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Managing Building Projects through Enhanced Communication – An ICT Based Strategy for Small and Medium Enterprises

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ABSTRACT

Information and Communication Technology (ICT) enhanced communication strategy can help building project managers in the successful delivery of their projects, particular for Small and Medium Enterprises (SME). This paper introduces a research that explores the technical, managerial and social issues of SMEs in order to formulate such a strategy. A questionnaire survey of SMEs in the Indian construction industry helped identify the present status of project management processes and associated ICT tools and technologies among three major SME sectors. Interpretive structural modeling (ISM) technique has been applied for developing a structural equation model that considers and evaluates causal relationship between factors effecting use of ICT. A framework is being developed for ICT enhanced communication protocols with the potential for industry, organisation and project level adoption during the management of building projects by SMEs.

Keywords: Communication, Building, Project management, ICT, Supply Chain

1. INTRODUCTION

Building project management requires effective collaboration and coordination between all the stakeholders and effective communication between all the members is believed to be crucial for successful project delivery. When project team organisations are geographically separated

and project team structures are becoming increasingly complex, the use of ICT can provide effective communication. Comparing to other industries, the construction industry has been slow in adopting ICT. Research is required to study the factors effecting use of ICT for building project management and to formulate strategies to be adopted at the industry, organisation and project level, with particular attention on technology, processes, culture and people.

In construction industry, 97% of the companies employ less than 20 persons, and can be classified as Small and Medium enterprises (SMEs) (Katranuschkov et al., 2001). Therefore to reach the majority of the industry, the research needs to address management and communication processes adopted by SMEs. While global trends need to be identified, a clear understanding of such processes in each distinct regional area or country is also very important.

2. ICT AND COMMUNICATION MANAGEMENT

2.1 An Overview

Experts in academia and the industry have highlighted such benefits of adopting ICT for construction project management as: 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 (Love et al, 2004; Root and Thorpe, 2001; Egbu et al., 2001). However, the application of IT to the design and construction activities is still primarily restricted to drawing activities, and much of the building information is exchanged by conventional human communication and printed drawings, leading to errors in drawings and documents.

Information Communication Technologies (ICT) support collaborative work. Effective use or diffusion of ICT through organisations needs to be effectively managed to better prepare for future ICT application adoption (Peansupap and Walker, 2005) and issues for slow adoption of ICT need to be studied. The issues can be technical, managerial, cultural, social and political due to differing perceptions of project team members. Holistic study is required at the level of industry, organisation and the people. It is more relevant in the context of ICT use in the construction industry, since organisations have found it difficult to quantify benefits of ICT adoption for project management.

2.2 Factors Influencing Use of ICT for Building Project Management

Factors affecting the use of ICT have been studied. In a survey conducted to assess the status of use of ICT in the Australian construction industry it

was found that annual turnover of an organisation has an effect on the uptake of ICT and training performance in ICT for an organisation. Also, not having an ICT professional on site or within ready access was a strong influential barrier to the uptake of ICT on projects, since adequate support to construction site processes is important for collaborative use of ICT in construction projects (Weippert et al., 2003). 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 configuration restrictions (Pena-Mora and Dwivedi, 2002).

Benefits of utilization of ICT for managing construction projects and improving overall organizational efficiency have been discussed in literature. To date however, a methodology has yet to be developed for the construction industry to examine the potential contributions of information management strategies in efforts to reduce overall project schedule and cost (Back and Moreau, 2000). This inability to quantify process improvements and uncertainty of benefit from process and culture changes is one of the primary barriers for effective implementation of ICT for construction project management. As a result, the benefits of use of ICT are primarily perception based and not quantifiable and these perceived benefits define the extent of use of ICT by the construction industry. Jaafari and Manivong (1998) summarise the research in this area by stating that effective implementation of ICT within projects, as well as the entire industry would improve the communication processes by an order of magnitude, and would thus benefit the delivery of all phases and functions on projects.

