

ENTERPRISE RESOURCE PLANNING (ERP) AND ECONOMIC PERFORMANCE: AN EXPLORATORY STUDY OF MANUFACTURING ENTERPRISES IN INDIA

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Abstract— Enterprise Resource Planning (ERP) is a software package that attempts to integrate all departments and functions of an enterprise into a single computer system that can serve different departments needs. It is observed that the operational and economic performance of enterprises can be enhanced if ERP is properly implemented. However the Indian manufacturing industries has not considered this important issue with an intension to enhance their economic performance. Therefore, this paper analyses the implementation issues of ERP and how it affects the economic performance of the manufacturing enterprises. To probe this a survey was conducted to study the ERP in Indian manufacturing enterprises. The study found that firms having ERP contribute more value to their product or services and exhibited a better economic performance.

Index Terms—Survey, Enterprise resource planning, economic performance, value added (VA)

I. INTRODUCTION

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. 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. A number of empirical and non empirical studies have addressed a variety of CSF for ERP implementation. There are large number of critical factors that contribute to ERP performance in industries. ERP in industries generally add value to industries. The main value added factors include improved information availability, cost saving, time savings and improved quality of work. Hence one of the main method to analyse the performance of industries having ERP implementation is to identify the value of the industries.

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Therefore the present study focus on ERP implementation in the context of Indian manufacturing enterprises.

The paper is organized into following sections. Section 1 covers introduction followed by literature review in section 2. Section 3 covers objective scope and methodology of the work. Section 4 will cover the characteristics of surveyed firms and relationship between ERP implementation and economic performance is mentioned in section 5. Section 6 which covers summary and conclusion and references will cover in section 7.

II. LITERATURE REVIEW

The researchers have amassed knowledge about ERP and have come out with various definitions. Some of them are Minahan (1998), defines ERP as a complex software system that ties together and automates the basic processes of a business. Al-Mashari and Zairi (2000), indicate that ERP represents an optimal enterprise-wide technology. Nah and Lau (2001), defined ERP is a packaged business software system that enables a company to manage the efficient and effective use of resources by providing a total, integrated solution for the organization's information-processing needs. E.W.T. Ngai, et al,(2008), states that the Enterprise Resource Planning (ERP) System is a generic term for a broad set of activities supported by multi module application software that helps organization to manage their resources.

The benefits of ERP can be summarized under two categories viz.tangible benefits and intangible benefits. Kenneth E Murphy and Steven John Simon (2002), analysed Intangible benefits valuation in ERP projects. This paper reviews the importance of intangible benefits, lists intangible benefits that are important in ERP projects and demonstrates the use of a scheme through which they can be incorporated into traditional evaluation techniques. Daniel o leary (2004), analyzed the empirical benefits of ERP system. In this the tangible benefits of ERP system include inventory reduction, personal reduction, productivity improvement, order management improvements, IT cost reduction, procurement cost reduction ,revenue increasing, transportation reduction, maintenance reduction and on time delivery. The intangible benefits they analyzed include information availability, customer responsiveness, new improved processes, cost reduction, integration, standardization, flexibility, globalization and business performance.

Markus and Tanis (2000), note that the benefits of ERP systems implementation should be assessed in relation to the organization's unique goals for the system. They also state that the measures of ERP success (the benefits attained) are relative to the period of time during which they are assessed. Huang, Z. and Palvia, P (2001), discussed ERP implementation issues in advanced and developing countries.

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They found that ERP has been widely adopted by organizations in developed countries. Meanwhile, ERP is beginning to appear in many organizations of developing countries. Botta-Genoulaz, et al (2005), conducted a survey on recent research literature in ERP systems. This survey confirms that the research on ERP systems is still a growing field, but has reached some maturity.

Mohammad Reza Moohebat et al. (2010), had carried out Comparative Study of Critical Success Factors (CSFs) in Implementation of ERP in Developed and Developing Countries. This research showed that in developed and developing countries Change in Management was most important factor and in developed countries Country-related functional requirements factor was less important factor and Fit between ERP and business/process was the least cited factor among developing nations. It concluded that national culture of developing countries has an impressive effect on ERP implementation in these countries. Bhushan T. Patil et al (2012), carried out the Performance Evaluation of Enterprise Resource

Planning (ERP) Systems in Indian Manufacturing Industries. The study related ERP performance in terms of profitability, productivity, reduction in rejections and faster service. They proposed a mathematical model to evaluate the performance of ERP implementations in the Indian manufacturing industries. They also tried to investigate the benefits that a company gains after the implementation of ERP.

