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Evaluation of Design-Construction Interface Problems in Building Construction Projects

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Abstract: *Interface management is one of the major keys for a successful completion of construction project. It is the management of the boundaries among project entities (people/participants, processes/phases, resources, environment, etc) to enable a dynamic and well coordinated construction system. Design–construction interface problems prevent the successful delivery of construction projects within the specified time, cost and quality. In this investigation we are going to focus on leading issues of interface management and its severity on the overall project performance. This research was conducted to identify the causes of design-construction interface problems in large construction projects of Surat region. To achieve the research objectives, a comprehensive questionnaire based investigation was carried out by referring various literature reviews, pilot study, interviews and site survey for collection of data and then final responses was analyzed to find out the most significant design-construction interface problems. Recommendations were made to enhance the coordination and management of construction projects that lead to reduction in the design–construction interface problems.*

Keywords: *Design, Construction, Interface management, Project performance, cost, time, quality, design-construction*

I. INTRODUCTION

The construction industry is one of the key industries of any country. It plays an important role in the economic development of the country by generating a huge number of employments and significantly contributing to GDP of country. Construction is the sixth largest economic sector in India, accounting for 7.8% of the country's GDP in 2016, the second-biggest employer after agriculture, with about 35 million people engaged with it. Any construction project starts with a group of ideas which can be transformed into reality to achieve the anticipated goals of the project. This transformation process requires input data from a varied and wide range of members of the project team. In large building construction projects, a set of teams need to coordinate, communicate and cooperate throughout the project's life cycle to end up with a successful and completed project. The stakeholders in the project can be owner, design consultants, project management consultants, execution engineers, general contractors, subcontractors, labor sub-contractors, material suppliers, equipment suppliers etc. So, whenever too many people are involved in a project; multiple interfaces would appear which are required to be managed. Disagreement between these various parties will cause problems in the design and construction phases. Interface problems affect the overall performance of the project regarding to cost, time and quality of work. Generally interface can be defined as a common point or common boundary between two or more systems, phases, organizations, etc where they meet, interact and influence each other. In construction point of view, Interfaces are generally considered as the links between different construction elements, phases of project, multiple stakeholders, etc. The experts defined the interface management as the management of communication, coordination and responsibility across a common boundary between two organizations, phases, or physical entities which are interdependent. It is the management of the boundaries among project entities (people/participants, processes/phases, resources, environment, etc) to enable a dynamic and well coordinated construction system.

II. OBJECTIVES

This research attempts to:

To investigate and identify the most significant project issues related to design-construction interface management for large construction projects in Surat region.

To check the effect of interface management problems on project performance regarding to project's cost, time and quality.

III. LITERATURE REVIEW

K. Keerthanaa, Dr. S. Shanmugapriya (2017), defined interface management system as “a systematic approach to effectively identify and handle interfaces through whole project lifecycle, with the objective of facilitating the alignment process between

stakeholders by defining the interface characteristics, responsibilities of involved parties, and the need time of deliverables.” They described steps involved in interface management systems which are; (1) Interface identification (2) Interface documentation (3) Interface transferring (4) Interface communication (5) Interface closing.

Mohamad Hazem AL Mousli et.al (2016), K.Z.Sha’ar et.al (2016), Sadi A. Assaf & Faisal Manzoor Arain (2007), in their study identify the potential sources of problems at the interface between design and construction and provide solution and recommendations to eliminate these sources of problems at the design and construction interface.

Qian Chen et.al (2008), presented the multi-perspective approach to investigate the causes of interface problems in different construction projects by using “The Cause and Effect (C&E) diagram method”. It is stated that a well designed interface management framework include quality management, cost management, contract management, resource management, time management, communication management, process management & risk management.

Yu-Cheng Lin (2012) proposes a new and practical methodology to track and manage interface events by using Network-based Interface Maps. Using NBIM, users can get an overview of previous and current interface events in a project and take appropriate actions to control and manage interfaces. They develop CNIM system to keep interface information in a digital format for easy sharing, updating and transfer. The CNIM system provides the available interface events, interface problem descriptions and solutions. Its limitation is that all are needed to follow the system but in construction project, many participants may not be used to web based system.

