Examining the critical success factors in the adoption of enterprise resource planning

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Abstract

This paper presents a literature review of the critical success factors (CSFs) in the implementation of enterprise resource planning (ERP) across 10 different countries/regions. The review covers journals, conference proceedings, doctoral dissertation, and textbooks from these 10 different countries/regions. Through a review of the literature, 18 CSFs were identified, with more than 80 sub-factors, for the successful implementation of ERP. The findings of our study reveal that 'appropriate business and IT legacy systems', 'business plan/vision/goals/justification', 'business process reengineering', 'change management culture and programme', 'communication', 'ERP teamwork and composition', 'monitoring and evaluation of performance', 'project champion', 'project management', 'software/system development, testing and troubleshooting', 'top management support', 'data management', 'ERP strategy and implementation methodology', 'ERP vendor', 'organizational characteristics', 'fit between ERP and business/process', 'national culture' and 'country-related functional requirement' were the commonly extracted factors across these 10 countries/regions. In these 18 CSFs, 'top management support' and 'training and education' were the most frequently cited as the critical factors to the successful implementation of ERP systems.

1. Introduction

The enterprise resource planning (ERP) system is a generic term for a broad set of activities supported by multi-module application software that helps organizations to manage their resources [77]. The ERP system has been shown to be able to provide significant improvements in efficiency, productivity and service quality, and to lead to a reduction in service costs as well as to more effective decision-making.

ERP began in the 1960s as material requirements planning (MRP) and, later, developed into a more advanced system called MRP II. Nowadays, the latest generation of ERP systems is more advanced and more effective in dealing with multiple business units including sales and operations planning, inventory/materials management, manufacturing, purchasing, order processing, accounting and finance, human resources, customer relationship management, and more. Given a wide range of benefits in terms of functionality, many businesses believe the ERP system can deliver strategic competitive advantages. Therefore, it is not surprising that many organizations have already adopted ERP systems [81].

However, the implementation of ERP is a complex exercise, and many adopters have encountered problems in different phases [45,87]. In fact, many cases of the failure to implement ERP because of either cancellations or cost/time overruns have been reported [35,62]. The high failure rate in the implementation of ERP calls for a better understanding of the process [67]. In order to reduce the failure rate of ERP implementation, a number of studies have attempted to identify the critical success factors (CSFs) in the implementation of ERP.

Bullen and Rockart [14] have defined CSF as 'the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organization. CSFs are the few key areas where "things must go right" for the business to flourish and for the manager's goals to be attained'. CSFs for ERP implementation bring a concept that helps an organization identify the critical issues that affect the process of implementation. Through a

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better understanding of the CSFs for the implementation of ERP, an organization can determine the corresponding solution to eliminate or avoid the most common causes of failure in implementation.

Although a number of empirical and non-empirical studies have addressed a variety of CSFs for ERP implementation, different studies have produced different sets of factors. For instance, Holland and Light [28] proposed a CSF model with strategic and tactical factors based on an analysis of eight companies. Al-Mashari et al. [5] developed a taxonomy of CSFs for ERP implementation through a comprehensive literature review combining research studies and organizational experiences. The taxonomy is comprised of various success factors from five perspectives: (1) setting-up, (2) implementation, (3) evaluation, (4) ERP success, and (5) ERP benefits. Somers and Nelson [69] identified a list of 22 CSFs associated with ERP implementation and analyzed the importance of these factors in different phases of implementation. Nah et al. [50] attempted to group related sub-factors to form 11 CSFs through a review of 10 articles in the area of information systems (IS) that were selected from a search through databases of published works and conference proceedings. Later, they added two more articles to their review, and these 11 CSFs were evaluated by the Chief Information Officers from Fortune 1000 companies [51]. They showed that top management support, project champion, ERP teamwork and composition, project management, change management programme and culture were the most critical to the successful implementation of EPR. Hence, there is no general agreement on which set of factors are the key to success in ERP implementation [88].

One possible reason why different factors were generated is that these studies were based on different samples and research settings, which may have placed more emphasis on some CSFs but less on others. This may explain why different studies have reported different subsets of CSFs rather than a comprehensive set of similar factors. In addition, the researchers conducted their research in different countries or territories. Cultures, government regulations, and economic environments differ among countries, a fact that raises some issues and challenges for ERP implementation [30,42,64]. Huang and Palvia [30] compared ERP implementation issues in advanced and developing countries. They showed some of the problems, issues, and characteristics currently faced in the implementation of ERP in developing countries. Livermore and Ragowsky [42] distinguished between ERP implementation patterns in two countries based on their cultures and styles of decision-making. Sheu et al. [64] pointed out that the differences in language, culture, politics, government, regulations, management style, and labour skills have an impact on ERP implementation practices in different countries.

Numerous CSFs for the implementation of ERP were found scattered across various studies. Meanwhile, some researchers have emphasized that the issues involved in the implementation of ERP differ in different countries. Regarding this point of view, two relevant questions may arise. Are the CSFs for the implementation of ERP the same across countries? Do the ERP adoption cases reported in the various countries differ in

performance with respect to certain CSFs? So far, little work has been done to reveal and systematically categorize the CSFs for ERP implementation, and to classify these according to different countries. The aims of this study are: (1) to identify the CSFs through a comprehensive and systematic literature review; (2) to group the related sub-factors into a common set of CSFs based on Nah et al. [51]; and (3) to report and analyze the identified CSFs and the performance of ERP cases in the CSFs across countries/regions.

This paper is organized as follows. Section 2 describes the research method. Section 3 reports the identified CSFs for ERP implementation based on the findings from the selected articles. The differences in the focuses and performance in the CSFs of the reviewed ERP implementation cases in various regions and countries are discussed in Section 4, in which a model of the country-related CSFs, vendor-related CSFs and organizational-related CSFs affecting ERP implementation is also presented with propositions for further research. The final section concludes the paper.

2. Methodology

A comprehensive search through the relevant literature was conducted in 2006 and 2007. In this study, articles from journals, conference proceedings, doctoral dissertations, and textbooks were identified, analyzed, and classified. Since ERP is a relatively new topic and we only focus on the CSFs for the implementation of ERP, it was necessary to search through a wide range of studies from different sources. The scope of the search was not limited to specific journals, conference proceedings, doctoral dissertations, and textbooks. Management, IT, and IS are some common academic disciplines in ERP research. Consequently, the following online journals, conference databases, and dissertation databases were searched to provide a comprehensive bibliography of the literature on ERP: ABI/INFORM database, Academic Search Premier, ACM Digital Library, Association for Information Systems eLibrary, Business Source Premier, Emerald Fulltext, IEEE Xplore, Hong Kong PolyU Library Catalogues, ProQuest Digital Dissertations, and Science Direct. The literature search was based on the descriptors, 'enterprise resource planning' and 'success factors'; while the time frame was based on the availability of the resources in these online databases.