From the literature review, it was observed that firms which follow ERP have many advantages in terms of productivity, turnover, automation, operation and economic performance etc., to name a few. Therefore, this paper attempts to explore relationship between ERP implementation and economic performance in the manufacturing enterprises. For this purpose, the firms were classified into two categories viz. ERP and non ERP firms and their performance were compared.

III. OBJECTIVES SCOPE AND METHODOLOGY

3.1 OBJECTIVES

The broad objectives of this paper is

- To study the status of ERP implementation in manufacturing enterprises in India.
- To study the characteristics of the surveyed enterprises in terms of their ERP capabilities.
- To probe a relationship between ERP and economic performance of enterprise

3.2 SCOPE

The study explored the status of manufacturing industries in India in terms of their ERP implementation. The study is based on primary data collected using semi structured questionnaire. The list of enterprises was taken from the database provided by District Industry Centre and the directory of SMEs. A total of 65 firms were selected from the list and finally a list of 57 firms was included because of incomplete data provided by 8 firms. Among the 57 firms 25 firms are already implemented ERP and the rest 32 are not implemented ERP so far. The data collected by the author itself between October 2014 and February 2015.

3.3 METHODOLOGY

A pilot study conducted by selecting 10 firms randomly. Firms having ERP and without ERP is selected for the study. Based on the pilot study questionnaire was modified and main study was conducted. The questionnaire has three parts, first part covers basic profile of the firms, second part covers data on economic indicators and the third part covers ERP related issues in the firms. The performance index selected to analyze the performance of the industries is Value added (VA). The methodologies adopted for data analysis include descriptive analysis, correlation and regression analysis using Minitab 17.

IV. CHARACTERISTICS OF SURVEYED FIRMS

The basic characteristics of the surveyed enterprises is analysed to generate insights regarding the various features. The study analyzed whether ERP implementation has any relationship with the age of the firms and the results is shown in table 4.1

Table 4.1 Age of the firm

ESTABLISHED YEAR	NON ERP FIRMS	ERP FIRMS
LESS THAN 1950	0	4
1950-1960	0	2
1960-1970	1	2
1970-1980	5	1
1980-1990	6	1
1990-2000	6	5
2000-2010	9	10
2010-2020	5	0
Total	32	25

From the above table it is clear that newly established and large scale firms are keen to implement ERP with an intension to improve economic performance compared to older and small firms.

Another feature analysed is the nature of the ownership. The results obtained from the analysis is shown in table 4.2 below

Table 4.2 Ownership type

OWNERSHIP	NON ERP FIRMS	ERP FIRMS
PRIVATE	14	18
SINGLE OWNER	16	1
PUBLIC	2	2
PARTNERSHIP	0	4
TOTAL	32	25

Majority of the ERP implemented firms are of private ownership type. This shows that management attitude is found important in this. The public limited companies, although they have capabilities in terms of capital and labour are not willing to adopt ERP. This may be due to government policies and attitude of the top managers.

The nature of the firms in terms of production flow is analysed and the results is shown in table 4.3 below.

Table 4.3. Production flow

FLOW TYPE	NON ERP FIRMS	ERP FIRMS
Batch	17	0
Continuous	3	2
Job shop	2	1
Flow	8	0
Project	2	22
TOTAL	32	25

For batch production ERP implementation is very low, whereas for project type ERP implementation is very high. This may be due to the reason that automation (for material handling and others) is very difficult in batch type production flow. The another feature analysed is number of employees and the result is shown in table 4.4 below

Table 4.4 Number of employees

EMPLOYEE RANGE	NON ERP FIRMS	ERP FIRMS
less than 100	31	0
100-200	1	2
200-300	0	3
300-400	0	2
400-500	0	1
500-600	0	4
600-700	0	3
700-800	0	0
800-900	0	4
900-1000	0	3
greater than 1000	0	3
TOTAL	32	25

From the analysis it is clear that numbers of employees are more in those firms with ERP. This shows that compared to smaller firms larger and medium firms have better scope for ERP implementation. The characteristics of the firms is further analysed in terms of capital investment

Table 4.5 Capital investment

CAPITAL INVESTMENT(IN Rs.lakhs)	NON ERP FIRMS	ERP FIRMS
0-25Lakhs	19	0
25-50lakhs	0	2
50-100lakhs	0	0
100-500lakhs	0	1
ABOVE 500lakhs	0	22
TOTAL	32	25

ERP implementation is a costly affair. Small firms cannot afford to implement ERP. This may be due to the fact that normally small firms look at immediate benefits and benefits from ERP can be expected by long terms. Another feature analysed is turnover and the results is shown in table 4.6 below

Table 4.6 Turnover

TURNOVER (IN Rs lakhs)	NON ERP FIRMS	ERP FIRMS
0-50 lakhs	14	0
50-100lakhs	5	0
100-5000lakhs	10	4
5000-10000lakhs	2	1
10000-15000lakhs	0	6
ABOVE 15000lakhs	1	14
TOTAL	32	25

For most of the ERP firms the turnover of the firms is greater than Rs1500000000. This shows that ERP implemented firms have better turn over than non ERP firms. ERP in the firms is contributing greater turnover.

