

Effects of Business Process Reengineering and Enterprise Resource Planning on Supply Chain Management Performance

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Abstract—In today's growing economy, all companies aim to increase their profits and they are getting more competitive. In this competition environment, companies which improves the performance of their supply chain gains an advantage. The use of both Business Process Reengineering (BPR) and Enterprise Resource Planning (ERP) systems are the most important factors that affect Supply Chain Management (SCM) performance. In this study, a deep field-study has been made on the Turkish enterprises to determine BPR's and ERP's effects on SCM performance. Understanding of these relationships is vital for realizing the importance of BPR and ERP. Findings have been analyzed with statistical methods to summarize the current situation in Turkish enterprises. Results of this study have showed that both BPR and ERP have positive effects on improving the performance of SCM. Also, these results can be used in cross-country comparisons of BPR applications' and ERP implementations' effects on SCM performance.

Keywords—Business Process Reengineering, Enterprise Resource Planning, Performance Evaluation, Supply Chain Management.

I. INTRODUCTION

GLOBAL economy continues to grow under highly competitive market environment nowadays, so that, enterprises are no longer competing independently. They have to rely on their supply chain systems. Having an effective Supply Chain Management (SCM) has therefore become a potentially valuable way of securing a competitive advantage and improving organizational performance [1], [2]. The benefits of supply chain management include cost savings through reductions in inventory and costs of transaction across the supply chain, faster response to changes in the market demands, lower product development, and increased competitiveness and profitability [3]. In order to achieve these benefits, one should consider the performance of supply chain along with all its channels. For this purpose, it would be enough to use some performance measures to efficiently manage an effective supply chain. These measures have an important role since they affect strategic, tactical, and operational planning and control. Performance measurement

and metrics are essential in setting objectives, evaluating performance, and determining future courses of actions [4].

Various performance metrics have been developed to measure, evaluate, and monitor the operation of the entire supply chain. Lockamy and McCormack [5] indicated in their research that there were only a small number of studies attempting to empirically link specific supply chain management practices such as quality assurance to supply chain performance. The appropriate performance metrics can be used to evaluate the probability of success in achieving the target, to provide advice or corrective suggestions to the organization, to provide a feedback system to the manager and to evaluate the internal input and output [6]. However, if the metrics within a supply chain lack consistency, it is difficult for managers to take the appropriate actions based on the performance evaluation [7].

There is a model called Supply Chain Operations Reference (SCOR) model prepared by Supply Chain Council [8] for a better SCM that consist of standardized terminology and processes. Some metrics selected from the SCOR model have been used in this study to evaluate performance of SCM systems of enterprises for a standardized comparison purposes.

The current trend of supply chain management is to apply Information Technology (IT) to integrate cross-enterprises and inter-enterprise processes [9]. Responding to the fast changing business environment of the modern markets, companies need to integrate their business functions into a single system [10]. Such solutions often referred to as Enterprise Resource Planning (ERP) systems, efficiently utilize IT and enable the internal sharing of data and information as well as the required communication with third-party vendors and customers [11][12]. The literature reveals the necessity for adopting IT to foster information sharing in a supply chain [13], [14], the use of ERP systems. ERP systems have been considered an important development in the corporate use of information technology in the 1990s, enhancing organizational cross-functional efficiency and effectiveness through the seamless integration of all the information flowing through a company. Thus, ERP serves as the vital backbone information system of the enterprise, helping a company achieve the efficiency, agility, and responsiveness required to succeed in a dynamic business environment [15]. ERP has been selected as one of the factors affecting the supply chain performance [16], [17].

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To realize a quantum leap improvement, reengineering the process control system is required [18]. ERP makes use of Business Process Reengineering (BPR) to develop a long-term improvement plan [19]. ERP can be defined as a strategy to bring deliberate and fundamental change in the business processes to achieve breakthrough improvements in performance. ERP systems organize the information management capability to support BPR [20]. Enterprises prefer reengineering their business processes by leveraging potential benefits of using IT in their functional units [21]. The notion of this new trend is called IT-enabled BPR.

Effects of BPR application on the success chance of ERP implementation have been proved by [16]. Erkan, Bac, Rouyendegh [16] focused on some aspects of SCM performance indicators instead of measuring the overall performance of SCM and independent effects of BPR application and ERP implementation have not been investigated. In this study, measuring the overall SCM performance by considering the availability of BPR and ERP separately has been done by more detailed analyses of Turkish manufacturing enterprises.

