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Scrutinizing Attributes Influencing Role of Information Communication Technology in Building Construction

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Abstract - *Information Communication Technology (ICT) can provide powerful strategic and tactical tools for construction industry, which, if properly applied and used, could bring significant advantages in promoting and strengthening their competitiveness. Construction project requires effective coordination and collaboration between the project participants due to large number of separated stakeholders involved at all the stages of the projects. This report discusses attributes that affect ICT in building construction. 36 attributes are identified from various literatures which influence ICT in building construction. For this, first pilot survey is carried out and got 31 relevant attributes which influence ICT in building construction. For this, questionnaire survey is conducted and analysis of these attributes will be done with the help of Delphi method and AHP method. From Delphi analysis 24 attributes are identified then give priority ranking to most affecting attributes using AHP method. This paper also focuses on ICT usage in construction building and benefits of ICT adoption in construction industry.*

Key Words: **Information Communication Technology, attributes, Construction industry, Building project, Awareness and adoption, Multi-criteria decision making**

1. INTRODUCTION

Information technology is defined as a collective benchmark Integration of computer and information technology and includes a wide range of techniques approaches to various problems. In construction industry, ICT can be defined as the application of support tools, which uses electronic machines and processing, storage, analysis, control, transfer programs And presentation of construction information data the entire life cycle of a construction project Information Communication Technology (ICT) can provide powerful strategic and tactical tools for organizations, which, if properly applied and used, could bring significant advantages in promoting and strengthening their competitiveness.

The applications of various ICT systems are seen as a way to enhance the productivity of the construction industry. The application of such technologies has great implications on current construction management models. It is believed that ICT, when appropriately used, can significantly contribute to the timely, economical, and successful deployment of construction projects. The use of information technology can help in increasing the competence of construction development.

ICT affect in every different construction phases i.e. predesign, design phase, maintenance and operation phase. ICT makes construction work easier, faster and cost effective. Use of ICT improves co-ordination, processes and collaboration between costumer, contractor and engineer. Information and communication technology (ICT) can provide powerful strategic and tactical tools for organizations, which, if applied and used correctly, it could provide significant advantages to promote and strengthen its competitiveness.

2. OBJECTIVES

1. To find out attributes related to role of ICT in construction projects.
2. To scrutinize attributes influencing construction projects.
3. To study these attributes using Delphi method.
4. To give priority ranking to most affecting attributes using AHP method

3. COLLECTION OF DATA

For identifying the attributes influencing in the construction projects, a literature survey is conducted in which several works of the researchers have been scrutinized and the critical attributes are identified. Further, the selected attributes are again classified in their appropriate or desired categories.

Total 31 numbers of attributes are identified by literature study and these attributes are classified into different six categories.

4. RESEARCH METHODOLOGY

For achieving aim of this paper two approaches are used; first one is Delphi Method which is used to identify most suitable attributes which influence in building construction While, the other approach used is analytical hierarchy process (AHP) which is used to calculate the relative importance of the main groups and the sub group under each group.

4.1 Delphi Method

The Delphi technique was originally proposed based on people's conjecture, judgment, and inspiration but gradually took the academic form. For the first time in the late 1950s, in a research by U.S. RAND Corporation, the Delphi was introduced for the scientific study of experts' opinions on military defense project.

The main purpose of the Delphi method is to acquire the most reliable consensus of a group of experts opinion by a series of intensive questionnaires combined with controlled opinion feedback. By obtaining the consensus of a group of experts using the process, researchers can identify and prioritize issues and develop a framework to recognize them.

4.2 Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process was developed by Saaty (1980) and is sometimes referred to as Satty method. It allows decomposition of the problem into hierarchical structure and utilizes its qualitative and quantitative aspects of evaluation. It is a Multi Criteria Decision Model (MCDM) that applied to different types of problems.

By the help of AHP the relative importance of each attribute can be find out which will help in ranking these attributes.

5. DATA ANALYSIS

The data analysis is done by both methods as follow.

5.1 Data analysis by Delphi method

There are three phases in Delphi method. In the first phase of the study, group and subgroups were prepared and which was sent to panelists and experts of the construction industry. To emphasize greater field experience, at least 5 years of professional experience in the building construction industry was kept as one of the criteria for the selection of experts. Based on existing literature reviews and interviews with 12 experts in the first round of the survey under the Delphi process, six major attributes and their sub attributes were selected. In the second round of the survey, the findings of the first round of interviews were presented to the experts. Experts were asked to evaluate the importance of the attributes on a seven-point scale.

