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The effect of ERP implementation CSFs on business performance: an empirical study on users' perception

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Abstract

This study is conducted on 220 employees involved in ERP implementation project in a multinational consumer goods company to investigate the CSFs and their effect on ERP implementation success from users' point of view. Findings indicate there are differences in which CSFs are perceived important and actually have effect on ERP implementation success. Interestingly, none of the ERP adopting organization environment CSFs had influence on project success. Nevertheless, 'careful selection of ERP software', 'software analysis, testing and troubleshooting', and 'vendor support' explain ERP project outcomes.

Keywords: Business process outcomes; Critical success factors (CSFs); Enterprise resource planning (ERP); ERP project outcome

1. Introduction

In today's globalized, fast changing business environment, staying competitive has become a matter of survival. In order to stay competitive, companies must streamline their activities and functions. Successfully implemented enterprise resource planning (ERP) systems are providing companies improved business practices and procedures (Bhatti, 2005).

ERP system is a set of integrated software modules and a central database that facilitates an organization to manage the efficient and effective use of resources (materials, human resources, finance etc.) by automating and incorporating business processes, data sharing throughout the enterprise and enabling information access in real-time environment (Laudon and Laudon, 2013; Nah, Lau and Kuang, 2001). ERP promises benefits in a wide range: increased efficiency, improved quality, productivity, and profitability through increased capability, also generate and communicate accurate and timely information (Bhatti, 2005; Ragowsky and Somers, 2002).

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Despite the benefits, not all ERP implementations have been successful (Maguire, Ojiako and Said, 2010; Zhang et al., 2005): reports reveal that 90 % of early ERP projects were either late or over budget, and only 30 % of promised benefits were delivered (Plant and Willcocks, 2007; Zhang et al., 2005). Moreover ERP implementations require a considerable amount of investment (Dezdar and Sulaiman, 2009; Karimi, Somers, and Bhattacharjee, 2007a). Given the high expenses and low success rates, causes of these failures need to be understood.

Rockart (1979) introduced critical success factors (CSFs) method in 1979. Since then CSFs are used to identify the factors affecting the ERP implementation success and failure. CSFs are “the few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his goals.” (Bullen and Rockart, 1981, p.3) As can be seen from the definition CSFs are not only attractive to researchers but also to managers hence to organizations. CSFs are reachable and vigorous moreover the identification and prioritization of factors that could influence implementation success (Brown and He 2007).

Many studies have been conducted to identify the CSFs affecting the ERP implementation success and failure. Some of the notable studies are conducted by Dezdar and Sulaiman (2009), Karimi, Somers, and Bhattacharjee, (2007a) Ngai, Law, and Wat (2008), and Somers and Nelson (2004). However, only a few studies have attempted to investigate the effect of proposed CSFs on ERP implementation success.