Researchers have identified that organizations consider initial cost and cost of keeping up to date with the technological developments in training and hardware/software as an important barrier for effective utilization of ICT (Root and Thorpe, 2001; Mitropoulos and Tatum, 2000). Root and Thorpe (2001) also linked it to a lack of strategic direction within the industry, both in terms of overall direction and the standards and protocols that would inform any IT investment decision. Thus, identification of organizational changes required for effective use of ICT (Froese, T., 1996; Mitropoulos and Tatum, 2000) and measuring benefits accrued by its' utilization are important enablers for its effective utilization (Mitropoulos and Tatum, 2000).

In collaborative work, benefits of any technology may come through widespread adoption of the technology. The lack of critical mass of construction projects requiring use of ICT has resulted in organisations being unwilling to make technological advances, especially with respect to communication technologies (Root and Thorpe, 2001). But, widespread technological change would require a good level of awareness of the technology throughout the industry, understanding of the technology and how to work with it (Froese, T., 1996). Project scope should also require the use of ICT (Root and Thorpe, 2001).

Organisations need a realistic and reliable knowledge base which needs to be transmitted in the organization at a fast pace and made easily and instantly available to engineers/managers at all levels (Pandit and Munshi, 1999). But SMEs often do not see justification in spending money on large databases in isolation and require help from large organisations and government bodies for the same.

Communicating information in standardized formats supports integration of different project phases. Also, effective information sharing could be achieved through use of common Internet services or shared use of common databases. Standardization of information transfer is very important at national as well as international level and can be achieved by industry level initiatives.

Effective communication, training, education and organization structure are identified as important cultural characteristics impacting upon the utilization and exploitation of IT for team-working (Egbu et al., 2001). Construction program graduates schooled in ICT technologies effect the uptake of technology in the industry. In part, contractors have adopted computerized cost estimating and other systems due to the fact that college-educated construction graduates were familiar with these tools. (Opfer, 1997)

Technology related barriers for effective use of ICT have also been identified. In a survey, it was found that most of the respondents agreed that the quality of IT equipment and infrastructure made available to them was a major factor in ensuring that they used it. (Egbu et al., 2001). Also, while using ICT, organisations have a fear of data security (Root and Thorpe, 2001). A project web site provides a centralized, commonly accessible, reliable means of transmitting and storing project information. But, people need a road map to integrate the project web sites as a tool into their work on a daily basis. (O'Brien, 2000).

Finally, cultural factors need to be studied at project, organisation and industry level. Recognising the type of culture that exists in organisations and project environments is particularly useful to enable managers to determine the approach and strategies that facilitate interaction and communication, and to avoid mishaps in business dealings (Tone 2005).

The above literature study and understanding of the construction industry has helped in categorizing factors at People, Organisation and Industry level, as illustrated in Figure 1.

3. ICT Enhanced Communication Protocols

'Protocol' is defined as an accepted behavior in a situation. Communication protocols define the accepted method of generating, storing and communicating information. In the construction industry, supply chains are typically formed by clients, developers, project managers, designers, consultants, material suppliers, contractors and subcontractors (Villagarcia

and Cardoso 1999). They are brought together to achieve one main objective, to develop and build a particular project. At all stages of the project, information is generated, stored and communicated by all the stakeholders. So, to have effective communication, the stakeholders should be following the accepted methods or the communication protocols. At any time each construction organisation is involved in more than one project and is a part of more than one supply chain. 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. With the advent use of IT, we need to develop protocols that support the use of IT by the whole industry.