Based on the results of the second round, all required statistical parameters like absolute deviation (AD) (median), coefficient of variation (CV), and range of the data were computed as presented in Table 4.2 to judge whether experts have reached consensus to a certain extent. Jordan and Javernick-Will (2013) computed absolute deviation (AD) (median) and coefficient of variation (CV) in their studies by using the Delphi method. Statistical parameters and their cut-off values depend on the requirement of the study. Therefore, it needs to fix the statistical parameters because of a lack of a guideline to measure the consensus in the Delphi method (Hallowell and Gambatese 2010). Hence, this study adopts the criteria that absolute deviation (AD) (median), coefficient of variation (CV), and range of the data, should be less than 1.00, 0.24, and 5, respectively. The criteria were decided based on variation in data and previous studies (Hallowell and Gambatese 2010; Jordan and Javernick-Will 2013, Patel D. A and K. N. Jha 2016).

5.2 Data analysis by AHP

After finalization of a conceptual model using Delphi techniques all attributes having 6 main attributes and 24 sub attributes are put into the questionnaire survey and sent for the view of stakeholders of building construction. 25 responses were used for AHP analysis and after analysis using AHP hierarchy of attributes was created using corresponding global and local weights.

After collecting data, data analysis is done using AHP, a matrix for each stakeholder is prepared and CR value of each matrix was identified. As consistency of all matrix is not achieved so to overcome the effect of that combined matrix method is used which do Wakchaure and Jha (2012) suggest. This method says that the value of CR for the combined matrix should be less than 0.1, which is achieved in all our cases, which is shown in detail analysis of each group.

Table 5.1: Prioritization of main attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
Management attributes	0.1813	3	0.0414
Traditional practice attributes	0.0659	6	
Planning attributes	0.0909	5	
Technology attributes	0.2392	2	
Finance attributes	0.3209	1	
Human attributes	0.1017	4	

The CR value and the ranking of the main group according to eigenvalue are shown in Table 5.1

Table 5.2: Prioritization of Management attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
Experience of the work teams	0.5092	1	

Training to use ICT and its tools	0.2716	2	0.0374
Organization culture	0.0613	4	
Inadequate ICT content in construction	0.1579	3	

The CR value and the ranking of the management related attributes according to eigenvalue are shown in Table 5.2

Table 5.3: Prioritization of Traditional practice attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
Lack of technological adoption	0.4264	1	0.0586
Resistance to changes in current business processes	0.2517	2	
Lack of a common standard for ICT adoption among firms	0.1111	4	
Ineffective Communication channels	0.0469	5	
Difficulty in understanding ICT in construction	0.1640	3	

The CR value and the ranking of the Traditional practice related attributes according to eigenvalue are shown in Table 5.3

Table 5.4: Prioritization of Planning attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
Communication within project teams	0.3039	2	0.0304
Continual need to upgrade	0.4553	1	
Specific contract's conditions to use ICT in projects	0.1683	3	
Security concerns/Privacy Fears	0.0725	4	

The CR value and the ranking of the Planning related attributes according to eigenvalue are shown in Table 5.4

Table 5.5: Prioritization of technological attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
Lack of Electronic devices	0.2000	3	0.0147
System and computer malfunction	0.2916	2	
Scarcity of software	0.4110	1	
Lack of support from government for technological advancement	0.0974	4	

The CR value and the ranking of the technological attributes according to eigenvalue are shown in Table 5.5

Table 5.6: Prioritization of Financial attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
The limited budget for ICT investment	0.1785	3	0.0178
Cost of ICT and its components	0.4778	1	
Limited benefits/low return on investment in ICT	0.0917	4	
High cost of employing ICT professionals	0.2520	2	

The CR value and the ranking of the financial attributes according to eigenvalue are shown in Table 5.6

Table 5.7: Prioritization of human attributes

Attributes	Eigenvalue	Rank	CR value for Combined Matrix
Lack of awareness of ICT among workers and management	0.5665	1	0.0129
Lack of specialized staff	0.3299	2	
Workers attitude and resistance to change	0.1036	3	

The CR value and the ranking of the Human attributes according to eigenvalue are shown in Table 5.7

In the final stage, the global weights of all criteria are obtained by multiplying the weight of the main criteria by the corresponding weight of sub-criteria. Rank is classified into two categories, first is based on the main criteria and the second one is based on the sub-criteria. By attaining sub-criteria of any main criteria, significant improvement can be seen in the main criteria, and that leads to enhancement in the overall implementation of the ICT. Final rankings are as below.