An initial search through the literature yielded more than 299 articles. The full text of each article was reviewed to eliminate those articles that were not actually related to CSFs for the implementation of ERP. Many of the articles were excluded because they did not meet the following selection criteria:

- Only empirical studies published in English that followed either a quantitative or qualitative approach, with an explicit description of where the research was conducted and how the CSFs listed for ERP implementation were selected.
- In order to avoid duplication, in the case where conference proceedings with the same sources and results were published in more than two different volumes, only the one with the

more detailed contents was included. For example, the article of Sumner [73] was selected instead of Sumner [74].

- Similarly, if a journal article was based on an earlier version published as conference proceedings, the earlier version was excluded, as journals represent the highest level of research. For instance, the article of Reimers [57] was excluded because the revised and enhanced version of Reimers [58] was subsequently published in an international journal.

Additional articles were identified through a manual search of the references in the articles that were initially selected. Finally, 48 articles on studies conducted in various regions/countries were identified. Each article was carefully reviewed, and the CSFs for ERP implementation were identified and classified based on the 11 CSFs identified by Nah et al. [51]. Those factors or sub-factors not related to these 11 CSFs were classified and labelled as other CSFs. Seven new CSFs were identified and included in this study. A total of 18 CSFs were distinguished, while 12 CSFs contained sub-factors that were interrelated with the main factor.

3. Results

Based on the selection criteria, 48 articles were investigated in this study. Table 1 shows the distribution of the articles under the categories of journals, conference proceedings, doctoral dissertations, and textbooks. The table indicates that 37 journals, 7 conference proceedings, 1 doctoral dissertation, and 3 textbooks contained articles on the CSFs for the implementation of ERP. The relevant articles were scattered across various journals and conference proceedings, most of them on IS, IT, operations, and information management. Table 2 presents the distribution of articles by regions and countries. The samples from the 48 articles were located in 12 groups of regions and countries including America (countries not specified), the USA, Europe, the UK, Denmark, Australia, Australia and the USA, Australia and China, China, the Middle East, and the Arab Gulf States and the USA.

Most of the selected articles were conducted in only one region/country while three articles involved a comparison of the CSFs for ERP implementation across two countries. Al-Sehali [6] identified and tested the same CSFs in the Arab Gulf States and the USA and showed that there were no significant differences between these two countries. Parr et al. [54] conducted in-depth interviews with companies that had implemented ERP and with ERP consultancy firms from Australia and the USA. Professionals from these two countries confirmed and proffered 10 CSFs for the implementation of ERP. Not all combined country studies showed consistent results. Shanks et al. [63] examined the differences in the CSFs for ERP implementation between Australia and China using national cultural characteristics. They found that some factors were common for both countries, while some were not.

Table 3 summarizes the results of the review that listed 18 CSFs for ERP implementation. Eleven out of the 18 CSFs were included based on the work of Nah et al. [51]. These factors were 'appropriate business and IT legacy systems', 'business

Table 1

Distribution of articles by journals, conference proceedings, doctoral dissertations, and textbooks

Type	Publication title	No. of articles
Journal		*37*
	Business Process Management Journal	1
	Communications of the ACM	3
	Communications of the Association for Information Systems	1
	Computers in Industry	2
	European Journal of Information Systems	1
	European Journal of Operational Research	4
	IEEE Software	1
	Industrial Management & Data Systems	1
	Information & Management	5
	Information Systems	1
	Information Technology & People	1
	International Journal of Accounting Information Systems	1
	International Journal of Human-Computer Interaction	1
	International Journal of Information Management	1
	International Journal of Operations & Production Management	1
	International Journal of Production Economics	1
	International Journal of Production Research	3
	Journal of Computer Information Systems	1
	Journal of Information Technology	1
	Journal of Management in Medicine	1
	Journal of Strategic Information Systems	1
	Knowledge and Process Management	1
	Production and Inventory Management	1
	Production Planning & Control	1
	Technovation	1
Conference proceedings		*7*
	ACM SIGCPR Conference on Computer Personnel Research	1
	Americas Conference on Information Systems	2
	European Conference on Information Systems	1
	Hawaii International Conference on System Sciences	2
	IEEE International Conference on Management of Innovation	1
Doctoral dissertations		*1*
Textbooks		*3*
Total		48

Table 2
Distribution of articles by regions/countries

Regions/countries	No. of articles
America (countries not specified)	2
USA	17
Europe (countries not specified)	7
UK	3
Demark	1
Australia	4
Australia and USA	1
Australia and China	1
China	5
Other Chinese and East Asia locations	4
Middle East (countries not specified)	2
Arab Gulf States and USA	1

plan/vision/goals/justification', 'business process reengineering', 'change management culture and programme', 'communication', 'ERP teamwork and composition', 'monitoring and evaluation of performance', 'project champion', 'project management', 'software/system development, testing and troubleshooting', and 'top management support'. After the review of the articles, various related sub-factors were identified and grouped into seven new CSFs for ERP implementation. They were labelled 'data management', 'ERP strategy and implementation methodology', 'ERP vendor', 'organizational characteristics', 'fit between ERP and business/process', 'national culture', and 'country-related functional requirements'.

In these 18 CSFs, 'top management support' and 'training and education' were the most frequently cited single factor/sub-factors for EPR implementation in all regions and countries. This reflected that top management support, and training and education are widely recognized and necessary for ERP implementation and may be independent across regions and countries. 'Clear and defined project plan' was another factor that was commonly cited in all of the regions and countries. Each of the CSFs is discussed in the following section.

3.1. Appropriate business and IT legacy systems

According to Holland and Light [28], 'legacy systems encapsulated the existing business processes, organization structure, culture, and information technology'. It is necessary to evaluate the current legacy system, as greater and more complex legacy systems require more technological and organizational changes during the transitional period of ERP implementation [28,51]. Nah et al. [51] pointed out that to be successful, ERP implementation efforts must overcome issues of complexity arising from business and IT legacy systems. In this study, this factor did not contain any sub-factors and was the least-cited of the CSFs.

3.2. Business plan/vision/goals/justification

Nah et al. [51] stated that the implementation of ERP usually exceeds the time frame for a typical project. The vision/goals/justification should be clearly stated in the business plan [28,51,88], including a justification for the investment, and a clear statement of the project mission and goals that should be related to business needs. The business plan should outline the anticipated strategic and tangible benefits, resources required, and risks and costs involved in the adoption of ERP. Business goals should be tracked. It is recommended that the goals of the project be set before the support of top management is sought.

