



## INFORMATION TECHNOLOGY IN THE INDIAN CONSTRUCTION INDUSTRY

**A. A. Gaikwad**

Lecturer, Department of Civil Engineering, Government Polytechnic Malvan.

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### ABSTRACT

The Indian construction industry is an integral part of a country's infrastructure, economic development and an essential contributor to the development process. The construction industry constitutes almost 50% of national capital expenditure on infrastructure development projects. It contributes 5.2% of the GDP and around 40% of investment in India. It is well known that effective use of computer and Information Technology can improve productivity of construction industry. Information exchange is an important aspect having significant influence on saving the time and cost of any project. Surveys reveal the usage of computers and Information Technology in Construction Industry can provide useful information about the benefits and also problems being faced by the industry. Keeping this in mind, a detailed research questionnaire is prepared to collect information from Indian construction industry. The information would be collected about Information Technology utilization for different work function/task and performance of firm. In addition to this of firm related to IT application, benefits and obstacles faced by construction professional etc. will also be collected. Based on the data collected, Regression analysis is proposed to test the relation between Information Technology and performance of firm. It is proposed to collect information from about 300 construction organizations. Here the detailed methodology of the research work is discussed.

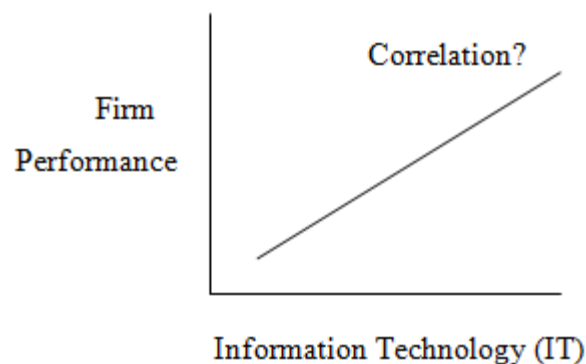
**KEYWORDS :** Information Technology , Construction Industry.

### 1. INTRODUCTION

Construction industry is one of the significant sectors of the Indian economy. Apart from its large size, construction acts as a Vanguard and sets pace to growth of all other sectors (Vaid 2000). Computer and Information Technology are entering the Construction Industry at rapid pace today. This is an irreversible development for the good. It is well known fact that Bjork (1999) explained Information Technology (IT) as the application of electronic machines and programs for the processing, storage transfer and presentation of information. However IT encompasses many technologies such as computers software, network and even telephones and fax machine. The main purpose of IT is to facilitate the exchange and management of information and has lot of potential for the information process component of the construction industry.

Advance technology is a major source of improvement for firms and industries. Unfortunately, construction firms are often slow adopters of new Information Technology. Construction industry has been described 'hesitant' in adoption of Information Technology tools (Andreson 2000). Tatum (2000) suggests two major reasons for lack of enthusiasm to incorporate technology: Uncertain competitive advantage from using new technology and lack of information regarding benefits of Information Technology. Jung-ho-yu (2006) suggests the expected benefits of Information Technology, which should be examined before Information System is implemented. A primary reason cited for the low level of investment in Information Technology is the low level of perceived benefits from IT investment among construction industry.

Thus it is necessary to study relation between construction firm performance and Information Technology utilization and study current scenario of application of information technology in Indian construction industry (Figure 1).



**Fig 1: Firm performance and IT utilization: Is there a correlation?**

## 2. OBJECTIVES

Numerous objectives are kept in mind while preparing this paper. A few of them are given below.

- 1) The basic objective of survey is to provide portrait of the use of Information Technology in Indian construction industry.
- 2) Obtaining data about degree of Information Technology utilization and performance of firm.
- 3) Measuring the impact of Information Technology on firm performance.
- 4) To identify Benefits and obstacles faced by construction professional while adopting Information Technology.

## 3. LITERATURE REVIEW

Goh Bee Hua (2005) conducted IT barometer survey in Singapore; the objectives of survey were to first to apply the IT barometer survey to Singapore, second to compare the results of Singapore with Nordic survey, Swedish survey, & Danish survey. He gives four important lessons for construction industry intending to adopt IT on large scale. First lesson is to avoid the "technology for the sake of technology" trap, second to develop standards, integrated databases and interactive application. Third lesson is business strategy must support investment in information system and fourth one is to focus on people, their It needs and ability to manage change.

Ajitkumar (2004) conducted survey to do realistic assessment of scenario of project management software used in Indian construction Industry. He sated that these days, project

management softwares flooding the market for carrying out planning, scheduling, controlling, monitoring, and resource leveling of projects. So it has become imperative to evaluate these softwares, for their working potential and for the lacuna's they have and how it could affect the project. It is also very important to see that to what extent these softwares are being used in the Indian construction sector. His findings were that the most construction firms use bar charts, while more advanced detailing techniques/ tools were used where large or prestigious projects so demanded. He stated that there is reluctance shown by certain section of the industry that still feels skeptical about the potential benefits derived by the use of project management software.

