
An Empirical Study on the effect of Enterprise Resource Planning(ERP) on Organizational Performance

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Abstract

ERP is a new generation of software which provides internal and external agencies real-time access to the systems data. But, ERP projects always contain a high level of risk and uncertainty. The purchase of ERP software is a high-expenditure activity that consumes a significant portion of the capital budget. A wrong ERP project selection would either fail the project or weaken the system to an adverse impact on the company's performance.

This paper focuses on effect of ERP on organizational performance.

Balance Score Card (BSC) model is used as a basis for measuring different parameters of organizational performance. Results showed that ERP significantly affects the over-all organizational performance.

Keywords: *BSC model, Customers, Employee Learning and Growth, Internal process, etc.*

Introduction

Previous to ERP systems, each functional unit in an organization had their own computer system, data and database and hence, these systems were not able to communicate with one another. ERP systems solve this problem by collecting data from various key business processes and storing them in a single comprehensive data repository to be used by all parts of business. ERP systems are software packages that manage and integrate all the enterprise's data, and provide information based on these data on a real-time basis. ERP is a method for effective planning and control of all resources needed to take, make, ship and account for customer orders in a manufacturing, distribution or service company. ERP systems have also been defined as commercially available, modularly packaged business software that

enables an enterprise to efficiently and effectively manage its resources, products and services, personnel, capital assets, etc. by virtue of being an integrated application.

ERP systems are profoundly complex pieces of software and costly systems; installing them requires large investments of time and expertise. An ERP project failure may threaten the existence of an organization. A wrong ERP project selection would either fail the project or weaken the system to an

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adverse impact on the performance of the company. While approximately one-third of all information systems projects are cancelled before completion, the failure rate for ERP implementation is 25%. Research shows that many large organizations that installed ERP system, had to abandon their implementation. According to another research (Chakraborty and Sharma, 2007), 90 percent of all initiated ERP projects failed as the project was not managed properly. Thus, for both researchers and executives, one of the key questions is whether or not investments in ERP pay off? Therefore, it is critical for organizations to have as much information as possible prior to embarking on an ERP projects and requires an evaluation of ERP.

Majority of ERP research focus on ERP selection, success factors and the implementation phase but seldom on post-implementation impacts. This highlights a critical research gap as there is a great need for continued improvement and assessment as ERP use evolves over time. Thus, researchers indicate greater need for further studies on ERP Systems. Researchers also suggest that evaluating ERP systems is an important tool for improving selection, development, implementation and usage since implementing ERP systems is not as much a technological exercise as it is an organizational revolution since it interacts with actors of the organization.

Thus, an extensive study of research done with respect to ERP, points at the scarcity of studies on ERP and its effect on organizational performance in the post-implementation stage. In India, the empirical studies on the ERP are almost negligible and very few have focused mainly on pre-implementation. To fill this void, the present study is undertaken with an aim to reassess possible benefits which could further clarify the myriad of factors affecting the ERP and firm performance and productivity relationships.

Literature Review :

Hsu and Chen (2004) discussed the importance of ERP into an integrated, process-oriented, and information-driven and real time organization. According to Nah (2007), numerous benefits include improvements in cooperation between managers and employees, consolidation of finance, marketing and sales, human resource and manufacturing

applications, management information available—real-time information available anywhere, anytime and informal systems for materials management/inventory/production control, lead-times, manpower costs, overtime, safety stocks, work-in-progress and delivery times.

Singla (2008) identified a total of forty-six variables in order to study the impact of ERP systems on small and medium-sized public sector organizations and proposed three categories for their taxonomy namely tangible benefits, intangible benefits and impact on business performance. Sedera et al. (2003) on the other hand, measured the organizational impact of an ERP system implementation with five items including organizational costs, staff requirements, overall productivity, product/ service quality and business process change. Moreover, in referring to Farbey et al. (1994) classification, Hedman and Borell (2004) conclude that ERP systems have an impact potential under all eight IT categories and cumulate the uncertainties associated to each category. Chen and Wang (2010) developed an index system for the analysis on performance evaluation system of ERP implementation based on sixteen factors namely human resources, software resources, hardware resources, management philosophy, collaborative commerce, decision-making, management standards, business reputation, corporate image, innovation learning, marketing, production, financial assets operation, capacity development and information resources.