3.3. Business process reengineering

A certain level of BPR should be involved for the implementation of ERP, as the packaged software may be incompatible with the needs and business processes of the organization [10,51,69]. In order to improve the functionality of the software in accordance with the needs of the organization, an organization should reengineer business processes to fit the software instead of trying to modify the software to fit the organization's current business processes [73]. Conversely, the cost and the possibility of error will be increased if more customization for the software was undertaken [18,85]. The complexity and magnitude of the efforts required may deter organizations from the approach of ERP customization. This was hinted at in the findings of the study by Mabert et al. [43], in which most respondents reported only minor customization. Empirically, ERP implementation projects have been found to result in changes in process [22]. An adequate degree of mutual fit between the organization and the ERP package is critical to the success of the implementation [29].

3.4. Change management culture and programme

The effective implementation of an ERP system requires change management strategies and an understanding of organizational culture. Change management involves the effective balancing of forces in favour of a change over forces of resistance [70]. Training and education is an important process in change management. Many previous studies conducted in various regions/countries have indicated that training and education should be provided to employees or users (See Table 3). This allows the users to understand the overall concepts of the ERP system and ensures their acceptance and readiness to use the new system. It needs to be pointed out that user training will be effective only if it also includes business practices and processes as part of its content [39,59].

3.5. Communication

Clear and effective communication at all levels of an organization is necessary before and during the implementation of ERP [8,51]. Communication includes the formal promotion of ERP project teams and advertisements on the project's progress to the rest of the organization [28]. Amoako-Gyampah and Salam [7] found that effective communication is one of the success factors that influence the acceptance of technology in an ERP implementation environment. In order to avoid failures in communication, an open and honest information policy communicated to the users can satisfy their need for

Table 3
CSFs for ERP implementation compared across various countries

ID	CSFs	America	USA	Europe	UK	Demark	Australia	China	Other Chinese and East Asian locations	Middle East	Arab Gulf States
BIS0	Appropriate business and IT legacy systems		[51]	[28]						[1]	
BPJ0	Business plan/vision/goals/justification		[48,51]	[28]	[83]	[33]		[58]	[38]		
BPJ1	Justify the project based upon factors of cost and economic scale		[73]		[83]						
BPJ2	Business process/rules are well understood		[49]		[83]		[24]				
BPR0	Business process reengineering	[36]	[20,22,48,51,61,68,69,73,78]	[12,28,32,65,84]	[3,83]	[33]		[87,88,90]	[19,29,38,66]	[1]	
BPR1	Minimal customization	[36]	[44,49,54,69]				[53,54]		[29]		
CMC0	Change management culture and programme		[51]								
CMC1	Change management		[6,48,69,80]	[12,65]	[83]		[63,86]			[4]	[6]
CMC2	User involvement		[6,16]		[83]	[33]		[88,89,90]	[38]	[1]	[6]
CMC3	Organizational culture and political structures				[3]	[33]	[24]	[90]			
CMC4	Commitment to change		[8,54]				[53,54]				
CMC5	Understanding corporate culture		[8]						[19]		
CMC6	Re-train IT workforce in new skills		[73]								
CMC7	Training and education	[13]	[6,7,8,44,48,49,68,69,73,78,80]	[12,28,32]	[3,83]	[33]	[24,86]	[40,58,87,88,89,90]		[1,4]	[6]
CMC8	Developed clear education and training strategy		[44]								
CMC9	Education on new business process		[69]						[19]		
COM0	Communication		[7,8,51,68]	[12,28]	[83]	[33]			[38]	[4]	
COM1	Inter-departmental communication		[68,69]	[2]				[40,58]			
COM2	Communicated regularly with all who would be affected		[44,68]						[38]		
COM3	Open and honest communication		[48,60]	[84]							
DAM0	Data management		[75]								
DAM1	Data analysis and conversion		[69]	[84]						[1]	
DAM2	Data accuracy		[80]	[32]				[40,63,88,90]			
DAM3	Data quality control						[86]				
SIM0	ERP strategy and implementation methodology			[28]							

SIM1	Regard as a technological, business, and organizational project					[33]					
SIM2	Alignment between business strategy and IT strategy		[68]				[24]				[4]
SIM3	Begin process changes first		[8]								
SIM4	Strategic alignment of exercise		[6]								[6]
SIM5	ERP is treated as a programme not a project		[49]								
SIM6	Phased vs. Big Bang				[83]			[58]			
SIM7	Use accelerated implementation strategy		[44]								
SIM8	Deep understanding of the key issues relating to ERP implementations						[46]				
SIM9	Select a good methodology		[8]						[38]		
SIM10	Careful selection of appropriate package		[9,22,69,82]	[2,12,81]	[31]				[38]	[1]	
SIM11	Suitability of software and hardware	[36]						[88]	[38]		
SIM12	Decision-making process/style							[58]			
TWC0	ERP teamwork and composition (Personnel)		[51,80]	[28]	[83]				[38]	[1]	
TWC1	Steering committee		[44,68,69]					[58]	[38]		
TWC2	Project team competence		[69,80]	[2,84]	[31]			[58,87]	[38]		
TWC3	Empowered decision makers		[54]			[33]	[53,54]				
TWC4	Selecting the right employees		[78]								
TWC5	Employee morale (incentives)		[78]					[58]			[6]
TWC6	Business and technical knowledge of team members and consultants		[6,8,69,73, 78]	[84]	[3]	[33]		[63]	[38]		
TWC7	Balanced or cross-functional implementation team		[8,54,60]			[33]	[46,53,54,63]				
TWC8	Managing consultants			[65]				[58]			
TWC9	Staff retention			[65]							
TWC10	Full-time team members		[54]	[84]			[53,54]				
TWC11	Employee/personnel relations			[84]	[3]		[86]				
TWC12	Sparing use of consultants		[16]								
VEN0	ERP vendor	[36]	[68,78]					[90]			
VEN1	Vendor-customer partnerships		[69]							[1]	
VEN2	Use of vendors' customization tools		[69]								
VEN3	Vendor support	[36]	[68,69,78]	[2]	[31]			[88,89]			
VEN4	Kept suppliers/customers informed		[44]								
MEP0	Monitoring and evaluation of performance		[20,51,68]								
MEP1	Benchmarked implementation progress against clear milestones or performance metrics		[44]	[84]							
MEP2	Focused performance measures		[48,80]			[33]					[4]
MEP3	Client acceptance			[28]	[3]			[58]			
MEP4	Monitoring and feedback			[28]	[3]			[58]			
OCH0	Organizational characteristics		[12]								
OCH1	Had technology/infrastructure in place		[20]	[12,44]	[3]		[24]			[1]	

Table 3 (*Continued*)