IV. RESEARCH METHODOLOGY

Research methodology of this study contains three main steps. First step includes literature Survey. The literature review was conducted through research papers, journals, internet, etc. Second step includes the non structured interviews conducted with experts in construction industry as project managers, site in charges, senior engineers. According to their suggestions and literature review, questionnaire was designed for survey. Questionnaire includes various interface (co-relationship) problems that exist during project life cycle. Questionnaire was distributed to expert participants of Surat to ask for their responses. Third step includes result analysis of collected data and conclusion with relative importance index method (Fagbenle et al., 2004):

$$RII = \frac{\sum W}{A * N}$$

Where W, is the weighting given by each respondent to each problems. A is the highest weight (i.e. 4 in our case) and N is the total number of the respondents.

V. QUESTIONNAIRE DESIGN

The questionnaire is divided into four main parts. Section- A gives introduction of interface management. Section- B is related to respondent’s details. Section- C includes the list of the interface problems which are exist during design, construction and combine of these both phases of the construction project. In section- D, respondents asked for their suggestions.

In Section- C, the respondent is provided with a Likert scale ranging from 1- not important to 4- extreme important. Respondents has to give importance rank to each interface problems for its effect on project’s cost, time and quality and overall impact separately.

VI. RESULTS AND DISCUSSION

The table 1 shows the top ten most significant design-construction interface management problems according to their overall impact on project.

Table I Most Significant Design-Construction Interface Problems (Overall Impact)

Rank	Interface Problems
1	Financial problems
2	Lack of specialized construction manager
3	Frequent changing in design
4	Insufficient & inaccurate working drawing and specifications
5	Poor decision making by higher authorities
6	Poorly written contract detail
7	Lack of communication & coordination between parties involved in project
8	Planning & scheduling problems
9	Awarding contract at lowest price regardless of quality
10	Lack of coordination inside the design firm

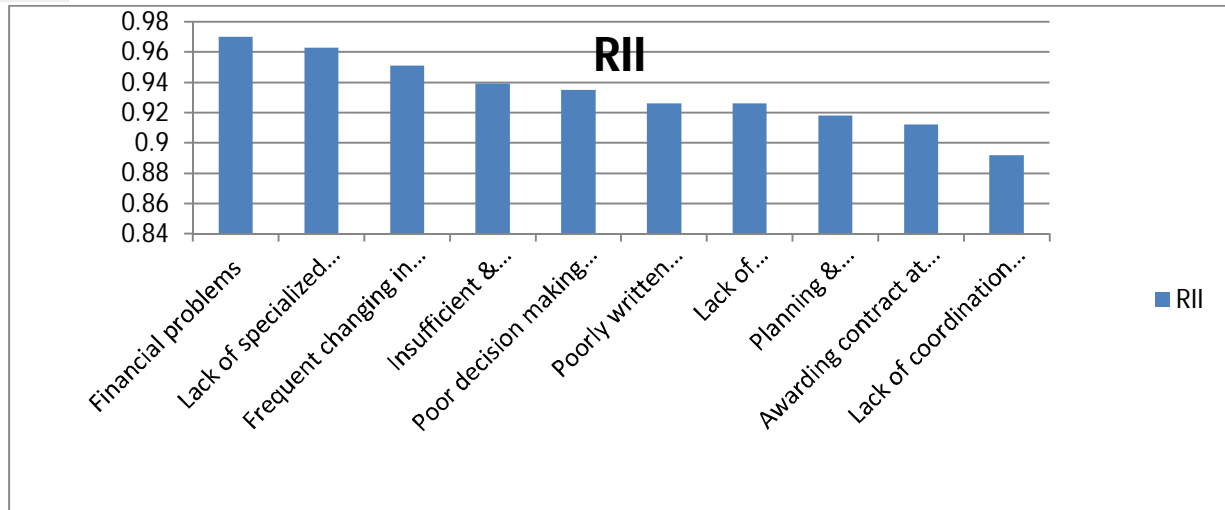


Fig.1 Most significant design-construction interface problems (overall impact)

The table 1.2 shows the top ten most significant design-construction interface management problems affecting the cost of the project.