Uwizeyemungu and Raymond (2010) suggested the ex-post evaluation of ERP systems is necessary not only to justify the investments made in these systems, but also and above all to better manage benefits sought by organizations from these systems. They after an extensive literature review suggested that IT impact evaluation models can be regrouped under four categories: causal models, contingency models, process models and scorecard models. Causal models (Byrd and Marshall, 1997; Sircar et al., 2000; Thatcher and Oliver, 2001; Hitt et al., 2002; Hendricks et al., 2007; Shin, 2006), also known as variance models, attempt to establish a cause-effect relationship between IT investments on the one hand, and organizational performance on the other.

Performance indicators of the ERP's introduction based on effectiveness have been found in the researches by Kaplan and Norton (1996), Booth (2000), Lipe and Salterio (2000), Banker et al. (2004), Dilla and Steinbart (2005). Saatçiyöğçü et al. (2008) conducted a study to evaluate the system by using benefits, barriers and risks with their effects on user satisfaction. For evaluating the impacts of ERP systems based on a balanced scorecard framework, Chand et al. (2005) identified parameters including such as Financial cost of ERP implementation, financial input necessary for achieving targeted performance level, Customer efficient support to individual needs, benefits derived for the company from a certain level of performance. ERP System are used in improvement of internal business processes, effectiveness and efficiency of internal processes in operations, innovation and learning and flexibility of ERP software help integrate future changes and future customer needs.

According to Kaplan and Norton (1992, 1993) "BSC is a framework to structure the relevant key performance indicators for performance management" – can be applied for measurement (Walton 1999, Van der *et al.*, 1999, Rosemann and Wiese, 1999; Brynjolfsson and Hitt, 2000). It is typically designed to monitor business processes and is the consistent conversion of visions into objectives and measures. It is considered more effective than traditional financial-based models that used to concentrate only on single departments (Seraphim, 2006) and since they provide data that are of much help to management in shaping overall strategy (DeBusk and Crabtree, 2006). Harvard business review listed BSC as one of the 75 most influential business ideas of the twentieth century since, it was received and used so enthusiastically and successfully in last year's (Bible *et al.*, 2006), while Kaplan and Norton's first BSC monograph (Kaplan and Norton, 1996a) was chosen as one of the 100 best books of all time by business columnists (Covert and Sattersten, 2009).

Research Methodology

Data were collected from 12 manufacturing organizations and the sample of the study constituted of 202 individuals working in these manufacturing companies. Using non-probabilistic judgmental sampling, a total of 237 surveys were collected after

several follow-up e-mails and phone calls. The reliability control has shown that 13.8 percent of respondents were unreliable, as some questions were left unattended. Moreover, in some cases, the observed responses were artificially inflated as a result of respondents' tendencies to respond in a consistent manner.

Literature revealed that some of the studies related to organizational performance have taken BSC model as a foundation. The present study also considered BSC as a basis of evaluating the organizational performance and productivity since it increases the completeness and the quality of ERP implementation reports and raises the awareness for relevant factors.

However, financial performance factor of BSC model was not measured since the manufacturing organizations were reluctant in sharing financial data. Elragal and Serafi (2011) suggested that financial benefits have been analyzed many times before and do not give a direct contribution of the effect of the ERP system. Velcu (2007) also suggested that a qualitative rather than a quantitative approach focusing on operational and intangible benefits can better outline the direct relationship between the ERP system and the business performance. According to DeLone and McLean (1992), Jacobs and Bendoly (2003), and Kennerley and Neely (2002) also, the system success is measured in language of financial costs and benefits but such measures are often not possible because of the problems in quantifying intangible impacts and isolating this effect from other environmental variables that affect organizational performance.