Nature of the firms is further analysed in terms of Value added

Table 4.7: Value added

VALUE ADDED (IN Rs.lakhs)	NON ERP FIRMS	ERP FIRMS
0-20lakhs	21	0
20lakhs-40lakhs	6	0
40lakhs-60lakhs	1	0
60lakhs-80lakhs	1	0
80lakhs-100lakhs	0	0
ABOVE100lakhs	3	25
TOTAL	32	25

From the analysis it is clear that for all the ERP implemented firms the value added range is above Rs 100 lakhs This shows that ERP firms have better value added range, and hence ERP firms have better performance than non ERP firms.

A comparison was made between ERP and non ERP firms based on features shown in the above table. The analysis concluded that ERP implemented firms have better economic and operational performance. This shows that ERP is greatly contributing to the performance of enterprises.

V. RELATIONSHIP BETWEEN ERP AND ECONOMIC PERFORMANCE

5.1 COMPARISON OF FIRMS BASED ON AVERAGE VALUES OF THEIR ECONOMIC INDICATORS

The economic indicators selected to compare ERP and non ERP firms are labour productivity, capital productivity, value added per value of output and returns to scale. From the data collected their average values are determined and they are shown in table 5.1 below

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Table 5.1 Average values of economic indicators

AVERAGE VALUES	NON ERP FIRMS	ERP FIRMS
Value added	2064343	62735508
Labour productivity	169742	10949937
Capital productivity	1.71	139.2
Value added per value of output	.214	.604
Returns to scale	<1	> 1

From the comparison table it is clear all values of the economic indicators are very much higher in ERP firms than that of non ERP firms. This shows that firms having ERP are better in terms of their economic indicators. To further probe this result a correlation analysis was also done between value added and selected economic indicators and the results are discussed in the following sections.

5.2 CORRELATION BETWEEN VALUE ADDED AND SELECTED ECONOMIC INDICATORS

The above average values does not means that ERP implemented firms are better in terms of economic performance. To further analyse the performance a correlation analysis was carried out with selected economic indicators and value added. The values obtained by the correlation analysis is shown in the table 5.2 below.

Table 5.2 Correlation values between value added and indicators

TYPE OF FIRMS	CORRELATION BETWEEN VALUE ADDED AND SELECTED INDICATOR	COIFICI ENT VALUE	SIGNIF ICANC E VALUE
NON ERP FIRMS	Labour Productivity	.519	0.002
	Capital Productivity	.568	.001
ERP FIRMS	Labour Productivity	.982	.000
	Capital Productivity	.949	.000

Both the correlation values are highly significant for ERP firms compared to non ERP firms. This shows that ERP activities are possible in labour and capital intensive industries. However the correlation analysis does not completely mean that there is a relationship. To further substantiate this a production function analysis is carried out and the results were discussed in subsequent sections

5.3 PRODCUTION FUNCTION ANALYSIS

The “production function” is essentially an engineering concept that relates the various input factors in production to the output from it. Traditionally, standard production models considered capital, land and labour as the fundamental factors of production. The Cobb-Douglas production function adopted for the analysis in both ERP and non ERP firms

For non ERP firms the production function analysis used is $Y=AK^aL^bM^cE^d$

Where,
Y=value added , K=capital investment, L=labour cost, M=material cost, E=energy cost
A,a,b,c,d= Parameters that when estimated describe the quantitative relationship between the

inputs and the output

Taking logarithms on both sides of equation , Cobb-Douglas production function is reduced to a loglinear relationship between output of production and factors of production. Therefore, it essentially takes the form of a multiple regression equation. If all the inputs and output are expressed in monetary terms, the coefficients of independent variables may be used for interpreting the importance of the independent variables in explaining the variation in the dependent variable

The regression results obtained is shown in Table 5.3 below

Table 5.3 Production function (regression) analysis for non ERP firms

INPUT PARAMETERS	REGRESSION OUTPUT
Ln {capital}	-0.099 (-0.64) [0.525]
Ln {Labour}	0.850 (2.56) [0.017]
Ln {material}	0.2216 (3.63) [0.001]
Ln {energy}	-1.135 (-3.08) [0.005]
Ln {A} – Const	775712 (2.36) [0.026]
Adjusted R ²	68.11%
N	32

Values within the parentheses and square brackets indicate the ‘t’ values and significance levels respectively

It is observed that the adjusted R² value is 68.11% for non ERP firms.