ID	CSFs	America	USA	Europe	UK	Demark	Australia	China	Other Chinese and East Asian locations	Middle East	Arab Gulf States
OCH2	Organizational experience of IT or organizational change projects of a similar scale				[3]		[46]				
OCH3	Company-wide commitment							[88]	[38]		
OCH4	Implementation of ERP was not due to competitive pressure	[13]									
PCH0	Project champion		[8,51,54, 48,68,69]	[2]			[53,54,63]	[58]			
PMA0	Project management		[48,51,68, 69,80]	[2,84]	[31,83]			[58,63,88, 90]		[1]	[6]
PMA1	Clear and defined project plan (goals, objectives, strategy, scope, schedule)		[6,16,44, 54, 68,69,80]	[2,28,84]	[3]	[33]	[24,53,54]	[58,63]		[1]	
PMA2	Smaller scope		[54]				[53,54]				
PMA3	Avoid scope creep									[4]	
PMA4	Implementation costs		[78]								
PMA5	Realistic deadlines for implementation are set		[49,68]								
PMA6	Realistic expectations with regard to ROI and reduced IT/IS costs exist		[49]								
PMA7	Management of expectations		[69]	[2]							
PMA8	Total-quality management		[61]								
PMA9	Interdepartmental cooperation		[69]	[2]							
PMA10	Dedicated resources		[69]								
PMA11	''To-be concept'' as project guideline			[84]							
PMA12	Knowledge management		[75]		[3]					[4]	
PMA13	Managing conflicts in ERP projects			[65]	[83]						
PMA14	Clear and simple project organization			[84]							
SDT0	Software development, testing, and troubleshooting		[51]								
SDT1	Defining the choices of architecture		[69]								
SDT2	Integration		[78]	[12]				[58,89]			
SDT3	Software configuration			[28,32]	[3]						
SDT4	Troubleshooting			[28]	[3]						
SDT5	Functional requirements are clearly defined before selecting an ERP product		[49]								
SDT6	Perceived complexity	[13]									[6]
TMS0	Top management support	[13]	[16,20,44,48, 49,51,54,60, 69,73,78,80]	[2,28,84]	[3,83]	[33]	[53,54,63, 86]	[40,58,63, 88,90]	[38]	[4]	
EPF0	Fit between ERP and business/process	[36]	[22,68]	[32,81]				[29]	[29,38,66]	[1]	
NCU0	National culture			[32,81]				[87,88,90]		[19]	
CFR0	Country-related functional requirements			[32]				[29,40,87]	[19,66]		

information [60,84]. Issues of communication in the implementation of ERP seem to be widely recommended in the USA and Europe.

3.6. Data management

Data management is one of the new factors not included in Nah et al. [51]. Since ERP contains various modules that are intricately linked with each other, data should be managed properly to ensure their accuracy. Zhang et al. [88] showed that the accuracy of the data has a positive impact on the success of the implementation of ERP. Data should be validated and converted into a single and consistent format before the system is used [69,84]. Data management has two important implications for organizations that choose to adopt ERP. First, before selecting an ERP package, an organization must ascertain that data model supported by the package is compatible with its data requirements [66]. Second, the mapping and conversion of data should be established as an integral task of any ERP project plan [1,37].

3.7. ERP strategy and implementation methodology

Most of implementation models underestimate the importance of the choice of ERP strategy [28]. Various ERP strategies for implementation were found in the studies. Holland and Light [28] discussed and briefly described the skeleton approach and single-module approach to implementing an ERP system. Managers should decide whether the organization is willing to change its business flow to fit the software, or whether it prefers to change the software to fit the business flow. Kraemmerand et al. [33] pointed out ERP implementation was regarded as a technological, business, and organizational project. Both business strategy and technology strategy should be balanced [4]. Selecting and developing an appropriate ERP strategy is regarded as one of the important factors for successful implementation. Once an ERP strategy has been considered, issues of project management can be considered.

3.8. ERP teamwork and composition

ERP projects typically require a balanced combination of implementation teams. Both technical and business competence must be available in a team [3,6,10,31,69]. In addition, the decision maker in the project team should be empowered to make quick and effective decisions [53,54]. In the articles examined in this study, the sub-factors under 'ERP teamwork and composition' were the most frequently cited. This indicates that teamwork and the composition of the project teams such as the availability of skilled project members and how to manage them, including external consultants, are essential for ERP success.

3.9. ERP vendor

There are many ERP vendors on the market. The selection of a suitable ERP vendor is very important, as a good vendor can provide support ranging from technical assistance to training

[10,69,90]. In addition, an organization can reduce the cost of implementation, gain other benefits from partnerships with the vendor, and use the vendor's customization tools [69]. In practice, the criteria for evaluating vendors often include the vendor's reputation, financial strength, technical capabilities, and corporate vision and direction [82]. The ERP vendor is one of the critical issues in the successful implementation of ERP in US companies, as seen by the fact that this factor was always discussed in research conducted in that country.

3.10. Monitoring and evaluation of performance

The monitoring and evaluation of performance is a critical factor in the success of any IT system, including ERP systems [4]. Implementation progress must be measured regularly for more efficient and effective control [44,84]. Through monitoring and feedback from the users, the performance of the ERP system can be reviewed and evaluated to see whether it is achieving business goals and objectives.

3.11. Organizational characteristics

There is no doubt that the characteristics of an organization have a significant influence on the success of the implementation. Organizations with experience in projects involving IT or organizational change of a similar scale will find it much easier to handle the implementation of ERP [3,46]. Bradford and Florin [13] have indicated that the competitive pressure to adopt an ERP system can have a negative effect on the successful implementation of ERP in an organization.

3.12. Project champion

The presence of a project champion has facilitated many successful projects [54]. Project champions are not only important for the implementation of many systems such as IS, but also play a critical role in the implementation of ERP and in handling organizational change. The project champion should be a high-level executive sponsor who has the power to 'champion' the ERP project throughout the organization [73]. ERP implementation usually requires employees to work long hours and overtime. The long hours and stress may lead to a decrease in morale among employees, requiring the project champion to cheer up the members of the project team during the implementation of the ERP system [51].

3.13. Project management

Factors related to project management was another CSF often cited by researchers. Interestingly, all of the studies conducted in China considered effective project management to be a significant issue for successful implementation of ERP [58,63,88]. Since the implementation of ERP is complex, covering as it does a combination of hardware, software, and organizational issues, effective project management allows companies to plan, coordinate, and monitor various activities in different stages of implementation [2,69]. A clear and defined

project plan including goals, objectives, strategy, scope, schedule, and so forth was a frequently cited CSF for ERP implementation in almost all of the regions and countries examined in this study.

