



ERP Technology Application Benefits in Construction Firms in India: Factor Analysis

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Abstract: The major reason of the ERP implementation needs huge investment time and money. It helps in improving the ROI of firms. The problems in these business improvements are solved by the powerful tool called ERP systems. In the implementation of these ERP systems, the construction in the industry sector highlights the benefits gained by the firms which are having this type of systems. The study had conducted to know about the post implementation benefits of ERP construction firms. This study considered 10 key factors to identify the construction firm's performance in time of product innovation, process automation and investment management. The efficient and effective utilization of funds and value chain management also can be possible with ERP implementation. This implementation arises some of the benefits like Project management in specific time within the budget, ability in improving the decisions, maintaining the stronger relationships between client, supplier and subcontractor, carrying out the inventory management and remote procurements. The goal of this work is to examine the appropriateness of the ERP systems for the contractor management. Through the implementation of ERP construction, firms can reap the benefits of project management, cost reduction, reducing time over runs etc... The paper begins with a detailed literature review shedding light on the basic concepts of ERP system, its advantages and disadvantages, and implementation. This is followed by two case studies illustrating the operation of ERP systems in the construction sector. At the end, the results of the questionnaire survey are shown and major findings are discussed.

Keywords: ERP Projects, Profitability, Productivity, Construction firms, Inventory management.

1. INTRODUCTION

The development of any country economy largely depends upon the growth of construction projects as a part of infrastructure development. Implementation of ERP in construction firms in order to help in improvement in project cost management and operational efficiency. The construction firm had obtained good improvement in terms of material resource, manpower planning in one hand and improving return on investment (ROI). This research paper studies the improvement of ERP implementation in construction firms in respect of operation, good governance, cost efficiency and CRM.

Objectives :

1. To study the implantation of ERP and its impact on ROI on construction firms.
2. To analyze the important factors of ERP contributed for growth and development of construction firms.
3. To suggest efficient and effectiveness for improving construction firm efficiency through ERP application.
4. To know the performance of ERP implemented construction companies in India
5. To analyze the impact of ERP implementation and its impact on construction firms *i.e.* Profitability, Productivity, Investment management, Material management and Customer acceptance
6. To identify the critical success factor impact on construction firms
7. To suggest best recommendations to improve construction firms performance

ERP technology helps construction firms in India to reap competitive advantages. The study has taken from the period 2005-06 to 2015-16. This research analysis considers five main critical success variables. *i.e.*

1. Profitability
2. Productivity
3. Investment management
4. Material management
5. Customer acceptance

The primary objective of this ERP implementation in the construction firms will help in a right initiation to face the domestic and global level. The Application technology and technical implementations through ERP brings product process and people management in construction firm in a better way.

The increasing competition, expansion in markets and rising customer expectations needs. This increases the pressure on companies to lower total costs in the expand product choice, shorten throughput times, entire supply chain, provide more reliable delivery dates and drastically reduce inventories, better customer service, improve quality, and efficiently coordinate global production, demand and supply.

In these days, the entire business world is moving closer to a fully collaborative model and adversaries improves their skills, to remain adversary; organizations must upgrade their own business proceedings and procedures. Companies also should increase in sharing with their customers, suppliers and distributors should be protected when their information is in critical stage. And the functions that are within the company must improve their capacity to develop and broadcast timely and authentic information.

To attain the aims like Supply chain management, Value analysing, market diversification, the companies are progressively turning to enterprise resource planning (ERP) systems. ERP supports two main advantages that do not endure in non-integrated departmental systems: (1) Enclosing of all the departments and their functions in a unified enterprise view of the business. and (2) an enterprise database where all business transactions are entered, monitored, recorded, reported and processed. The unified view develops the necessity for, and the range of, interdepartmental assistance and coordination. It also empowers the companies to accomplish their ambitions of increased communication and also understandable to all stakeholders. With the most research residing of case studies in other industries is required to facilitate ERP construction firms for monitoring and planning process. A limited analysis has been directed in the implementation of ERP construction industry. The following figure depicts the 10 key factors that are relevant in constructing firms.



Figure 1: Efficiency model variables for a construction firm

Furthermore, the demanding factors for enterprise resource planning implementation will be distinct than others because the characteristic of construction industry is dissimilar than others industries. Based on the interview and literature review, this paper presents the main factors that are difficult for implementing in construction industries.