For ERP implemented firms the same production function analysis is carried out and the results is shown in the table 5.4 below

Table 5.4 Production function (regression) analysis for ERP firms

INPUT PARAMETERS	REGRESSION OUTPUT
Ln {capital}	21.5 (12.8) [0.109]
Ln {Labour}	4.00 (3.47) [0.263]
Ln {material}	3.56 (1.60) [0.038]
Ln {energy}	8.26 (1.93) [0.000]
Ln {A} – Const	-4288824451 (-2.79) [0.011]
Adjusted R ²	97.30%
N	25

Values within the parentheses and square brackets indicate the ‘t’ values and significance levels respectively

For ERP firms the adjusted R² value is 97.3% which is very good value

A comparison is made between ERP and non ERP firms based on regression result and a positive return to scale is observed for ERP firms and for non ERP firms a negative returns to scale is observed. This shows that increasing returns to scale is due to ERP implementation. This again means for the surveyed firms high economic performance is mainly due to ERP. From all the analysis carried out above, the results shows that ERP implemented firms are having better economic performance compared to that of non ERP firms.

VI. SUMMARY AND CONCLUSIONS

The study probed the status of ERP implementation in manufacturing industries. From the data collected the characteristics of surveyed firms were analysed in terms of year established, ownership, production flow, number of employees, capital investment, turnover and value added. For all the above mentioned characteristics ERP implemented firms are having better results since ERP is greatly contributing to firms activities.

To further probe that ERP implemented firms are having better performance , the average values of economic indicators like value added, labour productivity, capital productivity, value added per value of output and return to scale is found that. The results obtained showed that ERP firms are having better performance. To further substantiate the fact that ERP implemented firms are having better economic performance correlation analysis is done between the key performance indicator (Value Added) and economic indicators labour and capital productivity. This results also proved that ERP implemented firms are having better economic performance compared to non ERP firms.

To again probe a relationship between ERP and economic performance a production function analysis (regression analysis) for both ERP firms and non ERP firms under same condition was carried out. From the results obtained the returns to scale value for both the firms were found out. ERP firms enjoyed an increasing returns to scale value while for non ERP firms decreasing returns to scale is obtained. This results also shows that ERP firms are having better in terms of their economic performance.

REFERENCES

- [1] Al-Mashari, M & Zairi, M. (2000), Enterprise Resource Planning: A Taxonomy of Critical Factors. European Journal of Operational Research, 146(2), pp 352-364.
- [2] Bhushan T.Patil, B.E.Narkhede, S.K.Mahajan, Aditya P.Joshi. (2012), Performance Evaluation of Enterprise Resource Planning (ERP) Systems in Indian Manufacturing Industries, International Journal of Research in Management & Technology, volume 2.
- [3] E.W.T. Ngai, C.C.H. Law and F.K.T. Wat, (2008) .Examining the critical success factors in the adoption of enterprise resource planning, Computers in Industry, Vol.59 ,pp 548–564.
- [4] Huang Z & Palvia, P, (2001), “ERP Implementation Issues in Advanced and Developing Countries”, Business Process Management Journal, pp 276-284.
- [5] Kenneth E Murphy & Steven John Simon (2002). Intangible benefits valuation in ERP projects, Info Systems J, pp 301–320

- [6] Markus, M.L., Tanis, C, & Fenema, P.C. (2000), Multisite ERP Implementations. Communications of the ACM, 43(4), pp 42-46.
- [7] Minahan, T. (1998), Enterprise Resource Planning Strategies not Included, Purchasing, 125(1), pp 112-127.
- [8] Mohammad Reza Moohebat, Asefeh Asemi, Mohammad Davarpanah Jazi (2010), A Comparative Study of Critical Success Factors (CSFs) in Implementation of ERP in Developed and Developing Countries, International Journal of Advancements in Computing Technology, Volume 2.
- [9] Nah, F.F & Lau, J.L. (2001). Critical Factors for Successful Implementation of Enterprise Systems. Business Process Management Journal, 7(3), pp 285-296.
- [10] V. Botta-Genoulaz , P.-A. Millet , B. Grabot (2005), A survey on the recent research literature on ERP systems, Computers in Industry , pp 510–522