3.14. Software development, testing, and troubleshooting

To enjoy the full benefits of implementation, various ERP software or packages are required to integrate the ERP system into the organization [10]. However, the integration of software is not an easy task, and should be managed properly. Software may need to be developed to integrate the legacy systems and the ERP systems. Testing and troubleshooting of the ERP system is necessary to ensure that the software functions according to plan. Troubleshooting for errors is particularly critical. Organizations that implement ERP should work closely with consultants to resolve problems [28].

3.15. Top management support

'Top management support' was the most frequently cited CSF for ERP implementation. The ERP project must receive approval and support from top management before it can be implemented. Top management must be willing to become involved and to allocate valuable resources to the implementation effort [28,51]. As ERP projects span divisional boundaries and affect many stakeholders in an organization, senior executives need to mediate between various interest groups to resolve political conflicts when necessary [18]. All of the studies in every region or country were in high agreement on the critical role played by top management support in the successful implementation of ERP. This showed that top management support is widely recognized as necessary for ERP implementation, and that this factor may be independent across regions and countries.

3.16. Fit between ERP and business/process

This is a critical factor that is widely cited by the literature for ERP implementation [18,29]. Thus, at the outset, companies adopting ERP systems should select an ERP package that fits the business practices and processes of an organization [38]. A gap analysis of company requirements and ERP features with the involvement of technical staff and key users is a necessary exercise. Selecting a package with the smallest gap and highest degree of fit will minimize the effort, time and risks for narrowing the gap through either business process changes, or customization later.

3.17. National culture

Several studies have recently pointed out the relevance of national culture to ERP implementation since it is embedded in organizational culture [23,32,88]. Hofstede [26] defined national culture as "the collective programming of the mind which distinguishes the inhabitants of one country from another". Basic values, beliefs and norms in different countries

will affect organizational culture, and in turn, the practices of professional activities, including ERP implementation [32]. For instance, Chinese managers tend to have a higher level of tolerance of unclear information, value the past [87] and consider data collected in business activities as their own assets rather than company assets [19]. These beliefs and attitudes may affect information sharing, business process re-engineering, and ERP implementation.

3.18. Country-related functional requirements

A number of studies have pointed out that the popular ERP packages developed by Western countries, though based on good business models, may not fit the requirements of other organizations [18]. Soh et al. have identified a list of misfits between an ERP package and a Singaporean health care institution [66]. Such misfits or discrepancies arose from the data, functional and output requirements that the ERP package failed to support. Many ERP adopting organizations in Asia have experienced similar misfits since many of the ERP packages purchased were produced by Western vendors [66]. Likewise, companies in China may have requirements (e.g. Chinese user interfaces, and report formats required by the government), which Western packages fail to satisfy [40,87]. Attempting to take a different perspective from that of some authors, we categorize such discrepancies as gaps in functional requirements rather than simply a cultural issue, though some of the functional requirements may arise because of cultural conditions (e.g. Chinese user interfaces [87]). We believe that it is natural for organizations in different countries to have country-specific functional requirements, which may arise because of different business practices, and legal and government requirements.

4. Discussion

Understanding and identifying the CSFs are essential to increasing the chances of a successful implementation of ERP. This paper identifies a comprehensive set of CSFs by reviewing the literature on the CSFs of ERP implementation in 10 different countries/regions. Our study indicates that the CSFs identified are generally relevant to the ERP implementation projects across countries. However, it is also found that the firms engaged in ERP implementation in different countries differed significantly in performance concerning some CSFs. These phenomena will be discussed comparatively in the following subsections.

4.1. The ERP trends across countries

It is not surprising that most of the research that was examined on the subject of CSFs for ERP implementation was conducted in the USA, because many manufacturing firms in that country have already adopted ERP systems [43] and the USA is the primary target of ERP sales revenues for many major ERP vendors [30]. Interestingly, there has only been limited relevant research conducted on some developing

countries such as Brazil and India, whereas there were four studies examining the CSFs for ERP implementation in China. China has achieved significant economic growth in recent years. The country has become the world's largest manufacturing base for goods because of its low cost of labour and raw materials. Manufacturing and technological industries play an important role in the Chinese economy. Many manufacturers in China have recognized the importance of developing ERP systems that fit their particular needs. In fact, ERP has started making inroads in India and Brazil as well [34], but still many of the existing studies on the adoption of ERP were conducted in developed countries [76]. Other researchers can consider investigating the CSFs for ERP implementation in developing countries, to see whether they are any different from those in advanced countries.

4.2. The CSFs in the adoption of ERP

Based on a comprehensive review of the literature, we have identified a list of potential factors considered to be critical to the success of ERP implementation. Some of them, in fact, can be applied to the development of IS/IT projects in general. The implementation of ERP is not only technological in nature, and some of the factors are specific to ERP implementation. The list as shown in Table 3 contains more than 80 sub-factors classified under 18 CSFs. Eleven out of the 18 factors were mentioned in Nah et al. [50,51]. These factors were 'appropriate business and IT legacy systems', 'business/plan/vision/goals/justification', 'business process reengineering', 'change management culture and programme', 'communication', 'ERP teamwork and composition', 'monitoring and evaluation of performance', 'project champion', 'project management', 'software/system development, testing and troubleshooting', 'top management support', 'data management', and 'ERP strategy and implementation methodology'. Although not frequently mentioned, 'ERP vendor', and 'organizational characteristics' have been listed as other important factors for ERP implementation. In addition, based on some of the studies that we have reviewed, we have identified 'country-related functional requirements' as an important factor. Due to unique business conditions and government standards, firms in a country may have to accommodate country-specific business practices, and it may result in different data, functionality and output requirements which a foreign ERP package may not be able to satisfy. Thus, ERP adopting firms must evaluate and select an ERP package carefully.

The search through the empirical literature shows that researchers have frequently cited 'top management support', 'ERP teamwork and composition', 'project management', and 'change management culture and programme' as the CSFs for ERP implementation. This result is nearly consistent with the work of Nah et al. [51], who evaluated these four factors and rated them as most critical to the success of ERP implementation. A similar result also can be found in Parr et al. [54].

Top management support has been recognized as one of the most important elements in the successful implementation of an IS/IT project. The implementation of ERP is no exception.

Regardless of national differences, top management needs to support, and to be involved in ERP implementation. This is important in both advanced countries (e.g. the USA and the UK) and developing countries (e.g. China). Since the primary responsibility of top management is to provide sufficient financial support and adequate resources, including people and equipment, to build a successful system, the support of management ensures that the ERP project will have a high priority within the organization and that it will receive the required resources and attention. Apart from this primary support, political and psychological or behavioural support is also important in making the development run smoothly, especially if there is significant resistance from the staff involved. Inadequate resources and a lack of financial and political support will inevitably lead to failure as demonstrated in some case studies [87]. A steering committee should be established with members committed to participate in project team meetings, to closely monitor the progress of the project, and to provide clear direction to the project [54,88].