2. STATEMENT PROBLEM

The implementation of ERP systems is a long-term program which is high-priced. Once the organizations have obtained the ERP packages from external vendors, a project team will be setup by involving the internal employees and external consultants. The construction business is managed around projects that are to be completed and delivered in expected time within budget. Since the production line is different the methodology of this ERP system is different. About 22 percent of ERP implementations are unsuccessful due to late or over budget and only about 60 percent are successful.

This study had extensively considered to understand the effectiveness of the construction firm in terms of overcoming the high level of investment, measuring project efficiency and monitoring system to address the cost, manpower, technology aspects.

2.1. Hypotheses

H0: There is significant connection between ERP favourable factors on construction firm's performance.

H1: There is no significant connection between ERP favourable factors on construction firm's performance.

3. RESEARCH METHODOLOGY

This study presents favourable factors in the implementation of enterprise resource planning system to construct an enterprise. The construction enterprises are started to acknowledge the ERP system implementation for the improvement of operational efficiency. This ERP system is successfully implemented on two construction companies which are selected as case studies. One uses SAP R/3 system and another uses IFS system. This research is conducted in a series of one-to-one interview with experienced managers, employees and the project team. The outcomes of interview are concise with the others literature and reports that are related. The aim of this paper is to reveal the favourable factors which may provide to implement the ERP system to construction industry.

Sample: The study has taken 4 construction firms performance covering with 2 companies each small and large scale. The study has taken from the period 2005-06 to 2015-16. This research analysis considers five main critical success variables. The study administered a structured questionnaire to selected 200 respondents of selected sample firms in India.

Key Variables of ERP: Implementing an ERP system is not a high-priced or risk-free attempt. In fact, 65% of administrative in organizations rely on ERP systems having at least a bearable chance of damaging their businesses because of the implementation for hidden problems. Therefore, to analyse the high range factors, a successful implementation must be determined. It is the worth to mention that all the above variables had positively contributed to the success of the ERP construction firm. The construction firm management is involved in implementing the best business practices, value chain management and employee productivity. Many authors have analysed different factors that can be treated to be critical in the ERP implementation.

ERP technology: Constructive firm’s performance

$$= f(\text{profitability, productivity Investments, materials management, customers acceptance})$$

$$\text{ERP} = \text{CFP} = + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + e$$

ERP : CFP : ERP technology on Firm’s performance

Where

X1 = Profitability	α is Constant β are coefficients to estimate e is the error term
X2 = Productivity	
X3 = Investment management	
X4 = Material management	
X5 = Customer acceptance	

The processes in a company must conform to the ERP model regarding the business process reengineering are: (1) Best practices; (2) Ready to change; (3) Innovation; and (4) Customer relation. Earlier studies allege that many organizations are willing to change for the more successful implementation. Business process is also one of the measure to determine the success of construction firm property management. If there is no proper information provided to the people within the company about the purposes of BPR, they would be a concern among them about their jobs, which can delay the progress of reengineering. Management should answer to each and every employee and the plan of action can be understood by every people by conducting a wide range of meetings held by company.

Table 1
Efficiency of operations management

S.No	Factors/ Variables	Likert Scale					Total Score
		1	2	3	4	5	
1.	ERP helps in improving profitability	8	12	6	48	126	200
		4%	6%	3%	24%	63%	100%
2.	Improvement of productivity	12	15	24	78	71	200
		6%	7.5%	12%	39%	35.5%	100%
3.	Efficiency in marketing operations	17	23	33	47	80	200
		8.5%	11.5%	16.5%	23.5%	40%	100%
4.	Efficiency in material management	16	22	32	42	88	200
		8%	11%	16%	21%	44%	100%

As a part of ERP, BPR had more relevant in terms of improving the business diversification, material management and resource planning.

The efficiency of operations management of construction firms profitability, productivity, and market and material efficiency shown in Table 1. That Table reveals that 80% to 90% of response expressed that the efficiency of operational management through ERP implementation provides qualitative improvement in terms productivity, profitability, and market and material efficiency.