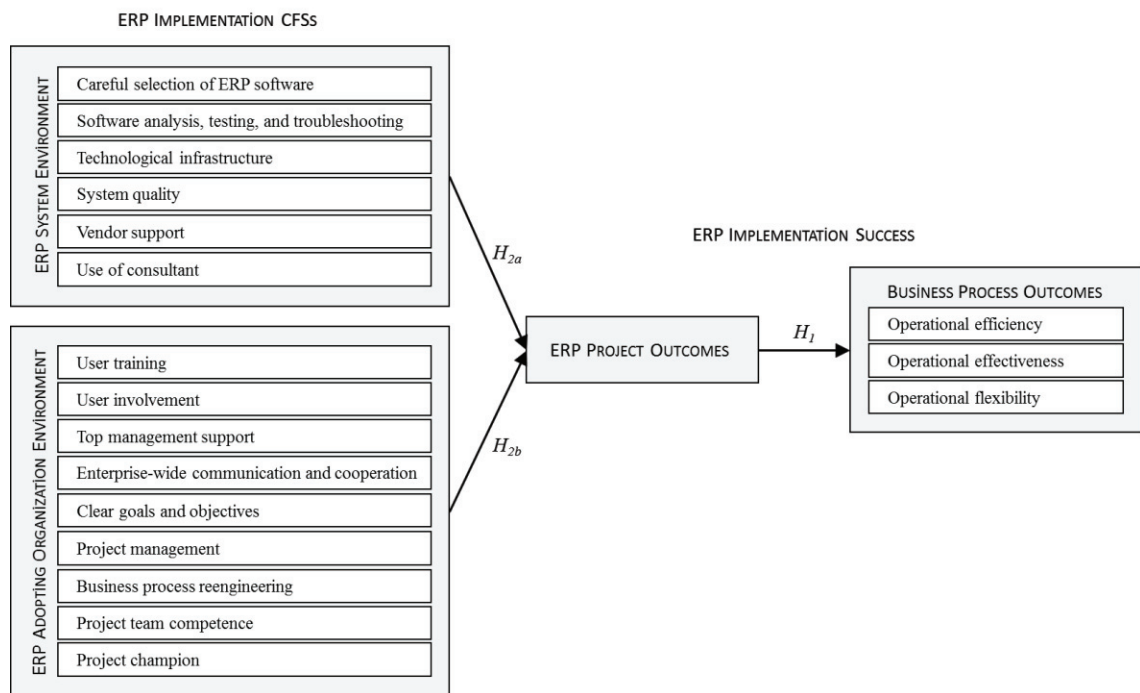


Fig 1. Research model

In majority of the research on CSFs, unit of analysis is taken as organizations; because of this, top managers have evaluated the CSF for ERP implementation project in their organization. Therefore, the perception of implementers or users of the project are not considered. Yet, in order to avoid failure and ensure success in ERP implementation it is necessary to understand partners involved. The implementation of such systems requires effective participation of the whole organization (Ahmad and

Cuenda, 2013). The aim of this study is to investigate the CSFs and their effect on ERP implementation success from users' point of view to help organizations plan and execute their ERP projects more successfully.

2. Hypotheses and research model

Performance of ERP projects are measured by a mix of project outcomes and business outcomes (Bhatti, 2005). ERP implementation results in business process outcomes of reduced cost and cycle time, improved productivity, quality, and customer service benefits (Shang and Seddon, 2002). Furthermore, ERP business outcomes can be defined in three dimensions: efficiency, effectiveness, and flexibility. As stated by Karimi, Somers, and Bhattacharjee (2007b) successful ERP implementation gives rise to

1. *business process efficiency* by reducing cost and cycle time, increasing productivity of the production process, and improving quality and customer service;
2. *business process effectiveness* by improving decision making and planning, and resource management and delivery; and flexibility by building and
3. *business process flexibility* into IT infrastructure to reduce IT cost, by differentiating products and services, and by establishing and maintaining external linkages to customers and suppliers.

ERP project success or in other words project outcomes are measured in terms of meeting the project due dates, budgets, and scope and performance expected (Markus et al., 2000). This distinction of project outcomes and business outcomes is necessary, as the former is the immediate effect of ERP while the latter assesses post-ERP project performance (Ram, Corkindale and Wu, 2013).

Therefore, in this study we hypothesize that immediate project success comes before business outcomes and has positive effect on. Thus our first hypothesis is

H₁: ERP project outcomes have positive affect on business process outcomes.

CSFs are key strategies to achieve the benefits of ERP systems (Liu and Seddon, 2009; Plant and Willcocks, 2007). As discussed earlier, CSFs for the implementation of ERP systems have been analyzed for substantial time; however, there are differences in findings and even in the terminology used to describe critical factors. After reviewing the literature, we chose to utilize fifteen theoretically important CSFs in this study (See Figure 1). We followed the categorization made by Dezdar and Sulaiman (2009) and analyzed CSFs in two environments: ERP adopting organization environment and ERP system environment (See Fig 1). In line with our aim we hypothesize, proposed CSFs have positive affect on ERP implementation success namely the project outcomes. Thus our hypotheses are

H_{2a}: ERP system environment CSFs have positive affect on ERP project outcomes

H_{2b}: ERP adopting organization environment CSFs have positive affect on ERP project outcomes

3. Methodology

3.1. Measures and research instrument

A multi-item questionnaire measured on a five-point interval scale is used in this study. Six ERP system environment CSFs are measured with 24 items and nine ERP adopting organization environment CSFs are measured with 35 items based on the literature (Bhatti, 2005; Dezdar & Sulaiman, 2009; Karimi, Somers, & Bhattacharjee 2007b; Plant & Willcocks, 2007). Business process outcomes are measured by 10-item scale (Karimi, Somers, & Bhattacharjee, 2007b) and ERP project outcome are

measured by four items; being on time, being within budget, achieving predetermined goals and being in line with quality standards. In addition, respondents are directly asked to evaluate how important are those critical success factors in realizing an ERP project.