ERP teamwork and composition is another critical issue for ERP implementation. The project team should be composed of both IT and business experts from within the implementation company or from an external consultancy. In order to have an effective and fast decision maker, the key member of the project team must be empowered. As shown in Table 3, factors related to ERP teamwork and compositions are mentioned in various studies. No single factor has been clearly identified as the most important for particular countries.

There is no doubt that project management is necessary for implementing any kind of project. Excellent project management against a project plan with clear objectives, deliverables, and milestones ensures that the project is effectively planned and delivered. For ERP implementation, a clear and well-defined project plan, including the goals, objectives, strategy, scope, and schedule of the project, are significant issues in project management. This factor was common in various countries and regions, regardless of cultural or national differences. Other more specific aspects of project management, such as setting realistic deadlines for implementation, dedicated resources, and the management of expectations were suggested in companies in the USA, United Kingdom, Demark, Europe and Australia. Among the studies conducted in developing countries, only two studies in China addressed this sub-factor. Developed countries tend to pay attention to detailed project management planning. This may be one reason why developed countries are more likely to succeed in implementing ERP systems [30].

Academic research has pointed out the impacts of national culture on organizational culture, and business practices. Therefore, the effects of national culture on ERP implementation cannot be ignored. Change management and organizational culture are also frequently cited as factors critical to the success of the implementation of ERP systems. Existing organizational structures and business processes may not fit with the new system, which introduces a certain level of change. Effective change management should be conducted throughout various stages of implementation. One of the critical

elements involved in any programme to manage change is training and education. In all countries and regions, training and education was regarded as critical. Organizations should provide a customized training and education programme that provides employees with tools and practical experience needed to integrate new processes, roles, and responsibilities; along with training in the differences between the new technology and the old technology to ensure a successful transition [12]. In order to improve the chances for the successful implementation of the system, organizations should also review their organizational culture and attributes, as well as the readiness of management and employees to change before implementing an ERP system.

4.3. Challenges and performance disparities in certain critical areas

This study also shows that some factors are accorded greater importance by organizations in individual regions or countries. While commonality in general exists across regions and countries in the critical success factors identified, the conditions and constraints for achieving adequate or excellent performance in these critical areas may differ. The differences in performance or the level of perceived importance may be a result of national culture, organizational culture, availability of expertise and resources, and special functionality and features required by the government and commercial practice in a country. Based on some of the studies reviewed, we shall examine the differences between the West (largely developed countries) and the East (largely developing countries). As China is a major developing country, much of the discussion is based on ERP studies in the Chinese setting (refer to Table 4).

Organizations around the world have diverse backgrounds and often differ in business requirements and corporate culture, while the attitudes, beliefs, and experiences of managers in some developing countries may adversely affect the ERP deployment process [40]. For instance, Li et al. [40] considered the 'disconnect' between advanced technologies and the thinking and styles of manufacturing managers in China to be a serious problem for MRP deployment. The managers that Li and his colleagues referred to had been under the influence of a state-planning economy for decades, and needed time to adjust to the business practices of a capitalistic world. However, the effects of the state-planning economy and the dramatic changes brought about by a gradual transition to a more capitalistic system could only partially explain the differences between China and the West. Rather, it is necessary to look deeper into the characteristics of the Chinese society before one can understand the cultural forces that may affect management behaviours in Chinese organizations. In this regard, Hofstede [25] illustrated the differences between Western and Chinese societies in terms of power distance, uncertainty avoidance, individualism-collectivism, and masculinity-femininity, and Redding [56] described the Chinese society in terms of paternalism, personalism, and systematic insecurity. Chinese executives and managers lean more towards collectivism, personalism and personal relationships in contrast to their Western counterparts [25]. Impacts of these cultural characteristics may in many ways manifest themselves in the management styles and behaviours of Chinese business executives and managers [27]. In Chinese organizations, the leaders have a tendency to manage their operations and business decisions by intuition and experience [90]. There is a stronger emphasis among Chinese executives and managers on person-to-person relationships, and flexibility and discretionary power [47], rather than on standardized practice and processes as valued by Western companies. In addition to the flexibility that they prefer to retain, Chinese leaders are less willing to invest in the long-term development of company infrastructure such as in technology adoption, internal human resources, and processes since they are thrifty, and focus on short-term profit maximization [15].

Such cultural influences may also manifest themselves in attitudes towards the use, ownership, and sharing of information. Chinese executives and managers often consider information accumulated in business transactions as a personal, rather than corporate asset [19,47], which is shared only selectively with in-groups for their own interest. Thus, the ownership and control of information is a source of power [17]. Unlike their Western counterparts, who take advantage of information systems to enable information sharing and support process improvement, Chinese executives are less supportive of information system adoption and process changes, and tend to use information systems for exercising control of the company [47]. ERP studies conducted recently in China have also pointed to similar tendencies and attitudes that may hamper ERP implementation. Chinese executives have an inclination to value the past or the status quo, being reactive to changes [87], and more tolerant of unclear information [90]. Similar to their conservative attitude towards information sharing [19], their lukewarm support of business process changes and information systems can be a hurdle to ERP adoption [87].

Davison [19] has pointed out that Chinese managers prefer to use a large number of printed reports for control purposes. This habit or preference, inherited from the era of legacy systems, can become a hurdle to business process re-engineering and ERP implementation, and lead to additional requirements that the ERP project team needs to satisfy. Other national culture related requirements reported include Chinese user interfaces, and properly translated terminologies [87] and the case studies showed that foreign ERP packages have failed to satisfy such requirements in many circumstances. On the other hand, we need to recognize the possibility that country-related requirements may arise because of government standards [87], and that organizations in various countries and regions may differ in their business practices, resulting in different needs in data models and system functionality. This serves to remind both ERP vendors and clients that ERP packages, though developed on the basis of good business models, will not fit all organizations universally. Successful implementation begins with careful selection of an ERP package that fits the requirements of the adopting organization.

