 'Education and training', which are all mentioned as relevant for ElevatorCo. Similarly, a firm in Australia (a developed nation) should focus more on 'Change management' and the presence of a project champion, both of which are reported as relevant for OilCo.

4.3.2. Experts survey

The proposed model has been evaluated by a panel of three experts in ERP systems implementation with long-standing working experience on different implementation projects mainly in Costa Rica and other countries in Latin America (see Table 10).

The results of the interviews can be summarised as follows. Expert 1 suggested to add one dimension related with the experience of an organisation in project management. This because organisations with generally good project management capabilities may need to focus more on non-project-management-related success factors, such as vendor quality or legacy systems. Expert 1 also commented that the results of an ERP implementation are often highly correlated with the initial phases of the project, e.g. vendor selection and blueprint, and that more resources should be spent on those phases to achieve success.

Expert 2 commented that the proposed model has some value particularly in respect of preparing consultants with less experience to pay attention to contextual factors, besides other typical technical concerns of ERP implementations. Based on their vast experience across different countries and in both public and private firms, Expert 3 commented that the proposed model should also consider political factors as a contextual variable, since these often shape key decisions in ERP projects, particularly in large public firms.

Table 10. Experts panel description.

Expert 1	SAP Consultant and Project analyst for 7 years
Expert 2	ERP Implementation Consultant with more than 10 years of experience
Expert 3	Finance BPO Manager with 18 years of experience with systems analysis and implementations

Finally, all experts agreed on the relevance of the model. In particular, they considered all the proposed dimensions relevant and they suggested that they may use at least part of the proposed model in the future to achieve a better understanding of the implementing firm.

5. Discussion and conclusions

Regarding research, the proposed model represents a first attempt to critically review the extant vast literature on CSFs of ERP implementations to advance theory in regards of what factors are critically important in different business situations for a successful ERP implementation. While this paper has proposed a first qualitative analysis of the literature, several aspects should be investigated by future academic studies, such as the ranking, modelling or risk assessment of CSFs in ERP implementation, by explicitly considering contextual dimensions into account.

The research model presented in this paper answers a call for research on CSFs to shift its focus from researching causality between CSFs and organisational performance to focusing more on contextual factors. Remus and Wiener (2010), in their call for multi-method research in CSF research, stress that CSF depend on a number of contextual factors, which can be identified and analysed only with the help of qualitative research methods. Similarly, Monod and Boland (2007) also stress that CSF research in information systems should better account for contextual factors. Contextual factors may be identified internally or externally to an organisation. The model proposed in this paper focuses on external factors.

Allen, Kern, and Havenhand (2002) have proposed a model similar to the one proposed in this paper for ERP implementations in the public sector. They also consider organisational culture as one of the contextual factors, but without breaking down culture into its sub-dimensions. They also consider political structure of the country where an organisation operates as an important contextual factor, as suggested by Expert 3 of our evaluation panel. This dimension is not considered by the model proposed in this paper and could be considered in the future, possibly breaking it down into sub-dimensions, such as stability of the political system or degree of state interference with private business.

Finally, a thorough review of ERP implementation CSFs by Shaul and Tauber (2013) has also considered dimensions such as type of country (developing v. developed) and type of firm (SME v. large firms). However, these dimensions are only used as classification criteria. The survey takes a historical perspective on CSF development, without analysing how different contextual factors influence the relative importance of CSFs in different ERP implementation projects.

Most of the insights in the proposed model are a reflection of previous studies focusing on specific dimensions or they can be explained logically by the characteristics and circumstances surrounding certain types of firms, such as in the case of bureaucracy around public companies slowing change and decision-making. In this regard, a notable exception is a previous study on the differences between developed and developing economies, which indicated that project management is of similar importance for companies from both developing and developed countries (Mooheba et al. 2010). This conclusion is contrast with the results underpinning the proposed model, in which only 54% of profiles in developed countries reported project management as a CSF in respect

of 97% in developed countries. This prompts for the need of more quantitative research to understand the specific role that project management can have in the success of ERP projects in developing and developed countries.

As far as managerial implications are concerned, the proposed model helps practitioners by identifying contextual dimensions that can influence the relative importance of CSFs in ERP implementations. Based on the identified contextual dimensions, managers are able to better prioritise different aspects of an ERP implementation project and, therefore, have a higher chance of implementing ERP systems effectively. ERP vendors and implementation consultants can also learn from this study to better target their products and direct their implementation efforts by being better able to assess the specific needs of customers, as identified by their context.

From a theoretical point of view, a main limitation of the proposed model is to consider each contextual dimension independently. On the one hand, this choice overlooks the interaction among these dimensions. More practical insights, for instance, could be generated by considering that some combinations of contextual values are characterised by specific combinations of specific CSFs. On the other hand, this makes the proposed model at times inapplicable in practical contexts, particularly when the analysis of context suggests the implementation of somehow conflicting CSFs. As already identified in Section 4, this is mostly the case of the cultural context dimensions, for which different individual contextual values may suggest different and possibly conflicting CSFs as more important. Finally, the evaluation of the proposed model can be extended. This can be achieved by collecting feedback and first-hand data about the usage of the model in real-world settings by practitioners. Also, additional case studies can be used for evaluating ex-post the applicability of the model proposed by this paper in the future.

For future studies, we stress the importance of considering quantitative surveys across the identified contextual dimensions. It would also be important, in our opinion, to combine these quantitative results with new case studies about the implementation of ERP systems that could be analysed ex-ante using the proposed model. In this regard, we suggest an action research approach, in which the researchers could influence the implementation of specific CSFs that are considered value-achieving based on the contextual dimensions characterising the implementing firm. This same type of study can be applied to other information systems for which the body of knowledge about CSFs is currently growing, such as customer relationship management or business intelligence systems. Finally, while this work considers mainly contextual factors external to the firm, future work should also consider how the notion context can be shaped within the boundaries of the firm. For instance, ERP implementation CSFs may differ for firms with a stable management or with a more open culture of change.

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