3.2. Sample and data collection

The survey of this study is conducted in a multinational consumer goods company, implementing ERP project from a business unit located in Istanbul. Questionnaire is distributed to 220 employees involved in the project and 184 questionnaires returned with 83.6 % return rate. The sample consists of 72 female (39.1 %) and 112 male (60.9 %) employees with an average age of 28.7 (SD=3.6). All the respondents are university graduates, 29.3 % of them have master's degree, and 2.7 % have doctorate. Working years in this company ranges between 1 to 7 with a mean of 2.7 and standard deviation of 1.3.

4. Results

Prior to path analysis, we conducted confirmatory factor analyses (CFA) to test the scale constructs. Endogenous variables ERP project outcome and business process outcomes showed good fit $\chi^2(2, N=184)=8.38; p=.02; CFI=.97; TLI=.91; RMSEA=.08$ and $\chi^2(32, N=184)=55.37; p=.01; CFI=.97; TLI=.96; RMSEA=.06$ respectively. As hypothesized, ERP project outcome is unidimensional and business process outcomes has three dimensions. The 24 items used to measure ERP system environment CSFs loaded on the six hypothesized factors with relatively poor fit. However, seven of the items had very low factor loadings (less than .30), after trimming those items the scale has indicated a good fit $\chi^2(104, N=184)=124.59; p=.08; CFI=.96; TLI=.95; RMSEA=.03$. The last CFA is conducted to test ERP adopting organization environment CSFs. We have hypothesized 35 items to load on nine factors however, like in system environment CSFs; some items had very low loadings, and some items were not significant. As a result, 'project management' dimension is eliminated and in addition, 'enterprise-wide communication and cooperation' and 'clear goals and objectives' dimensions merged together. As a result, a seven-dimension model is confirmed $\chi^2(149, N=184)=197.69; p=.01 CFI=.93; TLI=.91; RMSEA=.04$.

4.1. Path analysis

Since the objective of this study was to identify which CSFs increases the ERP project success and whether the ERP project success effects business process outcomes a path analysis is conducted using AMOS. The result of the path analysis showed a good fit of the model $\chi^2(201, N=184)=312.12; p=.00 CFI=.93; TLI=.91; RMSEA=.06$ See Table1. As a result, of the path analysis it is found that ERP project outcome is explained by 'careful selection of ERP software', 'software analysis, testing and troubleshooting', and 'vendor support'. 'Vendor support' and 'careful selection of ERP software' have higher effect on project success than 'software analysis, testing and troubleshooting' ($\beta_{\text{vendor support}}=.46, \beta_{\text{careful selection}}=.43, \beta_{\text{software analysis}}=.24$). Interestingly none of the ERP adopting organization environment critical factors have a significant effect on project outcome. ERP project success has quite high positive effect on business process outcomes ($\beta=.66$).

Table 1. Path analysis results

Path	β	t value
ERP project outcome → Business process outcomes	.66	5.61***
ERP System Environment		
Careful selection of ERP software → ERP project outcome	.43	2.90**
Software analysis, testing and troubleshooting → ERP project outcome	.24	2.64**
System quality → ERP project outcome	n.s.	
Technological infrastructure → ERP project outcome	n.s.	
Use of consultant → ERP project outcome	n.s.	
Vendor support → ERP project outcome	.46	2.47*
ERP Adopting Organization Environment		
Business process reengineering → ERP project outcome	n.s.	
Communication and cooperation & Clear goals and objectives → ERP project outcome	n.s.	
Project champion → ERP project outcome	n.s.	
Project team competence → ERP project outcome	n.s.	
Top management support → ERP project outcome	n.s.	
User involvement → ERP project outcome	n.s.	
User training → ERP project outcome	n.s.	
$\chi^2(201, N=184)=312.12; p=.00; CFI=.93; TLI=.91; RMSEA=.06$		
Note: * $p < .05$, ** $p < .01$, *** $p < .001$; n.s.= not significant		

Table 2. Friedman two-way ANOVA analysis results

	Mean rank
OE User involvement	9.39
OE User training	8.84
SE Use of consultant	8.74
SE System quality	8.65
OE Project Team Competence	8.61
SE Careful selection of ERP Software	8.42
SE Technological infrastructure	8.39
OE Project management	7.74
OE Enterprise-wide communication and cooperation	7.58
OE Top management support	7.51
SE Software analysis, testing and troubleshooting	7.51
OE Project champion	7.42
OE Clear Goals and Objectives	7.36
OE Business process reengineering	7.30
SE Vendor support	6.55
χ^2 Friedman test (14, N=184)=98.25, $p=0.00$	
Note: SE = ERP System Environment; OE= ERP Adopting Organization Environment	