TABLE II

Most Significant Design-Construction Interface Problems Affecting Project's Cost

Rank	Interface Problems
1	Financial problems
2	Poorly written contract detail
3	Unexpected changes in labor & material availability and prices
4	Lack of experience of execution team
5	Lack of specialized construction manager
6	Lack of communication & coordination between parties involved in project
7	Lack of project management as individual third party
8	Insufficient & inaccurate working drawing and specifications
9	Frequent changing in design
10	Construction errors & defective work at site

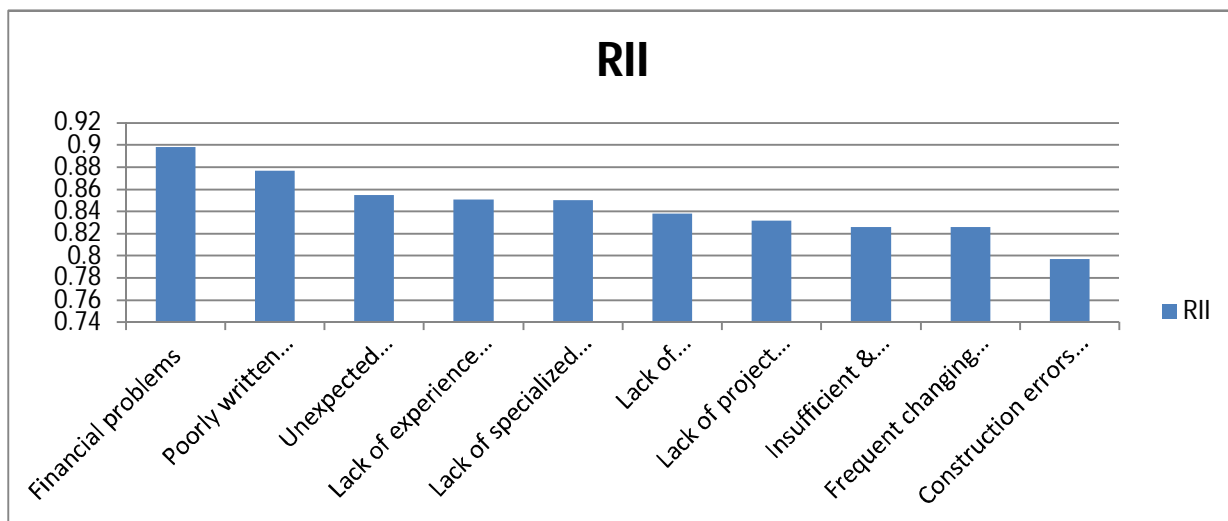


Fig.2 Most significant design-construction interface problems affecting project's cost

The table 1.3 shows the top ten most significant design-construction interface management problems affecting the completion time of the project.

TABLE III
Most Significant Design-Construction Interface Problems Affecting Project's Completion Time

Rank	Interface Problems
1	Delay in approval by government authorities
2	Financial problems
3	Frequent changes in subcontractors
4	Delay in approval of design and completed works by owner
5	Delay in material approval
6	Unexpected changes in labor & material availability and prices
7	Insufficient & inaccurate working drawing and specifications
8	Shortage of material at site
9	Lack of communication & coordination between parties involved in project
10	Planning & scheduling problems

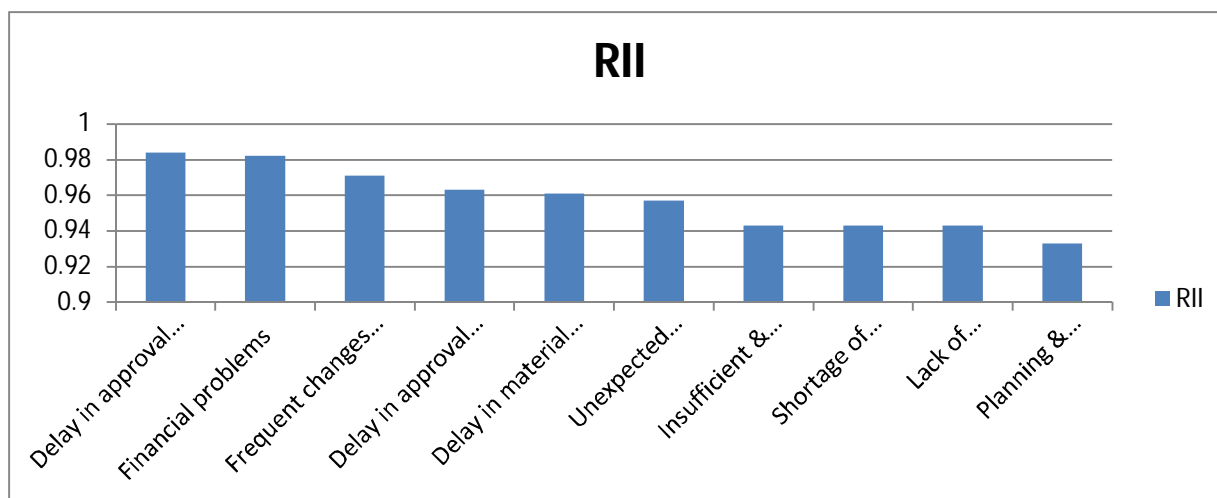


Fig.3 Most significant design-construction interface problems affecting project's completion time

The table 1.4 shows the top ten most significant design-construction interface management problems affecting the quality of the project.