Since unsuccessful ERP implementations may result in loss of big amounts of capital investments, making the necessary preparations will increase the chance of a successful ERP implementation. According to literature BPR has a vital role on the ERP success. Both of these strategies have a positive effect on the SCM performance. So, knowing the amount of these effects individually has a great importance on the strategic investment planning.

Main purpose of this study is to measure the contribution level of each strategy to the overall performance of supply chain separately. For this purpose an overall SCM performance evaluation metrics have been gathered together and converted into questions to be measured on manufacturing firms. Instead of focusing some parts of SCM capturing an overall picture would provide a better insight on performance increments caused by BPR and ERP strategies. Also consideration of each strategy have been made independently for each company have been made together with the evaluation of companies at which both strategies are being used. Such a diversion was necessary to acquire better results free of dependency exists between the two strategies.

II. METHODOLOGY

A questionnaire has been prepared and applied on Turkish enterprises to determine the effects of BPR and ERP on SCM's performance. In this study, questionnaires have been applied on different type of manufacturing companies.

The questionnaire study has been conducted in 132 companies in Turkey, which have been mostly applied by the face-to-face method. Based on the preliminary interviews with the project leaders, BPR and ERP experts, a better understanding of the concepts and metrics in the questionnaires have been achieved. The questionnaires were filled by 106 enterprises and conducted at different sized

companies in manufacturing field. The distribution of companies according to their usage of BPR and ERP has been given in Table I. 33 companies were both using BPR and ERP, 31 companies were only using BPR, 32 companies were only using ERP and 36 companies were using neither BPR nor ERP. The distribution of the size of investigated enterprises according to their number employees has been given in Fig. 1.

TABLE I
DISTRIBUTION OF COMPANIES ACCORDING TO THEIR BPR AND ERP USAGE

	Using ERP	Not Using ERP	Total	Percent
Using BPR	33	31	64	48.5
Not Using BPR	32	36	68	51.5
Total	65	67	132	100
Percent	49.25	50.75	100	

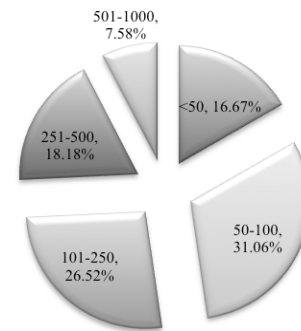


Fig. 1 Size of companies according to number of employees.

Erkan, Bac, Ozdemir [17] analyzed the following metrics to determine if ERP implemented successfully in a company with ERP implementation project leaders under three main titles, which are functionality, scalability, and integrity. Similarly in this research, the main ERP implementation key performance indicators (KPIs) used are: The financial input necessary for achieving the targeted key performance level, benefits of the organization deriving from a certain level of performance, the internal processes effective and efficient in assuring of performance, the new ERP system having sufficient potential for possible future customer needs, measuring the monetary perspective, measuring the customer perspective, measuring the internal process perspective, measuring the human resource perspective goal, measurement of budget compliance hardware, measurement of software, measurement of training, measurement of consulting goal, measurement of processes reducing bottlenecks, reducing operational problems and availability of the ERP system.

To determine if a successful BPR implementation exists in the company, KPIs such as the following have been questioned with BPR experts: user involvement level, pilot implementation availability, top managements contribution to the project, expectations feasibility, etc.

Erkan, Bac, Rouyendegh [16] measured SCM performance according to KPIs such as; greater flexibility, increased efficiency, improved communication, lower operating costs, increased revenue, reduced cycle times, better collaboration, higher profit margins, higher customer satisfaction, inbound

logistics performance, outbound logistics performance, human resource management performance. These indicators have been measured according to some metrics that have been selected from the SCOR model [8]. There are many metrics in the SCOR model. Along those metrics ones related with in-bound/out-bound logistics success, service levels/accuracies, delivery times, cycle-times at different levels have been selected. Erkan and Bac [22] suggest these particular ones to be selected by considering their availability in the ERP systems.

III. HYPOTHESES

As mentioned before, BPR application and ERP implementation have effects on SCM performance. Those effects of BPR and ERP have been explored with a field-study in Turkey in this study. To prove these effects three hypotheses have been defined:

H1: Using BPR improves SCM performance in a manufacturing company.

