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Study of ICT adoption for building project management in the Indian construction industry

Vanita Ahuja [a,*], Jay Yang [b,1], Ravi Shankar [c,2]

[a] Project Management Consultant, 204, Sector-A, Pocket-C, Vasant Kunj, New Delhi, 110070, India
[b] Associate Professor, Faculty of Built Env. and Eng., Queensland University of Technology, GPO Box 2434, Q4001, Brisbane, Australia
[c] Professor, Dept. of Mngmt. Studies, 205, Vishwakarma Building, Indian Institute of Technology Delhi, Hauz Khas, New Delhi, 110016, India

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ABSTRACT

Building project management requires effective coordination and collaboration between multiple project members. It can be achieved through real time communication flow between all. In present scenario, it can be achieved through adoption of Information and Communication Technologies (ICT). Construction industry primarily comprises small and medium enterprises (SMEs). Also, ICT adoption has been slow in the industry. Research is required to assess the factors that affect ICT adoption at the three levels of industry, organization and people, with focus on SMEs. This paper discusses a component of the research undertaken to study these factors and issues in the context of Indian construction industry. A questionnaire survey was conducted and through quantitative data analysis the extent of adoption of formal Project Management processes, ICT adoption for these processes and factors including perception based factors affecting ICT adoption were studied. Results of data analysis includes identification of issues that require action at the three study levels. The results can be generalized for other countries with due considerations, specifically for countries where the construction industry is similar to Indian construction industry in terms of working methodologies or for large countries.

1. Introduction

Successful building project management requires a combined effort of the project team. But, the most important person is the project manager, who has to plan, track and monitor the project and coordinate between the entire project team members for successful project delivery. This relates directly to the effective communication, which is widely believed to be crucial for further efficiency gain in construction [5].

Collection, analysis and real time communication of information is essential for the quick detection of time, cost, scope and quality deviations from planned performance and timely decision making for responding to problems, disputes and deviations detected from the planned performance. At present, the communication problems between the team members are often a cause for project delays, expensive reworking and building defects [5] and with traditional tools of communication, the project managers often lose the ability of timely change management. Use of Information Communication Technologies (ICTs) provides opportunities for real time access of information to all and improves coordination and collaboration between the project team members. Its benefits include an increase in the quality of documents and speed of work; better financial control and communications, and simpler and faster access to common data as well as a decrease in documentation errors [20] as use of incorrect data can compromise the scheduled completion of a project and lead to wastage of resources [14].

In the present scenario, organizations and project team structures in the construction industry are becoming increasingly complex. As a result, real time information flow is critical to an organizations' ability to be flexible, agile and competitive [11]. In relation to project management there is also a need for a system that provides shared project information, analysis tools to analyze the information, a collaborative infrastructure to handle the flow of information, a multi-device access to the pertaining information and a system that ensures the persistence of the underlying information among the participants [9]. ICT tools and technologies provide these facilities. But, construction industry has been slow in adopting ICT and often available and easily accessible technology is not being utilized to the full extent. This is reflected both in the literature and practice [3,23].

At all stages of a building project, information is generated, stored and communicated by all the supply chain members. So, to have effective communication, all the members should follow the accepted methods of communication or communication protocols. Also, at any time, each construction organization is involved in more than one

* Corresponding author. Tel.: +91 9811472372.
E-mail addresses: vanita_ahuja@yahoo.com (V. Ahuja), j.yang@qut.edu.au (J. Yang), ravi1@dms.iitd.ernet.in (R. Shankar).
[1] Tel.: +61 7 31381028.
[2] Tel.: +91 9811033937.

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project and is a part of more than one supply chain [1]. This unique nature of the construction industry necessitates that the communication protocols are adopted by the industry as a whole and do not remain project specific. Thus, in multiple enterprise scenario of the construction industry, ICT adoption for building project management would be effective if all the project team members uniformly adopt it and the methodologies or protocols are defined for its uniform uptake in the industry. People, who are a part of different project team organizations, manage projects and the project team organizations are a part of the construction industry (Fig. 1). So, the communication protocols have to address technical, managerial and people issues and are to be implemented at the levels of industry, organizations and projects or people. The protocols are required to be specifically aligned for requirements of SMEs as construction industry primarily comprises small and medium enterprises (SMEs).

One of the most important issues that hinders the growth of SMEs in a globalized scenario is that of access to appropriate technology when technology upgradation is the key to face global competition [19]. It is easier for large firms to be involved in the development and adoption of the emerging technology [29], whereas SMEs have difficulty in dedicating resources to research, development and training [28]. In many SMEs, the use of IT will depend upon whether or not the firm has recruited a recent graduate with IT skills. The large companies on other hand, would invariably have staff with IT skills and would have invested in the necessary technology [14]. Consequently requirement is to study the factors that affect ICT adoption by SMEs for building project management. These issues can be addressed by global research, but also require clear understanding of the management and communication processes followed by SMEs of each distinct regional area or country. The research discussed in this paper studies these issues with respect to the Indian construction industry.

