

ROLE AND SCOPE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN CONSTRUCTION ENGINEERING IN INDIA

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Abstract: *In this modern era, information technology became an effective management tool in all types of industries. However, because of its complex nature and fragmented structure, construction industry is the slowest one in adaption of information technology tools. With the advancement in all the areas, and increase in the awareness of the participants about advantages of using ICT tools, the current decade experiences a considerable surge in the use of ICT within construction. The construction industry and its participants needs to handle huge amount of data in terms of designs, time and cost calculations, transportation updates etc. in most sustainable manner. In order to address this challenge in an effective way, the industry must use appropriate ICT tools. Aim of this paper is to study the role and scope of ICT in construction industry and discuss the factors that affect its implementation from the prospective of Industry, Organisation and Participants. The paper has exploratory approach with the aim of researching existing literature, describing the present state of ICT implementation with the objective of highlighting the role and scope of ICT and emphasize on the existing barriers in context of Indian construction industry.*

Keywords: ICT, Construction Industry, Construction Project, Information Technology, India, ICT barriers, ICT utilization, Automation

1. INTRODUCTION

In recent years, many researchers have studied the construction sector for its complex nature and the role and scope of ICT to achieve effective solutions to enhance its productivity.

The construction industry in itself is a vast organisation. Almost all the construction projects involve large number of participants and processes and demands for an effective communication amongst them. The important factor involved is the need for proper information management and clear communication amongst all the project participants. However, due to the extended fragmentation, enhancing the communication amongst all the project participants is a challenging task. Huge amount of data with wide dissimilarities involved complicates the information management task.

The development team of a construction project encompasses work force with wide variation of expertise, professional skills, computer acquaintance, educational background and working environment, which further

complicate the process. The distance between the construction office and the site renders the communication even harder. Each project differs in its location, surroundings and project participants, making the information standardisation, a difficult job. The volume and type of information to be communicated is also massive. Effective information transfer needs properly structured data. An efficient way to provide such information transfer is using information management system. In order to achieve the expected results more emphasis is given on ICT tools. Both the researchers and the ICT professionals have employed several ICT tools to provide solutions to the construction industry. This paper aims to identify the role and scope of ICT that can enhance the productivity of the construction industry in India.

2. Literature review

Today construction industry is facing many challenges, including the need to change current work practices, become more clients orientated, become more competitive, and become more productive (Love, 1999). With this background and several socio-economic developments, many countries have identified the significance of improving the performance of their construction industry to meet the objectives of its developmental goals (Ofori, 2000). The construction industry's processes and the working style is always of a temporary nature (Gann, 1996). Due to the complex nature of the construction projects, large number of participants need to interact and co-operate. The distance between the administrative office and the actual construction site makes the process of communication much harder. The use of ICT can simplify the process in an efficient way. (A.P.Chassiakos, 2007). Proper documentation is another area where the construction industry prominently lacks, which affects their decision making speed. Some basic IT tools are commonly used by the design personals but latest technology adoption remains the area of challenge, which results in delays at the operational stage of big project.

In order to achieve effective project management and implementation many levels need to be studied from the perspective of ICT implementation.

According to PwC's new report – 'Global Construction 2030' – In three countries, China, US and India, the amount of construction output will grow by 85% to \$15.5 trillion by 2030. Many research studies exists on innovation in the

construction industry especially in the field of materials, management and Information Technology (Peansupap, 2004). In India IT technology entered in late 90's. The construction field adapted few IT applications like Virtual Reality, 2D & 3D barcodes, and 4D-CAD. The introduction of internet and remote access have improved the project efficiency. From the literature review of abstracts of recent journals, it is evident that IT innovations related to ICT have been progressively used in construction projects over current years (Walker D. H., 1998). As observed by Peansupap, many IT research surveys are conducted in countries like Canada, Saudi Arabia, Hong Kong, Denmark, Finland, New Zealand and Australia. The survey results shows lesser ICT usage in existing construction industry (Peansupap, 2004). At present the construction documents are exchanged on paper or discussed in person by the practitioners (Hore, 2005). This can lead to miscommunication and timing issues. Traditional construction management practices never focus on improving construction efficiency within this complex environment (Latham, 1994). With various parties involved, the process of information sharing and proper communication becomes vital. So, there exists wide scope for improvement in construction productivity and targeted efforts must be taken to achieve the same.

The construction project managers mostly spend major portion of their time in data handling. The prime purpose of introducing ICT in construction field is to facilitate the participants with analytical and info tools to have effective control over the ongoing construction process and delivery. With the introduction of IT applications and improvement of information flow, we can expect enhancement in functioning and coordination to introduce an effective decision-making. For example, visualisation technologies can improve project information and effective communication between project participants (Liston, 2000).