Table 5.8: Final Prioritization of ICT attributes

Sr. No.	Main Attributes	Sub Attributes	Global Weight	Rank
1	**Management Attributes**	Experience of the work teams	0.0923	3
2		Training to use ICT and its tools	0.0492	8
3		Organization culture	0.0111	19
4		Inadequate ICT content in construction	0.0286	13
5	**Traditional Practice Attributes**	Lack of technological adoption	0.0280	14
6		Resistance to changes in current business processes	0.0165	17
7		Lack of a common standard for ICT adoption among firms	0.0073	22
8		Ineffective Communication channels	0.0030	24
9		Difficulty in understanding ICT in construction	0.0108	20
10	**Planning Attributes**	Communication within project teams	0.0276	15
11		Continual need to upgrade	0.0413	8
12		Specific contract's conditions to use ICT in projects	0.0152	18
13		Security concerns/Privacy Fears	0.0065	23
14	**Technology Attributes**	Communication within project teams	0.0726	5
15		Continual need to upgrade	0.1089	2
16		Specific contract's conditions to use ICT in projects	0.0402	10
17		Security concerns/Privacy Fears	0.01734	17
18	**Financial Attributes**	The limited budget for ICT investment	0.0572	7
19		Cost of ICT and its components	0.1533	1
20		Limited benefits/low return on investment in ICT	0.0294	12
21		High cost of employing ICT professionals	0.0808	4
22	**Human Attributes**	Lack of awareness of ICT among workers and management	0.0576	6
23		Lack of specialized staff	0.0335	11
24		Workers attitude and resistance to change	0.0105	21

6. CONCLUSIONS

In this study, an attempt is made to create a hierarchy of attributes, which are crucial for successful implementation of ICT in Surat, building construction industry. For that study is made in two-stage first stage is to identify and select attributes for the study using Delphi method and second stage is to give ranking to those attributes using AHP tool.

The primary objective i.e. prioritizes the attributes for successful implementation of ICT is considered as the first level. In the second level main criteria namely management attributes, Traditional practice related attributes, Planning attributes, Technological attributes, Finance attributes, and Human attributes are there. At the third level, 24 sub-criteria shortlisted by a panel of experts from Delphi are kept.

The present research framework is prepared to identify and to prioritize attributes, which hinder effective implementation of the ICT in building construction industry. With the help of this, stakeholders of building industry can place emphasis on most important attributes and can formulate strategies to overcome their influence. The AHP approach is used to rank and prioritize ICT attributes and found useful in tackling uncertain judgments perceived by the experts.

The finding (Table 5.8) depicts the ranking of the attributes which hinder the successful implementation of ICT. By attaining sub-criteria of any main criteria, significant improvement can be seen in the main criteria, and that leads

to enhancement in the overall implementation of the ICT in building construction industry. Out of all the main criteria i.e. financial attributes has, a weight of 0.3209, which means that about 32.09 percent of obstacles ICT implementation, is due to the financial. However, it needs to be understood by all organizations that for ICT may be initial cost can be an issue but after implementing it will definitely increase project performance which will be beneficial in terms of finance. The technological attribute followed by the management attribute is having the weight of 23% and 18% respectively, which reflects that the absence of involvement of technology in construction industry can create huge impact for successfully implementation of ICT in building industry and it will enhance the project performance by coordination of management and human resources. The attributes like Human, Planning, Traditional practice are the least concern according to the experts.

Turning to the sub-criteria, based on the global weight of the attribute like Cost of ICT and its components, Continual need to upgrade, Experience of the work teams, High cost of employing ICT professionals and Communication within project teams are the top hindrance in successful implementation of ICT in building construction. Due to the thinking of an organization that initial investment cost needs to be lower many organization resist to implement despite knowing that if we apply ICT it will help us to reduce construction errors, improve productivity and complete the project within time and budgeted cost. Sometimes top authority of organization is so rigid that they do not want to implement the new concept in the field but if somehow they are convinced that they can get so many benefits just by adopting ICT, they can surely for increase performance of the project. The developed methodology will help the building industry in making a citywide priority for successful implementation of the ICT.

The ranking of attributes presented in this study will help the stakeholders of building construction industry to the successful implementation of ICT in Surat. It is anticipated that the current framework will positively act as a rewarding input for all the stakeholders to improve the approach towards their future work.

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