A frequently reported problem in China and other East Asian locations is the lack of experience and resources. Both

Table 4
Challenges and under-performance reported

Nature	Challenges and under-performance reported	Study
Cultural issues	• Chinese leaders are less eager to conduct organizational changes than Westerners since they are more inclined to value the past and more reactive to changes, a tendency which may pose a hurdle to BPR.	[87]
	• Joint-ventures with Western parents tend to be more professional, tightly-controlled, and open and therefore more conducive to ERP implementation. In comparison, Chinese state-owned firms may be more parochial, closed and loosely controlled.	[90]
	• Chinese state-owned firms are more tolerant of unclear information, and top managers tend to rely on personal experience and intuition in making decisions.	[90]
	• Chinese organizational culture may adversely affect ERP implementation outcomes.	[88]
	• Chinese managers and employees tend to treat data gathered from their work activities as their own, rather than company assets. This belief may adversely affect the attitude towards information sharing, and business process re-engineering.	[19]
Functionality requirements	• Western ERP packages lacked the flexibility to support drastic organizational changes.	[87]
	• Western ERP packages failed to meet report format requirements of the Chinese government in two firms studied.	[87]
	• Western ERP packages failed to support the requirements of Chinese user interfaces (including adequate translation of menu features and terminologies) of firms under study, the requirement of one firm in actual costing of raw materials, and requirements of another in finance, purchasing and costing.	[87]
	• Chinese organizations have a tendency to rely heavily on printed reports as in pre-ERP days. This requirement may be a constraint to BPR.	[19]
	• Western ERP package failed to support data, functionality and output requirements of Singaporean hospital.	[66]
Expertise and people	• Chinese firms studied experienced very high turnover rate of project staff.	[87]
	• Chinese firms studied lacked understanding and experience in ERP and therefore not ready for ERP implementation. Consultants hired were also inexperienced.	[87]
	• Small and medium enterprises (SMEs) in China had to cope with the weakness of IT human resources.	[41]
	• Unavailability and high turnover of project personnel are two major difficulties in Taiwan.	[79]
ERP practices	• Insufficient training was offered to those involved in ERP, and BPR was not conducted.	[87]
	• SMEs in China usually have weak IT infrastructure.	[41]
	• Problems in companies under study include poor communication, lack of support from department heads, poor training services from vendor, and low user involvement.	[90]

executives and staff in these organizations do not have a proper understanding of ERP adoption and therefore are not ready for such projects [87]. Some ERP implementation projects in China and Taiwan suffered from the unavailability of experienced staff, and a very high turnover rate of both staff and consultants [41,79,87]. Other problems reported are lack of BPR [87], poor communications, lack of support from management, limited level of user involvement, poor training from vendors [90], and weakness in existing IT infrastructure [41]. These reported cases of ERP failures, in which many of the critical factors were ignored or poorly managed, show that the CSFs identified are relevant to ERP implementation in both the West and China. In order to improve the likelihood of

implementation success, organizations in China (and other developing countries) must enhance their efforts and resources investment in the abovementioned areas.

The ERP movement in developing countries such as China is several years behind that of advanced countries. Through training and the accumulation of experience, the problems or underperformance in some of the critical areas can be mitigated or resolved. It would be reasonable to conclude that ERP-adopting organizations in other regions and countries could benefit from the widely used and time-proven methods of advanced countries while due attention and actions are needed to deal successfully with local requirements and practices.

4.4. A framework with propositions

This study categorizes the ERP CSFs identified into three groups, namely organization-related, country-related, and vendor-related. Vendor issues such as business knowledge, technical strengths, consulting capabilities, software upgrade policies, and support services of ERP vendors, are known to be critical to the success of ERP projects, and must be considered when selecting an ERP product and when implementing it. The country-related factors include 'national culture' and 'country-related functional requirements'. The organizational-related factors refer to a set of factors fundamental and commonly known to most ERP-adopting organizations such as 'business process reengineering', 'inter-departmental communication' and 'top management support'. Just knowing that an ERP product is from a prestigious vendor with good built-in business

practices (of the Western world) is not enough. There is a need to take note of the functionality gaps that may exist when it is imported to a different country [19,66,87].

Using the above defined concepts of ERP success and CSFs, a further study may consider a basic ERP success model, as illustrated in Table 5.

The model postulates that the presence of the country-related CSFs, vendor-related CSFs and organizational-related CSFs will result in successful ERP implementation, while neglecting the CSFs will lead to failure of the ERP project. It is expected that organizations that do not manage all the CSFs well will incur failure in ERP implementation. It would be an interesting topic of research to see whether the country-related CSFs and vendor-related CSF influence organizational-related CSFs which will in turn affect ERP success. Therefore, we propose the following propositions:

Table 5
Model of the country-related CSFs, vendor-related CSFs and organizational-related CSFs affecting ERP implementation
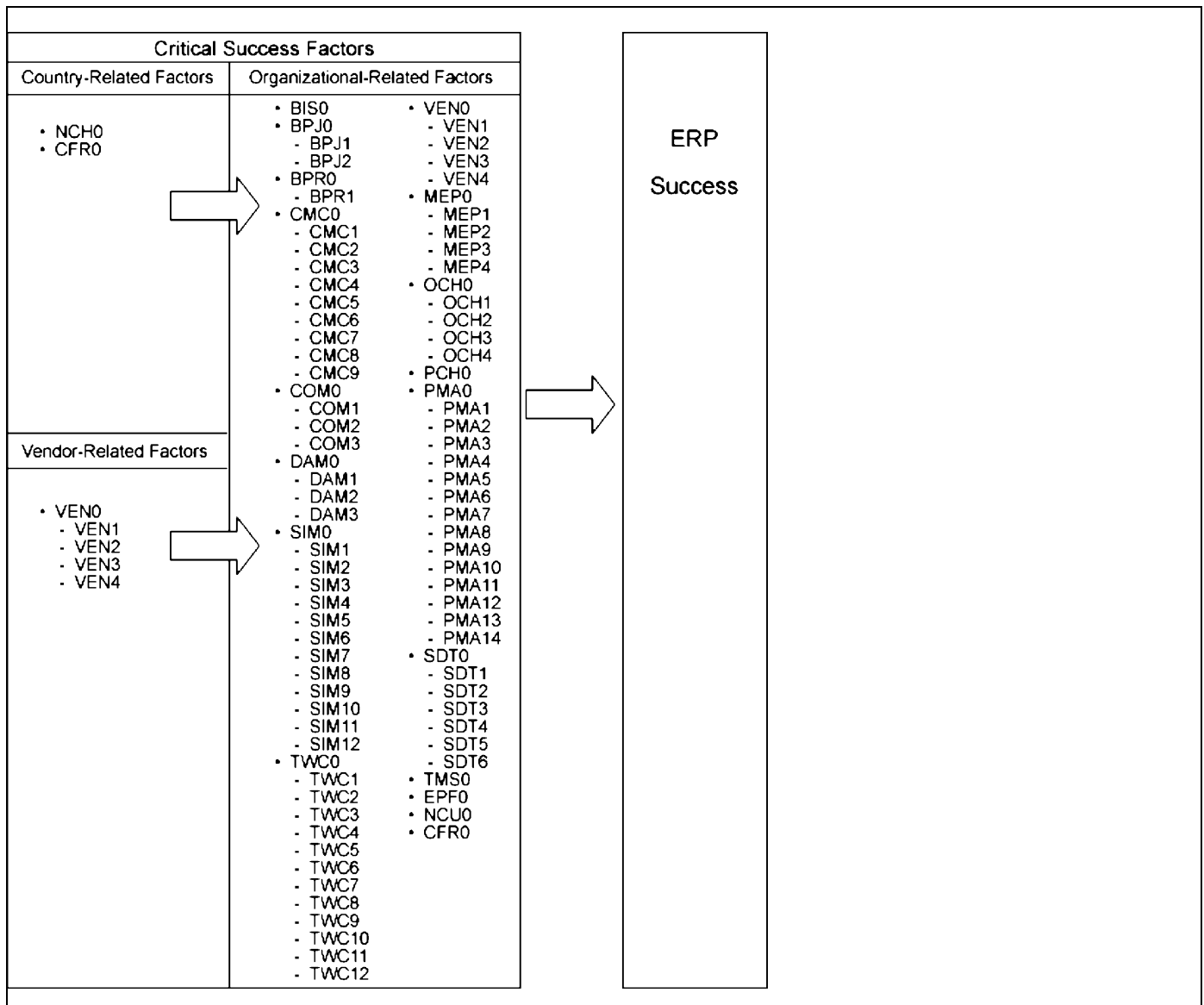
Proposition 1. Country-related CSFs influence organizational-related CSFs which will affect ERP success.