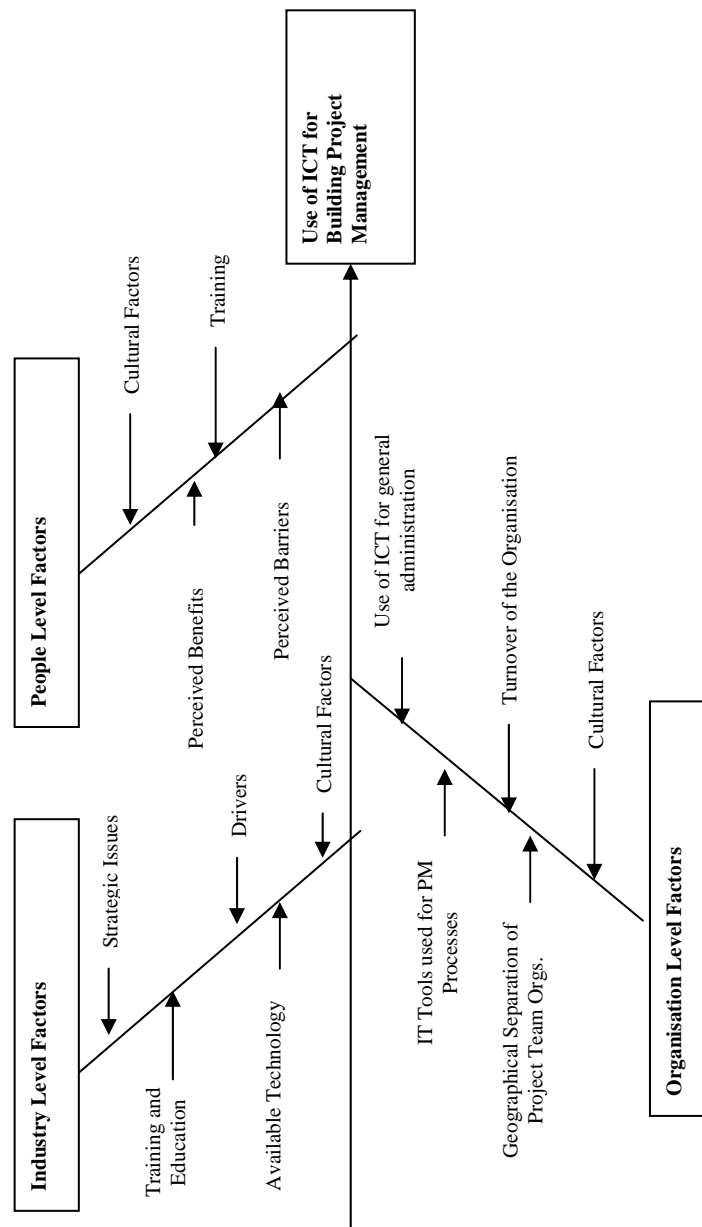


Figure 1 Factors Influencing ICT Use for Building Project Management

SMEs AND THE INDIAN CONSTRUCTION INDUSTRY

3.1 SMEs and their Specific Requirements

The construction industry is predominantly comprised of SMEs, which are typically defined by the number of people they employ (Love et al., 2004; Nitithamyong and Skibniewski, 2004). SME sector is highly heterogeneous comprising of tiny un-organised enterprises to modern and more organized enterprises. The majority of these small firms are specialist subcontractors working with the general contractor (Hegazy and Ersahin, 2001). While there is no clear definition of SMEs globally, it is generally acknowledged that SMEs employ less than 250 staff, handle less than 5-10 projects simultaneously with no individual project exceeding 200000 to 1M man-hours (Laufer and Tenah 1985, Dainty et al. 2001, Sturges and Bates 2001, and Love et al. 2004).

Decentralisation of information, resources and the decision-making processes are commonly found in SMEs and there are low levels of management structures (Huin, 2004). It cannot be expected that SMEs would have an Internet strategy or ICT manager with the required knowledge to allow for his/her company to participate in the new economy (Katranuschkov et al., 2001). Also they cannot afford the complicated conversion from paper to electronic processes, which often require expensive information exchange technology (Ribeiro and Lopes, 2002). So there is still a long way to go especially for small and medium business use of the electronic information standards and Internet technology.

With respect to SMEs, it is necessary to develop means to get information about innovations out rapidly and in a form that will interest the potentially concerned decision makers. It has been discussed that there has to be a link between any technology watch service and the deep knowledge of the 'client' SME (Davidson, 2001)

3.2 The Indian Construction Industry

Construction is the second largest activity in the Indian economy, employing over 31 million people. However, construction is generally not seen as IT savvy sector and it is felt that the information age has done little to transform this sector. IT benefits users in the automation of processes, systems, data collection – all of which are issues faced by larger companies. In the construction industry, where most of the players are small and proprietary/individualistic in nature, with 90% of total construction executed by them, they see little benefit for embracing IT in relation to the cost. The impact of e-business – the coming together of the web and information technology is sinking in gradually. A large number of Indian companies are watching the developments with interest, but very few of them have actually crystallized their strategy and committed investments

that would enable them to take advantage of e-business. At the heart of this revolution is the explosion of the Internet that connects millions of computers and people all over the world in one giant, virtual handshake (Nehru, 2001).