Importance of Communication in Construction: The effectiveness of the project life cycle and collaborative work entirely depend on timely and correct communication. From the prospective of a project manager, an organisation can gain effective control and perfect documentation with the use of ICT. Even the consultant firms experience benefits like most organized work flow and quality assurance are possible and for contractors benefits include tracking of documents and timely approvals (El-Saboni M., 2009). Table 1 gives information about the stakeholders of construction project and various document utilized by them for communicating information:

Table 1 Information Producer-User Matrix for a Typical Project Chain-Source: Adapted from Murray et al (2001)

Role Players					
Documents	Architect	Quality Surveyor	Engineer	Contractors	Sub-Contractors and Suppliers
Drawings	✓		✓	✓	
Specifications	✓		✓		
Bills of Quantities		✓	✓		
Budget		✓			
Contracts		✓	✓	✓	
Planning		✓	✓	✓	✓
Personal Control		✓		✓	✓
Material Control		✓		✓	✓
Equipment Control		✓		✓	✓

1) Stage-wise Role of ICT in Construction

Earlier study shows that ICT creates productive environment to give a strategic approach to project. The construction project involves site-positioning, designing, material selection, budget planning where ICT plays a vital role. Timely communication during the lifecycle of

any construction project is of key importance. Using different ICT communication tools, this purpose is served at ease and the process of information transfer and document sharing becomes easy.

Figure 1 shows the role of ICT in different construction phases:

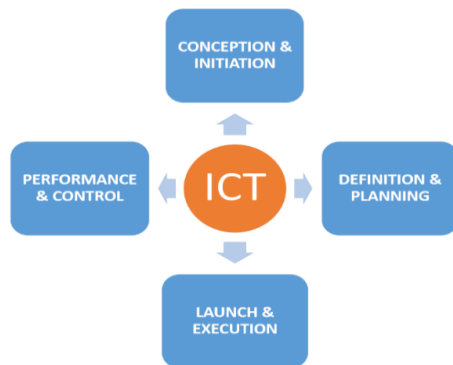


Figure 1: ICT in Construction Process

3. ICT Benefits:

According to (Perkinson & Ahmad, 2006), a contractor can upsurge his competitive benefit by incorporating ICT technologies thus benefiting the construction project. Benefits of ICT in three perspectives are,

a) Industry Perspective:

According to (Fujitsu, 1998), ICT can provide long term benefits to the industry and create new ways of doing business and offer competitive advantages. The general benefits provided by this practice can -Increased Business Turnover, Shorter Time Cycle, Easy Management of Complex Projects, Improved Documentation, and Gain in Productivity.

b Organisational Perspective: The important drivers' that can drive construction sector to implement ICT are: Technological Opportunity, Performance Enhancement, External Demands, and Competitive Benefits.

c) Project and Stakeholder Perspective:

As per (Gann, 1996), automation using ICT can help in decision making from early planning and conception stages, through design, engineering and procurement, to erection, installation, commissioning, operation and facility management.

Barriers affecting ICT implementation in construction industry

According to the study of Rivard (H, 2000), ICT implementations have raised productivity in many areas like administration, design and project management in construction. However, the benefits of ICT is at a cost, the reason being complexity of work, the proportion of new operations, the administrative needs and the business cost. Studying these challenges, there seems several factors affecting the nature of this changing industry (ÇİFTÇİ, 2005).

The research highlights various barriers and factors in mainly three perspectives for implementing ICT systems in construction sectors which are as below,

a) Industry Perspective

- High cost of initial investment for the systems
- Reluctance to invest in ICT
- A lack of skilled workers
- In-availability of required infrastructure
- Not identifying the risk factors while working in a remote and dangerous areas
- Resistance to engineering change
- Lack of awareness
- Unclear regulatory issues like legal, financial, tax, to participants resulting in 'major restrictions'.

b) Organisation Perspective

- Current decentralized structures of construction industry is a major barrier (Young and Davis, 2001).
- ICT immaturity levels
- Poor availability of tools
- Lack of a coherent ICT strategy
- High up-gradation costs
- Lack of effective ICT training in using the system
- As per study by Ahuja, "IT infrastructure at project sites and IT capability of site staff is an important factor and needs improvement in Indian construction industry" requires action at the organization level (Ahuja, 2009).

c) Participants Perspective

- Lack of motivation in participants to adopt ICT
- Fear of change or intervention into routine.
- As indicated by Young & Davis, if ICT applications don't fit in users/group culture, the implementation or adoption could be difficult (Young and Davis, 2001).
- Workplace environment such as open discussion, assurance, personal worry, and frustration.

Gap in Literature

It was seen from the literature that many organisations support ICT adoption, but they lack the efforts on actual ICT implementation. The study finds knowledge gaps on how to manage and encourage the ICT implementation within the firm. Thus there is a need to do more study in the area of factors hindering ICT implementation and find effective strategies to overcome the hurdles.

4. Conclusion

The review of literature concludes that there has been an uneven decrease in the research papers since 2002, which actually resulted in less publications in 2015. However, the awareness of ICT is still high especially after the introduction in BIM application in this industry. According to Hewage et

al. (2008) the Construction Industry considerably lacks in satisfactory execution and use of modern ICT technology as compared to other industries. The paper discussed various barriers while implementing ICT from the perspective of industry, organisation and participants. Lack of understanding of how the effective implementation of ICT can be done into a construction sector is a substantial research gap. To see this problem, this research paper suggest further in-depth studies to be undertaken to understand the role and scope of ICT and suggest different measures in implementation process at different phases of construction project.

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