For measuring the effect of ERP on organizational performance and productivity, the list of 67 items were formed. As the study incorporated tools that were new to this research, further retesting of these tools was deemed necessary to assess their robustness to a different population of firms and to derive confidence in subsequent analysis, a pilot survey was executed before conducting the main survey. The purpose of the pilot survey was to examine whether or not the proposed model was well developed and suitable to analyze ERP success. The conceptual ERP success model and contents of the main survey were modified based on the results of the pilot survey and it provided 62 items that were selected for the submission to the panel of judges for assessing content and construct

validities. The final list on the basis of the frequency of choices of the judges comprised of 56 items (with 84% acceptance).

Subsequently, these 56 items of effectiveness were allocated into the three facets of the Balanced Scorecard namely Internal Processes, Innovation, Learning and Growth of Customers, Suppliers and External Agencies in order to construct the effectiveness framework of ERP system. These indicators in the tool were employed on 7 point Semantic Differential scale ranging from very less to very high for both before ERP implementation and after ERP implementation.

Paired t-test checks the confidence intervals for the difference between a pair of means (Armitage and Berry, 1994; Altman, 1991). This test compares the means of two variables by calculating the difference between the two variables and tests to see if the average difference is significantly different from zero. A paired t-test measures whether means from a within-subjects test group vary over 2 test conditions. The paired t-test is commonly used to compare a sample group's scores before and after an intervention. First, the paired t-test is applicable when measuring how a static group measuring organizational performance performs in two conditions and this requirement is met. Second, the paired t-test is appropriate when the independent variable is dichotomous. In our experiment, the two test conditions, (presence of a ERP system or lack thereof) fulfil the requirement.

Testing of matched pair permits us to control for confounding macroeconomic or industry influences. Since, 202 employees participate in the experiment, so the study is marginally safe in assuming the dependent variable followed a normal distribution (the central limit theorem proves distribution is normal with a sample size of 30 or more). Thus, we can say that paired t-test is valid in our analysis.

RESULTS AND DISCUSSION

H_{01} : There is no significant difference in the organizational performance and productivity due to ERP installation.

H_{01} stands rejected

The hypothesis stands rejected at 1% level of significance ($p < 0.01$). Thus, organizational performance was significantly affected due to ERP installation. Also, the total mean before ERP installation was 204.27 and after ERP installation was 267.08. Hence, there has been an improvement in the organizational productivity due to ERP installation.

Effect on the different facets of BSC model for measuring organizational performance and productivity

H_{02} : There is no significant difference in the internal processes of an organization due to ERP installation.

H_{03} : There is no significant difference in the Innovation, Learning and Growth Factors of an organization due to ERP installation.

H_{04} : There is no significant difference in the Customers, Suppliers and External Agency Factor of an organization due to ERP installation.

Hypotheses H_{03} , H_{04} and H_{05} stands rejected. Internal processes, Innovation, Learning and Growth, Customers, Suppliers and External Agencies of an organization were significantly affected due to ERP installation and the hypothesis stands rejected at 1% level of significance ($p < 0.01$). In case of internal process, the total mean before ERP installation was 144.67 and after ERP installation was 187.79. This shows that, there has been an improvement in the organizational productivity related to internal processes of an organization. The total mean before ERP installation was 32.61 and after ERP installation was 44.65 for innovation, learning and growth. Hence, due to ERP installation, there has been an improvement in the organizational productivity related to innovation, learning and growth of an organization. Also, the mean before and after ERP installation was 26.99 and 34.65 respectively, indicating improvement in customers, suppliers and external agencies.

The outcome of the study indicated that ERP has significantly affected the organizational performance and productivity. The results as regards the benefits of the ERP system agree with the classification of Hitt *et al.* (2002), Anderson *et al.* (2003) and Shang and Seddon (2002) on this issue and contradict Staples

et al. (2002), whose users' expectations outweighed their final perceptions.