4. THE RESEARCH

Study of the literature and related background information has helped identify gaps in literature and research aim and objectives. Accordingly the research framework was designed.

4.1 Gaps in Literature

Past research has primarily considered the construction industry as a whole. There is a need study the building construction projects and engineering projects separately, as the characteristics of supply chain issues, management procedures and contract conditions are different in two categories of projects. They also tend to focus on the adoption of ICT by the construction industry, which would include applications for individual functions and communication technologies. Research is required to study ICT adoption separately,

Past research conducted studied the use of ICT either at the industry level, organisation level or at the project level, while the inherent linkages between the three levels are ignored. The design and execution stages are also well researched for ICT applications, while other stages, particularly those with less quantitative data, have been neglected. There is also an urgency to study ICT applications in developing countries, as research findings for Europe, USA and Australia may not necessarily apply. Moreover, project management processes as interpreted and executed by the SMEs need to be studied for effective use of ICT for building project management. A framework for benchmarking the extent of use of ICT for building project management will be required at the organisation level as well as the project level.

4.2 Research Aim and Framework Development

Based on the discussion above, the research aim was established to develop ICT enhanced communication protocols for building project management by Small and Medium Enterprises in the Indian construction industry.

The research framework adopts a mixed methods approach; formulating hypotheses and assumptions, collecting and analyzing both quantitative and qualitative data sequentially. The inquiry is based on the assumption that collecting diverse types of data best provides an understanding of a research problem (Creswell, 2003).

Phase 1 – Data Collection

This research began with a quantitative phase (questionnaire survey) with both standardised checklist of predetermined items and some open-ended questions nested in them. Therefore extensive literature review was undertaken initially to help establish a rationale for the research questions and to ascertain the extent and depth of existing knowledge on factors affecting use of ICT for building project management. The identified factors are shown in Figure 1.

For this research, SMEs have been categorized as organisations having staff up to 250. Those organizations of the Indian construction industry were included in the sample, which were either managing building projects after being appointed as the Project Managers or had the authority to manage their projects if a Project Manager was not appointed formally. Therefore three groups of organisations were included in the sample: real estate/developer organisations that construct and manage their projects; project management consultancy organisations which are formally appointed as project managers on building projects; and architectural organisations which manage small to medium sized building projects for which project managers are not formally appointed. Targeted respondents were the senior level executives in the organisations.

Phase 2 – Data Analysis

Interpretive Structural Modeling (ISM) technique has been used to analyze the relation between the identified perceived benefits and to understand the dependence and driving power of each benefit with respect to other benefits. This analysis will help managers decide other driving benefits to be achieved prior to their planned use of ICT for certain benefits and also the dependent benefits by default. The analysis requires examination of direct and indirect relationships between the benefits of use of ICT rather than considering these benefits in isolation. ISM is an appropriate technique for such analysis.

The developed ISM model showed that Organisational efficiency and Technology related benefits have high driving power and are 'strategic benefits' for the project team organisations. Thus organisations need to give more attention on strategically increasing these benefits from ICT use and if such use for general administration in the organisation is matured, appropriate IT tools are included in the working framework and team

management issues are planned at the earlier stages of the project, then project related benefits will be achieved by default. The four groups of benefits are inter related and can't be achieved in isolation.

Structural Equation Modeling (SEM) technique has been utilized for testing causal relationship between different factors that could be compared at the organizational level for all the three groups of respondents. Other factors have been studied separately for each group. SEM is an extension of the general linear model (GLM) and is a family of statistical techniques, which incorporates and integrates path analysis and factor analysis (Structural Equation Modeling, 2006). It allows the evaluation of entire model simultaneously, which brings a more macro level perspective to the analysis rather than a micro-level one. View of the entire landscape (the whole model) has precedence over that of the specific details (individual effects) (Kline, 1998).

The structural model shown in Figure 2 is used to test the research hypotheses as indicated on the causal relationship arrows.