4.2. Friedman analysis

During the research, we have also asked respondents to evaluate how important the critical success factors were in realizing an ERP project. Therefore, we further conducted a Friedman two-way analysis of variance by ranks test to reveal the differences between importance given to CSFs. As a result of the analysis, it is found that there is a significant difference between the amount of importance assigned to CSFs by employees. The most important factor to achieve success in ERP project implementation is ‘user involvement’ according to respondents, which is followed by ‘user training’. The least important factor is ‘vendor support’ according to Friedman analysis. These findings are contradictory with path analysis result where ‘vendor support’ is one of the most important factors that explains the project success. Moreover, ‘user involvement’ and ‘user training’ are not significant factors. Mean ranks of all the CSFs can be seen from Table 2.

5. Conclusion

ERP implementations enables organizations competitive strategies however, not all projects have been successful regardless of the huge investments made. Obviously, there is an increased experience and capability since the early ERP project implementations; however, ERP systems have proven to be overwhelming in many organizations (Maguire et al., 2010). In addition, because the software and technology are changing so quickly with time, new risks, and issues are presented. Furthermore, over time, organizational learning leads to different perspectives on what critical success factors might be, and where management emphasis needs to lie (Plant and Willcocks, 2007). This research is an attempt to extend the ERP implementation research by testing the CSFs effect on ERP implementation success from user’s perception.

CSFs have to be accomplished in an organization for an ERP system to be successful (Ram, Corkindale, and Wu, 2013). Researchers have suggested that organizational and technological CSFs are most important, and beneficial to the organizations (Karimi, Somers, and Bhattacharjee, 2007a). Yet in our study, we found that organizational CSFs do not have a significant effect on project success and indirectly on business outcomes. Our findings indicate that ERP project outcome is explained by ‘vendor support’, ‘careful selection of ERP software’, and ‘software analysis, testing and troubleshooting’. In other studies ‘vendor support’ is found to have positive influence as well, yet other influential factors: process re-engineering, project management, and training were not significant in our study (Ram, Corkindale and Wu, 2013). Finding regarding ‘careful selection of ERP software’ is consistent with Liu and Seddon (2009). However, they also found top management support as an important factor that was not significant in our study. As expected ERP project success has quite high positive effect on business process outcomes. Since business process improvements is the major motivation for ERP implementations (Karimi, Somers and Bhattacharjee, 2007a) this finding supports expectations.

CSFs are mostly investigated in literature by providing a list of critical items, and asking the IS executives to identify the degree of importance of each CSF in their organizations’ ERP implementation (Plant and Willcocks, 2007; Somers and Nelson, 2001; 2004). Since in this study user’s perception is considered this ranking procedure is replicated. As a result of the findings it is found that, the most important factor to achieve success in ERP project implementation is ‘user involvement’ according to respondents’ perception, which is followed by ‘user training’. The least important factor is ‘vendor support’. These findings are contradictory with path analysis result where ‘vendor support’ is one of the most important factors that explains the project success. Moreover, ‘user involvement’ and ‘user training’ are not significant factors. These findings indicate that the importance attached to critical success factors is independent of the actual effect of CSFs on the ERP implementation success. Majority of the ERP

adopting organization environment CSFs were rated highly even though none of them had significant explanatory power on implementation success. Organizational factors may be acting as hygiene factors during the implementation.

One of the limitations of this study is stages of ERP implementation process are not considered. In the future testing the model for different stages may give more insights. Moreover, the data is collected from one organization, as the aim was to understand implementers' perception however; it limits the generalizability of the study. Nevertheless, the differences in the findings indicate this study must be replicated in different companies and industries to find the effect of CSFs effect on firm performance. Different organizations have different requirements and the scope of that ERP projects can alter the 'critical' success factors that are actually critical for achieving success in implementation and improving output performance. Therefore, more empirical research is necessary to determine whether ERP 'critical' success factors are necessarily critical in practice. Better understanding of the effects of CSFs for ERP project implementation will help organizations to plan and execute their ERP projects more successfully.

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