Rivard (2000) conducted a modified version of the IT barometer survey in the Architectural, Engineering, and Construction industry in Canada. He states his purposes as to investigate availability, usage, and perceived impact of IT among respondents. He explains that the purpose of IT is to facilitate the exchange & management of information. He states that IT & computers are now integral parts of the day-to-day business within most of AEC industry. His survey shows that almost all firms use word processors and spreadsheets, with fewer firms using databases and project planning software and evaluates the extent of computerization of some business process. He indicates that most firms have increased the IT investment in the past two years and will increase IT investment in coming years. He reports the top motivators for IT uses as: efficiency of technical work, means of competition, and efficiency of administrative work etc. According to respondents from Canada, the benefits of IT comes at a cost since the complexity of work, the administrative needs, the proportion of new operations, and the costs of doing business have all increased. Rivard (2000) makes the following concluding remarks:

- Information technology represents a paradigm shift with respect to the transfer and management of information.
- Technological improvement in this industry is usually driven by necessity rather than by the need to be at the cutting edge.

Anderson (2000) studied a new framework for measuring the benefits of IT in construction. The framework is based on the principle that benefits realization must be managed by: planning for strategic alignment and business-driven exploitation, managing the process of predicting benefits, and by measuring resulting benefits after a system or innovation is implemented. Three distinct types of benefits are identified within the new framework associated with business efficiency, business effectiveness and business performance. A primary reason cited for the low level of investment is the low level of perceived benefits from IT investments amongst construction industry professionals.

M.J.O'Brien (1999) take the analysis of the economic structure of the construction industry in Saudi Arabia and in particular the degree to which Information Technology has established itself in that industrial sector. He stated that Saudi Arabian construction industry is one of the largest in the world, but due to uniqueness of it, industry posses problem of adoption of innovative IT construction system. He found from his survey that Saudi Arabian construction companies are reasonably well advanced with regards to use of computers on their site. Yet at the same time the communication structure appears poor. The awareness of electronic data exchange, Internet is poor. But large numbers of survey respondent are ready to use the new advance technology.

Howard (1998) summarizes the results of the IT barometer survey that was conducted in Denmark, Sweden, and Finland. The project aims at creating and performing a survey for measuring the use of IT in the construction industry. He reports that productivity gains, according to respondents as a result of using IT are in the areas of administration, design, and project management. Neither site management nor materials management experienced productivity gains as a result of IT use.

**4. METHODOLOGY**

It is clear from literature study that Indian construction industry should examine the benefits of Information Technology. Thus a research questionnaire survey is designed for obtaining data about Information Technology utilization & firm performance. The questionnaire is divided in five parts. Part I is devoted to collection of information about respondent and General Information of firm (i.e. type of industry, Annual turnover). Part II is designed to collect information about application of Information Technology in Firm (i.e. Different softwares used in firm, Internet uses etc.) and part III collect information about Degree of technology used in given work function. Purpose of this information is to quantify the level of technology used. Part IV of the survey questionnaire collects information pertaining to Overall Performance of the firm. Part V information about benefits and obstacles faced to adopt IT by construction industry is collected and will be processed.

For this study total number of work functions is thirty, which is taken from the conception, design, procurement and construction management phase. For this study, the participants have to assess the degree of technology used in executing each work function for that project. In assessing the degree of technology used for each work function, O'Connor (2000) offers the respondents three levels of technology utilization as shown below:

- a) Level 1: no electronic tools were used in executing the work function. Information is conveyed verbally or on paper and transmitted via mail, or courier.
  - b) Level 2: common electronic tools played key roles in executing the work functions, but human workers still dominate the work process. Information was stored primarily in stand-alone electronic formats and was transmitted via isolated electronic media such as disks or as e-mail attachments, etc.
  - c) Level 3: while human workers still participate, fully automated systems dominated execution of the work function. Information is stored on a networked system accessible by all appropriate participants.
- The work function data then summarize for each firm and a composite score of IT use, IT index is calculated as follows (O'Connor 2000)

$$IT\ index = \frac{[\text{Sum of work functions scores} / (\text{Total No. of work functions} - \text{No. of "N/A" responses} - \text{No. of "Don't know" responses})] - 1}{5} \dots\dots\dots \text{Equation (1)}$$

Where, N/A represents not applicable.

The IT index score for each firm is used as Independent variable in the regression analysis.

The dependent variable for regression is firm performance, for this metrics of performance is used from Mohammad El mashaleh (2006). The following metrics are considered for firm performance: schedule performance, cost performance, Customer satisfaction and profit. Definitions of these metrics is given in Table 1

**Table 1 Metrics of performance that composes firm performance (Mohammad El mashaleh 2006)**

<b>Metrics</b>	<b>Method of measurement</b>
Schedule performance	Percentage of the time projects delivered on/ahead of schedule
Cost performance	Percent of project delivered on/under budget
Customer satisfaction	Percent of repeat business
Profit	Net profit after tax as a percent of sale.