Hypotheses 1, 2, 3 and 5 have been supported by the data. Analysis of these causal relationships helps us understand that an increased and matured use of ICT for general administration within the organization would lead to an improved ICT infrastructure within the organisation, development of electronic databases and the staff that is confident of using IT tools. In such a scenario, staff would use advanced software and IT technologies for project management processes and that may lead to increased use of ICT for project management processes. But, for general administration also, ICT usage would be enhanced if the organisation is interacting more with geographically separated agencies and senior management perceives that significant benefits would be accrued by use of ICT by the organisation. All the factors are interrelated and their effect can not be maximized in isolation. This analysis also validates the ISM model.

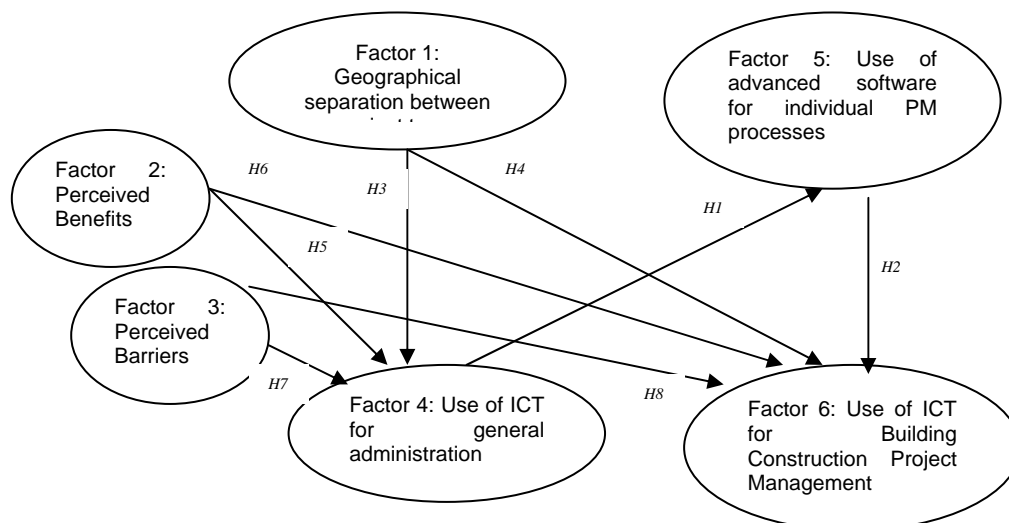


Figure 2 Structural Model

Statistical analysis of the data also shows that extent of ICT use for project management is influenced by the size of the organisation, primarily defined by the clients' requirements and is driven by the industry scenario. Collaborative use of ICT is less as compared to internal use of ICT and providing adequate ICT infrastructure and ICT-aware staff on project sites is an issue of concern. Large organisations and professional bodies need to establish methods for adoption of higher ICT technology and establish benchmark practices for use of ICT for building project management, with equal consideration of technological, managerial, sociological and cultural issues.

Phase 3 and 4

The research is ongoing with Phase 3 planned to include data collection through semi structured interview survey and case studies for understanding the cultural issues at industry, organisation and individual level effecting use of ICT for building project management, establishing a framework for benchmarking the use of ICT for building project management in the construction industry. Finally Phase 4 will complete the modulation of the ICT enabled communication strategy and its validation through case studies.

5. CONCLUSION

Building project management requires effective communication management between all project team members. This can be achieved through the strategic use of ICT at the industry, organisation and project levels. Construction industry is fragmented with the majority of organisations being SMEs. Research is required to study the factors influencing the use of ICT at all three levels and also the inherent relationship between these factors across the levels.

This research is being conducted in context to the Indian construction industry. Data collection for the first phase was completed through questionnaire surveys. Parametric and non-parametric statistical analysis, Structural Modeling and Structural Equation Modeling techniques have been utilized. Results to date show that the increased use of ICT for general administration within the SME organisations can lead to increased use of ICT for building project management. Other factors such as the perceived benefits of ICT use, geographical separation between the project team members, and the size of the organisation are also dominant factors.

To show the way, large organisations and professional bodies need to establish methods for adoption of higher levels of ICT technology and establish benchmark ICT practices for building project management, with equal consideration of technological, managerial, sociological and cultural

issues. Further research will be conducted to study the cultural factors through an interview survey and case studies.

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