H2: Using ERP improves SCM performance in a manufacturing company.

H3: Using both BPR and ERP improves SCM performance more than using any of them individually in a manufacturing company.

After hypotheses have been defined, independent samples two-way variance analysis and independent samples t-test have been selected as statistical analyses methods.

According to independent samples t-test, means of two samples have a statistically significant difference if the 2-tailed significance value is less than 0.05 in the 95% confidence interval. In the analysis phase, SPSS software has been used to test the hypotheses.

IV. STATISTICAL ANALYSES

SCM performance has been measured according to mentioned metrics. Seven points Likert-Scale has been used to measure these metrics. To test the effects of BPRs existence (independent of the existence of ERP) on SCM performance, independent samples t-test has been used. Result of this test have been given in Table II.

TABLE II
INDEPENDENT SAMPLES T-TEST RESULTS (BPR APPLICATION)

Hypothesis	BPR	N	SCM Performance Score Mean	Std. Deviation	Std. Error Mean	Independent samples t-test significance (2-tailed)
H1	Not Existing	68	3.09	1.671	.240	0.000
	Existing	64	4.73	1.664	.217	

These results show that there is a significant difference between the performance scores. 64 companies, which applied BPR, have better SCM performance scores. Findings confirm the H1 hypothesis. The result of independent samples t-test is valid in the 99% confidence interval according to significance

value acquired in the test.

A second independent samples t-test has been used to test the effect of ERP usage (independent of the existence of BPR application) on the SCM performance. Results of this test can be seen in Table III.

TABLE III
INDEPENDENT SAMPLES T-TEST RESULTS (ERP IMPLEMENTATION)

Hypothesis	ERP	N	SCM Performance Score Mean	Std. Deviation	Std. Error Mean	Independent samples t-test significance (2-tailed)
H2	Not Existing	67	3.21	1.653	.211	0.000
	Existing	65	4.82	1.541	.203	

ERP implementation has similar results on the performance as suggested by H2. The ERP system usage has positive effects on SCM performance scores. 65 companies, which have been implemented an ERP system, have better performance scores. The result of independent samples t-test is valid in the 99% confidence interval according to significance value acquired. For both analyses there are more than 1.6 performance score difference (over 7) in the results.

To test the effects of BPR and ERP together on the SCM performance another test is required. For this purpose, independent samples 2-way variance analysis is being used to test the combined effect of more than one independent variable on a dependent variable. This analysis has been used to test the combined effect of ICM and ERP on the SCM performance. Results of this analysis have been given in Table IV.

TABLE IV
INDEPENDENT SAMPLES 2-WAY VARIANCE ANALYSIS RESULTS (COMBINED EFFECTS OF BPR AND ERP)

Hypothesis	BPR	ERP	N	SCM Performance Score Mean	Std. Deviation	Significance
H3	Not Existing	Not Existing	36	2.11	1.068	0.005
	Existing	Existing	33	5.52	1.490	

Final analysis has been made to emphasize the performance effects of using both systems together. As it can be seen from Table IV, SCM performance score differs drastically between the companies that use both BPR and ERP than the ones that don't use any of them. Findings confirm the H3 hypothesis. This result of independent samples 2-Way variance analysis test is also significant in 99% confidence interval. When combined with first two hypotheses it can be said that the increase acquired in SCM performance score is greater if BPR and ERP systems are used together instead of using them separately.

V. CONCLUSION

As a result of this study BPR application and ERP implementation strategies in Turkey have been identified and their success evaluations have been made. Also, effects of these strategies on SCM performance have been evaluated.

Findings show that, using either of the BPR or ERP strategies has positive effects on SCMs overall performance where it has been found that successful implementation of ERP has more improvement chance on performance. Furthermore, it is proved that using both BPR and ERP together improves the SCM performance further to the points where neither BPR application nor ERP implementation may reach individually. This concludes that BPR acts as a success factor for ERP systems, which improves the chances of successful ERP implementation. Since implementation of an ERP system is a risky and costly process this issue is very important for strategic investment decisions. These results give great insights to the managers of the supply chains who already use or plan to invest into any of these strategies.

This study has been made in the Turkish manufacturing companies. For further studies, industrial differences of the effects of BPR and ERP on SCM performance can be investigated. Also, cross-country comparisons can be made to state any possible differences between different countries.

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