Table 2
Good Governance

S.No	Factors/ Variables	Likert Scale					Total Score
		1	2	3	4	5	
1.	Management policy	11	19	37	43	90	200
		5.5%	9.5%	18.5%	21.5%	45%	100%
2.	Transference in administration	17	23	32	48	80	200
		8.5%	11.5%	16%	24%	40%	100%
3.	Efficient audit	16	34	42	53	55	200
		8%	17%	21%	26.5%	27.5%	100%
4.	Efficiency of decision management support system	6	24	38	42	90	200
		3%	12%	19%	21%	45%	100%

The Good Governance practices of construction firms related variables that are management policy, Transference in administration, Audit and Decision making efficiency presented in Table 2. The calculated percentage of the above mention variables was highly influenced by ERP implementation.

Table 3
Cost Efficiency

S.No	Factors/ Variables	Likert Scale					Total Score
		1	2	3	4	5	
1.	Overall reduction in costs	7	23	44	56	70	200
		3.5%	11.5%	22%	28%	35%	100%
2.	Product cost analysis	8	12	37	43	100	200
		4%	6%	18.5%	21.5%	50%	100%
3.	Process cost analysis	17	23	29	71	60	200
		8.5%	11.5%	14.5%	35.5%	30%	100%
4.	Just in time implementation	19	31	37	43	70	200
		9.5%	15.5%	18.5%	21.5%	35%	100%

The cost efficiency in respect of construction firms influenced by ERP implementation to improve the deduction in costs, product and price costs and just in time implementation. The ERP implementation helped the construction firm to improve their efficiency to the extent of 85% further deduction in product process cost also improved through ERP implementation ranging Between 70% to 80%.

Table 4
Customer relationship management

S.No	Factors/ Variables	Likert Scale					Total Score
		1	2	3	4	5	
1.	Improving customer service quality	11	29	43	37	80	200
		5.5%	14.5%	21.5%	18.5%	40%	100%
2.	Retained customer	21	29	33	43	74	200
		10.5%	14.5%	16.5%	21.5%	37%	100%
3.	Promotional efficiency	3	17	52	28	100	200
		1.5%	8.5%	26%	14%	50%	100%
4.	Customer loyalty	5	25	38	43	89	200
		2.5%	12.5%	19%	21.5%	44.5%	100%

The customer relationship management factors such as service quality (80%), customer retention (75%), promotional efficiency (90%), customer loyalty (85%), was shown in the below Table 4. The overall analysis shows that there is a positive relationship and improvement in the above said variable based on the likert scale 5 points parameters.

Table 5
Efficiency of operations management

S.No	Factors/ Variables	Factor loads	Eigen value	Percentage of variable
1.	ERP helps in improving profitability	0.924		
2.	Improvement of productivity	0.820		
3.	Efficiency in marketing operations	0.756	3.150	14.614
4.	Efficiency in material management	0.648		

Table 5 presents the factors of profitability (0.924), productivity (0.820), marketing operations (0.756), and efficiency of material (0.648) have the order of significant positive loadings. The Eigen value factor 3.150 and percentage variable 14.614 also represents a good positive relation with variable factor. *i.e.* efficiency of operations management on ERP firm performance.

Table 6
Good Governance

S.No	Factors/ Variables	Factor loads	Eigen value	Percentage of variable
1.	Management policy	0.978		
2.	Transference in administration	0.827		
3.	Efficient audit	0.786	3.278	15.173
4.	Efficiency of decision management support system	0.687		

Reveals the factor loading of management policy (0.978), transference in administration (0.827), efficiency in audit (0.786), and Decision making support systems (0.687) further the Eigen value 3.278 and percentage of variance 15.173 reveals that there is positive relationship between Good Governance and its factors loadings.

Table 7
Cost Efficiency

<i>S.No</i>	<i>Factors/ Variables</i>	<i>Factor loads</i>	<i>Eigen value</i>	<i>Percentage of variable</i>
1.	Overall reduction in costs	0.878		
2.	Product cost analysis	0.876		
3.	Process cost analysis	0.927	3.552	15.578
4.	Just in time implementation	0.871		

The factor loading of customer relationship management related factors shown a good improvement through ERP implementation, since it's Eigen value 3.180 based on the likert scale the percentage of relationship had increased in respect of service quality (0.937), customer retention (0.847), promotional efficiency (0.754), customer loyalty (0.642) also indicated that strong relationship with the defined variables.