2. Literature review

Construction is an information dependent industry. The amount of information generated and exchanged during a project lifetime is substantial. Thus, it is essential that the information exchange is managed as efficiently as possible [12].

Experts in academics and the industry have highlighted the benefits of adopting ICT for construction project management like: richer information to aid decision making, project information obtained quicker, improved communication, closer relationships, improved information flow, greater management control and getting geographically dispersed groups to work together [3,4,7,23]. However, much of the building information is still exchanged by conventional human communication and hard copy drawings and documents, leading to errors in drawings and documents, since such a communication is not real time communication. In a survey conducted in a leading construction organization, it was found that 30% of all the questions that came from the construction site managers to the designers were related to the inconsistencies in drawings from the architectural, structural, and mechanical designers [10].

A survey in the UK construction industry showed that most project information is currently stored using a mix of paper and electronic media, with only one in six projects surveyed, using electronic systems as the primary medium for information storage. The survey also highlighted some variations in the level of IT awareness in different parts of the supply chains of the construction projects [14].

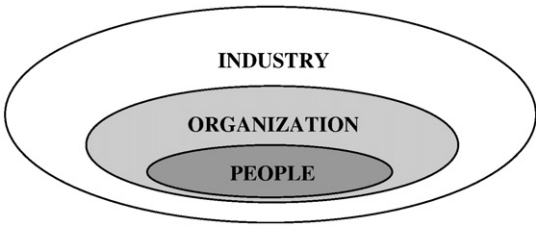

Fig. 1. Relation between industry, organization and people.

Factors affecting ICT adoption have been studied. In a survey conducted to assess the status of ICT adoption in the Australian construction industry, it was found that annual turnover of an organization has an effect on the uptake of ICT and training performance in ICT for an organization. Also, not having an ICT professional at site or within ready access was a strong influential barrier to the uptake of ICT on projects [27], since adequate support to construction site processes is important for collaborative use of ICT in the construction projects. Onsite work conditions may sometimes permit only the use of wireless or portable devices. However it must be recognized that portable and handheld devices simply cannot handle computationally heavy jobs due to their specific hardware configurations [9].

Internet helps in effective collaboration and coordination between project team organizations. Its use as a communication medium can help information-transfer occur faster and more effectively and can provide new opportunities for the development of distributed systems that can cross organizational boundaries and can offer a unique opportunity for teamwork and workflow automation [20]. E-mail services have been considered an important communication method. But, in a survey 65% respondents maintained that although e-mail does enable some degree of global teamworking, it can never replace interpersonal teamworking [2]. In a way that also explains why telephone calls sometimes follow the e-mails.

Networks are important components for implementing integrated technology solutions. Internet or Intranet gains importance not only for organizing, storing, searching and retrieving information but also for sharing information in an organization in all the directions, i.e. upward, downward and laterally [31]. In this scenario, 'Infrastructure surety' including safety, security, reliability, integrity, authentication, protection and operational assurance assumes significance [11].

Web based project management system combines the power of project management systems with the Web, making the details of the project available to anyone from anywhere and overcoming the problems of timely updates, multiple copies and real time project schedule updates [9]. Most of the organizations are adopting these services because their competitors are influencing them or they are being forced to adopt it by their clients [21].

Utilization of these technologies in the construction industry and primarily in the multi-enterprise scenario of project management requires readiness not only within one organization, but also within all the organizations involved in the construction processes [20]. Researchers have highlighted that effective utilization of these technologies requires equal consideration of people issues along with the technological issues [5,11,14,15,21]. It has also been found that 80% to 90% of IT projects in general do not meet their performance objectives, with the main reasons not related to technical issues [21]. Also, any 'new' connections and networks (social and technical) that develop as a result of the introduction of individual ICTs will be far more effective if they are somehow interconnected with existing, locally appropriate systems and structures [15].

Empirical research is required to holistically study the factors affecting ICT adoption in the multi-enterprise scenario of building project management. Pena-Mora and Tanaka [10] have identified Environmental Scan and Internal Scrutiny as the first two steps for such a study. 'Environmental Scan' would include understanding of the factors, issues and industry drivers for ICT adoption at the industry level and would provide the basis for strategic planning and implementation of ICT at the organization and industry levels. It would also identify the possible benchmark practices for organizations. 'Internal Scrutiny' is at the organization level. It involves analysis of organization structure, relevant project management processes and