However, in a 2001 survey of APICS members, IT user groups and others, approximately 70% of respondents reported that their ERP systems were 'successful' or 'very successful'; however, 30% self-described as 'neutral' or 'disappointing' (Mabert *et al.*, 2003). In a 300-day longitudinal study of a single company's archival data, McAfee (2002) found that operational performance indicators initially dipped but eventually exceeded the levels that existed when ERP was implemented. Ross and Vitale (2000) also found a performance dip after initial implementation of an ERP system. Wieder *et al.* (2006) did not find any significant performance differences between ERPS adopters and the control group - neither at the supply chain level, nor at the overall firm level. According to Kang *et al.* (2008) also, these mixed findings imply that ERP investment does not always yield positive effects on business performance, leading us to adopt a contingency perspective on its effectiveness.

The results of our study are also in contradiction to the studies by Williamson (1997), Barker and Frolick (2003), Davenport, (1998), Gargeya and Brady (2005) who indicated that 3/4 ERP projects were considered as failure and cannot be accepted. In some cases, it has led to organizational bankruptcy (Bulkeley, 1996; Davenport, 1998; Markus and Tanis, 2000; Scott and Vessey, 2002). Scheer and Habermann (2000) estimated that over half of ERP projects ended in failure. However, this could be because, these studies were conducted during the initial and launching phase of ERP, when less number of modules were included in ERP package and where appropriate training facilities were not there. Now, the features and modules of ERP have improved due to requirements and continuous feedback of the customer and increased demands in an organization after the experience and usage of ERP systems.

CONCLUSIONS

The study showed that organizational performance and productivity had improved after the installation of ERP system among the sample under study. Hence, companies should rejuvenate the legacy systems they use and upgrade their systems from time to time as the development of the IT technology accelerates

constantly. The study provided managers, a clear view of the relative performance of the various segments of the organization. This can be used to identify improvements required and take action accordingly. Managers could periodically evaluate the performance indicators benchmark results with the expected level of satisfaction and diagnose which factors were problematic and need further consideration. Organizations that have future designs will form a clear understanding of business requirements, gain more vision and acquire ability to expand knowledge and skills to better assimilate and utilize ERP system, and therefore minimize the risks associated with this particular investment. Besides, it is important for researchers to be aware of the fact that many firms are reluctant to share financial information. It is very likely that the case study methodology will continue to be the empirical research tool of choice in this area until usage of this system become more widespread and routine.

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Appendix

Table - 1

	Mean	N	Std. Deviation	Std. Error Mean
PreERP	204.27	202	37.173	2.615
PostERP	267.08	202	44.213	3.111

Table 1 a - Paired Samples Statistics for Over-all Performance Indicators

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig.
PreERP PostERP	-62.8	64.249	4.521	-13.8	201	0

Table 1 b - Paired Samples Test for Over-all Performance Indicators

	Mean	N	Std. Deviation	Std. Error Mean
PreInternalProcesses	144.67	202	27.933	1.965
PostInternalProcesses	187.79	202	33.245	2.339
PreInnovationLearningGrowth	32.61	202	8.212	0.578
PostInnovationLearningGrowth	44.65	202	9.006	0.634
PreCustomersSuppliersExternal	26.99	202	6.634	0.467
PostCustomersSuppliersExternal	34.65	202	7.863	0.553

Table 2 a - Paired Samples Statistics for Facets of BSC Model

	Mean	Std. Deviation	Std. Error Mean	T	df	Sig (2-tailed)
PreInternalProcesses – PostInternalProcesses	-43.1	50.692	3.567	-12.1	201	0
PreInnovationLearningGrowth – PostInnovationLearningGrowth	-12.0	13.333	0.938	-12.8	201	0
PreCustomersSuppliersExternal – PostCustomersSuppliersExternal	-7.66	10.47	0.737	-10.4	201	0

Table 2 b - Paired Samples Test for Facets of BSC Model