TABLE IV
Most Significant Design-Construction Interface Problems Affecting Project's Quality

Rank	Interface Problems
1	Lack of specialized quality control team
2	Awarding contract at lowest price regardless of quality
3	Poorly written contract detail
4	Limited skills of labors & engineers at site
5	Insufficient & inaccurate working drawing and specifications
6	Lack of experience of execution team
7	Poor decision making by higher authorities
8	Improper work packaging and subcontracting
9	Financial problems
10	Communication gap between design and execution team

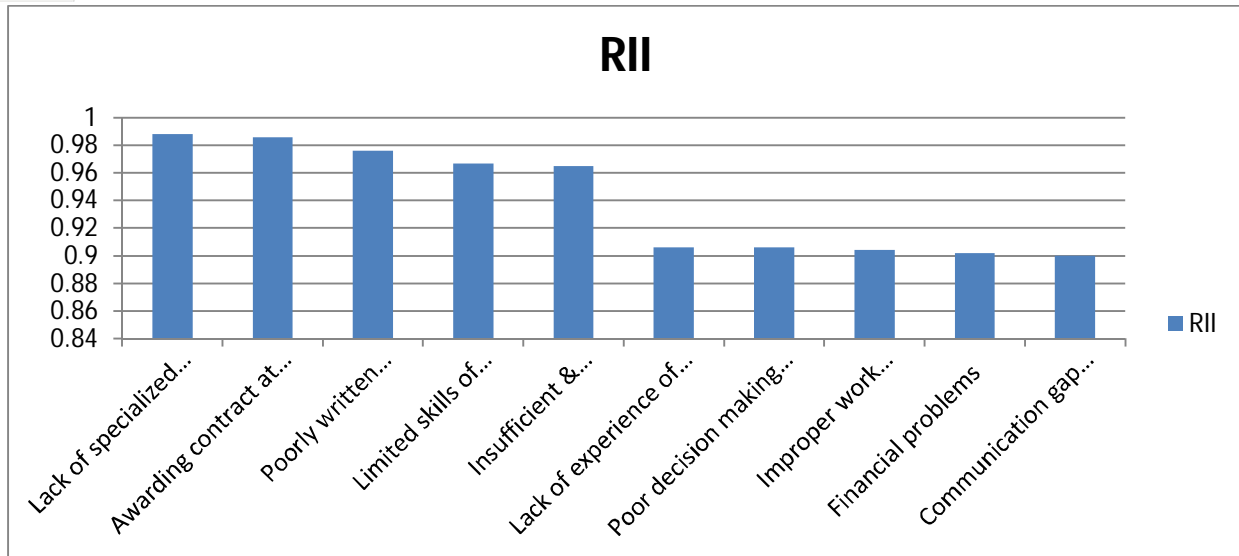


Fig.4 Most significant design-construction interface problems affecting project's quality

VII. CONCLUSIONS

Interface management (IM) is an emerging area of project management in the construction industry. It is extremely important for multi-disciplinary construction projects. Properly managing interfaces among the client, developers, designers, contractors, government agencies, environments, or facility/project components, is essential to project success.

Based on the results, most significant design-construction interface problems in surat region include; Financial problems, Lack of specialized construction manager, Frequent changing in design, Insufficient & inaccurate working drawing and specifications, Poor decision making by higher authorities, Poorly written contract detail, Lack of communication & coordination between parties involved in project, Lack of coordination inside the design firm.

One of the challenges of today's fragmented projects is the management of the interactions between stakeholders. Similarly, this study shows that the main design-construction interface problems are caused by the lack of coordination and management throughout the construction project. The other major problems are the lack of specialist construction manager and project management as a professional service. Partnering and teamwork can also help in reducing the interface problems and increase chances for project success.

To enhance the interface management, reduce the frequent design changes. If changes are inevitable, they should be handled through a properly coordinated and controlled process and retained throughout the project life cycle.

It is possible to utilize Building Information Modeling (BIM) as an advanced panacea for reducing design errors and rework in construction and engineering projects.

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