**4.1 Data collection**

Data for study is proposed to be collected from various construction industries from India through research questionnaire (available on request). Data is to collect either by personal interview or by E-mail or by postal correspondence. It is proposed to post a link of questionnaire to our College of Engineering web site. Respondents will ask to provide information regarding firm performance (Table 1) and to rate the level of IT utilization for each 30 work functions. Additional information is also to be collected about the respondent and general information of firm, Information Technology used by their firm etc. Different softwares used by their firm. An appeal is proposed to make their opinion about Benefits and obstacles in adoption of information technology, so that complete picture of adoption of technology and the current obstacles to overcome will be clear. The outline of the proposed questionnaire is given in Table 2, in which the details the organization regarding Information Technology are requested.

**Table 2 The outline of Questionnaire related to Information Technology in the organization.**

<b>Part 1: General Information of respondent and firm</b>						
Respondent name and designation						
How does u classify your firm?						
Contractor		Consultancy firm				
Builder		Other (specify).....				
To which of the following industry sectors does your firm belong?						
Residential		Commercial				
Infrastructure		Other (specify).....				
<b>Part 2: Application of information technology in the firm.</b>						
Does the company have their own web site?						
Yes						
No (specify).....						
What software do you use for project management, design etc.?						
Influential factors on decisions to use or not to use software for constructions?						
Training/support		Software /Hardware availability				
Complexity of project		Size of project				
Financial feasibility		Others (Specify)				
<b>PART 3: Use of Degree of Technology</b>						
Please indicate the level of use of Degree of Technology for each task in the different phases of a project. LEVEL 1: No electronic tools LEVEL 2: Specialized stand-alone electronic tools LEVEL 3: Integrated electronic tools						
D	Work function	Use of Degree of Technology				
Conception phase		Don't Know	1	2	3	NA
01	Conduct market analysis for new facility.					
02	Develop; evaluate the project's scope of work.					
03	Estimate a budget from the scope of work.					

04	Study economic feasibility of project.					
Design phase		Don't Know	1	2	3	NA
05	Design the structural system and related drawings.					
06	Design the plumbing system and related drawings.					
07	Design the electrical system and related drawings.					
08	Prepare project specifications.					
Procurement phase		Don't Know	1	2	3	NA
09	Determine the lead time required to order equipment and materials.					
10	Conduct a quantity survey of drawings & Link it to the cost estimating process.					
11	Link supplier cost quotes to the cost estimating process.					
12	Develop the procurement management plan.					
Construction Management Phase		Don't Know	1	2	3	NA
13	Develop the construction schedule.					
14	Track the work progress by daily work diary, DPR etc. and report it to office.					
15	Analyze earned value calculations, including budgeted cost of work performed (BCWP), schedule variance (SV), and cost variance percent (CV).					
16	Communication in between project team.					
<b>Part 4: Overall Performance of Firm</b>						
<b>Schedule Performance</b>						
For projects closed in the last 2 fiscal years, how often were these projects delivered on/ahead of schedule?						
<b>Cost Performance</b>						
For projects closed in the last 2 fiscal years, how often were these projects delivered on/under budget? (i.e., 40% of the time)						
<b>Customer Satisfaction</b>						
What is the percentage of repeated business customers? (i.e., 20% of customers return for a repeat business with the firm)						
<b>Profit</b>						
What is your firm's Net Profit after tax as a % of Total Sales?						
<b>Part 5: Information Technology Benefits and Obstacles</b>						
<b>A) Benefits identified by the firm</b>						
Areas of benefits		Strongl	Slightly	Slightly	Strongly	

	y Disagree	Disagree	Agree	Agree
The competitive advantage of the firm				
Customer satisfaction				
Better quality of work				
Better communications				

<b>B) Obstacles identified by the firm</b>				
Obstacles faced.	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
Lack of investment				
Lack of commitment from management				
Greater know-how required from staff				
Continual demand for upgrading				

**4.2 Data analysis**

Simple regression analysis is proposed to be used to investigate whether IT has positive impact on firm performance or so. Four hypothesis, (Table 3) that IT has positive impact on firm performance are proposed to investigate by regression analysis. For all regression model IT index is the sole explanatory variable.

F-test and t-test are proposed to assess the reliability of the model and its individual parameters.

**Table 3 Proposed research hypotheses**

Number	Hypothesis
1	IT index and Schedule performance are positively correlated
2	IT index and Cost performance are positively correlated
3	IT index and Customer satisfaction are positively correlated
4	IT index and Profit are positively correlated

**5. CONCLUSIONS**

It is clear that with globalization, Indian market is opening up and facing increased competition, thus Indian construction industry should have technical advance in terms of Information Technology. From this research the Indian construction industry and society would be benefited as industry can know the perceived benefits from IT and they will think in future for more investment in Information Technology. The IT utilization in industry helps in harnessing the best in human brain with the speed and flexibility of computer. The need of the hour is that firms in construction sector should realize the true value of Information Technology and reengineering of the traditional system. Modifications in the

proposed methodology and research hypothesis are invited for realistic correlation between construction industry and IT industry.

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