Proposition 2. Vendor-related CSFs influence organizational-related CSFs which will affect ERP success.

A further research area which may be of interest is to explore the relationship between the composite CSFs and ERP success.

5. Concluding remarks and implications

5.1. Academic and professional implications

This comparative review of the literature has shed light on common critical success factors for ERP implementation that are shared across regions and countries. Although this paper cannot claim to be exhaustive, it does provide a comprehensive review of the CSFs for ERP implementation. The results presented in this paper have several important implications for ERP practitioners and researchers alike.

First, there is a set of factors fundamental to the successful implementation of ERP. They are common to most ERP-adopting organizations, implying that the experience of organizations in advanced countries should be shared by those in developing countries in order to level the learning curve, and raise the success rate of ERP projects. There are a significant number of successful ERP installations in the USA, and much has been reported on the subject in the academic literature. However, many companies have faced considerable difficulties implementing large, complex, and time-consuming ERP systems as there is a lack of effective guidance on the implementation of ERP. The CSFs identified in this study can serve as a checklist that covers all possible success factors associated with ERP implementation across different countries. It can also raise the awareness of critical issues that those involved in implementing ERP systems should take note of, depending on their location. Appropriate planning and solutions should then be carried out to achieve a greater degree of success in implementation.

Second, this thorough review and analysis of prior studies of ERP implementation has led to the development of a framework of ERP CSFs and the propositions as a basis for further study. The framework not only lists a comprehensive set of CSFs, but also highlights the relationships that are likely to exist between the organization-related ERP CSFs, and country-related and vendor-related CSFs. This brings to the attention of academic researchers the needs to consider forces originating outside the ERP adopting organizations in relevant studies.

5.2. Research directions

In recent years, there has been an abundance of research on ERP in Western contexts. Many studies in the ERP literature have examined the issue of the adoption of ERP at a higher level. We believe in-depth studies into the experience of the success (failure) of ERP for both advanced and developing regions/countries will be of great benefit to organizations. For instance, the literature has alluded to the proper management of consultants, and training as critical to the success of ERP projects. There have been many recent reports in the industrial literature about the managing of consultants and training as causes of ERP failures [71,72]. Conversely, training is regarded as one of the critical resources of an organization that must be managed on an on-going basis [55]. An in-depth study of existing cases would uncover the details of the 'what' and 'how' of ERP implementation. This detailed knowledge and practical experience is what is still lacking in the literature, and would benefit business managers and MIS practitioners the most, especially those based in the developing world.

While many developing countries are now adopting ERP, there has not been much research on the success or failure of its implementation in these regions/countries. We believe that additional effort should be directed to projects in these regions/countries as they represent a vast potential ERP market and a very large pool of companies. More studies can be conducted in developing countries such as China, India and Brazil. These countries are relatively new to ERP implementation and face technical and business problems such as inadequate IT infrastructures, poor government policies, and a lack of experience in ERP [30]. At present, only a few studies can be found on the subject; thus, researchers have an opportunity to further explore the CSFs for these countries. Therefore, there exists enormous potential for maximizing the impact of research findings, by helping to disseminate the experiences of other successful organizations to organizations in these regions/countries.

Similarly, while many studies in ERP have extensive coverage on CSFs for ERP implementation, they primarily listed the CSFs without investigating the relationships among the factors [31,52]. With a static view of ERP implementation, these studies primarily focus on examining what the factors were without probing the interactive effects of the CSFs and the organizational environment [52]. We need to stress that business processes and the overall organizational environment are dynamic, and therefore the implementation process must not be treated as static. The ERP system and the business processes of a firm are mutually dependent. This recognition leads us to emphasize that it is of paramount importance for academic researchers and those involved in ERP implementation to thoroughly understand the business practice and knowledge of the ERP adopting firms, which are necessary for excellent performance in CSFs such as BPR, and ERP fit. Also, the business knowledge, practice and processes may vary across firms and industries. For instance, the value chain processes of traditional manufacturing firms are different from those of services firms, including government and non-profit agencies [12]. As a means of further advancing ERP research, additional effort is needed to pinpoint the best practices for the identified CSFs for ERP implementation in different sectors, and also understand the causal relationships among the factors.

Lastly, most of the studies on ERP CSFs, including this one, have focused on the factors of implementation [11,21]. We would argue that other post-implementation activities are as important in the lifecycle of an ERP system, including the operation, and upgrading and maintenance of the software, in

order to maximize the organizational benefits of the system. Thus, it is advisable to examine the CSFs of the whole ERP lifecycle. Fortunately, some researchers have begun recently to pay attention to post-implementation issues [11].

5.3. Limitations

The limitations of this study are that it could be difficult to make generalizations based on the contents of the articles that were examined, and that there were relatively few articles on particular countries for analysis and comparison. Some articles took a case study approach, analyzing one or several companies. This approach is less representative for a particular country than a survey-based study. Moreover, relatively few articles could be found for most countries, except for the USA. Readers should be cautious in interpreting the results of this study. Further research is needed to investigate the disparities in the performance in certain CSFs and the reasons underlying such disparities, for organizations of different countries. Although some of these factors may or may not be equally important to different countries, this study has highlighted the critical areas in ERP implementation projects that must be handled cautiously.

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