The cost efficiency in respect of overall cost deduction (0.878), product cost analysis (0.876), process cost analysis (0.927), just in time implementation (0.871) all this factors Eigen value was 3.552 and percentage of variance 15.578 reveals that there is a positive relationship of ERP implementation in construction firms.

Table 8
Customer relationship management

<i>S.No</i>	<i>Factors/ Variables</i>	<i>Factor loads</i>	<i>Eigen value</i>	<i>Percentage of variable</i>
1.	Improving customer service quality	0.937		
2.	Retained customer	0.847		
3.	Promotional efficiency	0.754	3.180	14.622
4.	Customer loyalty	0.642		

The factor loading of customer relationship management related factors shown a good improvement through ERP implementation, since it's Eigen value 3.180 based on the likert scale the percentage of relationship had increased in respect of service quality (0.937), customer retention (0.847), promotional efficiency (0.754), customer loyalty (0.642) also indicated that strong relationship with the defined variables.

Table 9
ERP technology and Construction firm's performance

	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>
Profitability	200	3.857	.44565
Productivity	200	3.650	.39422
Investment management	200	3.782	.49516
Material management	200	3.806	.44355
Customer acceptance	200	3.791	.45780
Overall construction firms performance	200	3.945	.56078
Valid N (list wise)	200		

ERP Technology and firm’s performance, factors are presented in Table 8. It reveals that the impact of various factors *i.e* probability, productivity, investment management material management and customer acceptance in ERP implemented firms in India. Based on the mean and standard deviation factors show’s that all the above mentioned factors are significantly influencing on improving the performance of construction firms.

Table 10
Regression and ANOVA Analyses

<i>R</i>	<i>R Square</i>	<i>Adjusted R Square</i>	<i>Std. Error the Estimate</i>
0.856	0.396	0.388	0.58604

The regression and ANOVA analysis of construction firms in India depicted in Table 9. The Analysis of Regression and co-relation shows the calculated Significance value 0.05 which is greater than the significance value 0.000. It indicates that null hypothesis at 5% level of significance and proves the correlation between dependent variables and Independent variables. Therefore the construction firms performance greatly influenced by the factors such as probability, productivity, Investment management, material management and customer acceptance.

The adjusted R² value of 0.685 indicates the model that is explained about 68% of the factor liable for improving the performance in construction companies.

Table 11
Analysis

	<i>Sum of Squares</i>	<i>Df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig</i>
Regression	90.528	5	15.040	42.219	.000
Residual	142.062	386	.356	43.512	.000
Total	235.611	392	.366		

Table 11 presents the significant f values and its impact on construction firms performance thorough the selected variables *i.e.* probability, productivity, Investment management, material management and customer acceptance showed a significant impact on the firm’s performance.

Table 12 reveals the regression coefficient of selected variables of construction firms. Based on “*t*” values of productivity, probability, Investment management, material management and customer acceptance all ‘*t*’ values show a significant correlation with construction firm’s performance.

Table 12
Regression Coefficient Analysis of the model

	<i>Un-standardized Coefficients</i>		<i>Standardized Coefficients</i>	<i>t</i>	<i>Sig</i>
	<i>B</i>	<i>Std Error</i>	<i>Beta</i>		
(Constant)	-.192	.269		-.804	.492
Profitability	.261	.065	.181	4.312	.003
Productivity	.408	.078	.286	5.256	.006
Investment management	.257	.059	.256	4.738	.005
Material management	-.344	.182	-.269	-1.598	.108
Customer acceptance	.068	.195	.058	.362	.786

4. CONCLUSION

Based on the literature review, questionnaire survey and case studies, it can be concluded that a majority of contractor organizations have some “know-how” about the ERP systems. These organizations assumes that the implementation of ERP systems could benefit and thereby affords better assimilation of working environment, more flexibility in operations and more information access and more automation. However, it is noticed that this ERP system implementation utilizes a lot of human and technical resources and a lot of capital. In this case, it will not be easy for the small contracting firms to invest their potential on such a mega-system. Hence, it is suggested to start with the large contracting organizations to implement this type of ERP systems in the construction industry and then gradually moves down. In industry to develop more customized solutions, the vendors of ERP software must work with the professionals. It is also noticed that only a small number of ERP software’s are developed for the construction industry. This might be the one of the reason for slower implementation.

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