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# Application of Technical Advancement in the Supply of Structural Design and Drawings to Improve the Efficiency and Adopting a Best Practice Model to Minimize Delays in Construction Projects

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**ABSTRACT:** Necessity of changes in structural specifications during construction is a common occurrence. The study focuses on the causes of discrepancies at the design and construction interface to avoid delays and speed up the construction by the application of technological advancement. The subject is divided into two parts. The first part covers a review of literature discussing the subject of design construction help of the interface issues. The review which includes major research papers, and some text books, is summarized into various parts; interface between employees, construction details, the cost and pricing aspects, and the management and administration of change orders. The information and recommendations made in this part were used to develop and establish direction for the second part of the study. Initially pilot study was carried out based on survey questionnaire developed through literature review and with the questionnaire the problems are ranked and then the Expert System is to be formed as the rectification method for the defects.

**KEYWORDS:** Design-construction interface, BIM mode, Design-built model, time delay.

## I. INTRODUCTION

Transforming an idea into reality, whether a building, a heavy civil or an industrial project, requires input from a wide range of members of the project team. This project team is normally composed of planning, design, operation and construction management of construction facilities.

The planning team comprises of members who plan and schedule each work to finish it within time and budget. The design team includes representatives from all the technical design disciplines involved in the project.

The execution team includes the representatives who work onsite as per schedule to maintain good quality in construction. The management team comprises of members involving in coordination of all the faculties in various sector and also between the contractors, subcontractors and client.

To develop design and construction collaboration in practice, it is crucial to understand the aims of the design and construction activities. However, the collaboration between the construction managers and designers is mainly studied by tracing patterns of interaction, levels of task-based or socio-emotional interactions, or communication networks.

In many projects these are complex tasks, which are made even more difficult by the problems created by the differences between the intrinsic nature of design, and of the intrinsic nature of construction operations. The quality of the total project team decision-making and implementation process is a direct result of the availability, accessibility and reliability of information, combined with an ability to visualize what other parties communicate. The design construction interface is especially important since the quality of construction facility many times is a function of the

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quality of the information generated during the planning and design phases, and especially of the degree of construction input to the design process.

## II. LITERATURE SURVEY

Songer and Molenaar (1996) expressed the historical proof of design-construction interfaces, and articulated that design-construction interface has been traced to ancient Mesopotamia, where the Code of Hammurabi (1800 BC) fixed absolute accountability upon master builders for both design and construction. Mendelsohn (1997) observed that probably 75% of the problems encountered on site were generated at the design phase. This is not to say that contractors do not create a slew of problems of their own but that these problems were often compounded by inherent design flaws. If one were to seriously consider ways to reduce problems on site, an obvious place to begin with is to focus on what the project team can do to eliminate these problems at the design phase. Tarja Maki (2015) says that in modern, complex construction projects site meetings are typically the arena in which designers, engineers and managers co-create and develop new design solutions, give feedback to each other and jointly discuss design-related issues. In these meetings, project partners transcend their traditional, distributed job descriptions in order to share their knowledge to create better design details. This study explores what design-related issues are addressed in the site meetings, who participates in the discussions and creates new design solutions, and with whose expertise the decisions on the new design solutions are finally made. Sugumaran B, Lavanya M R (2013) expresses that in many projects it is more difficult to predict the problems created by the differences between the intrinsic nature of design, and of the intrinsic nature of construction operations. The quality of the total project team decision-making and implementation process is a direct result of the availability, accessibility and reliability of information, combined with an ability to visualize what other parties communicate. The design construction interface is especially important since the quality of construction facility many times is a function of the quality of the information generated during the planning and design phases. Luis F. Alarcon and Daniel A. Mardones (1998), describes a performance study of the design-construction interface. This study comprised: interviews with experts, data collection from several projects and design and implementation of improvement tools. QFD was used to identify the most effective tools and to set priorities for implementation. The proposed changes were implemented in a construction company participating in the study with significant impacts on performance. The implementation comprised new design and review procedures, standards for communication as well as explicit definition of internal customer requirements and design attributes. The implementation of these changes brought important reductions on design defects and their corresponding impacts in this company, some of these results are discussed in this paper. Owolabi James D, Oloke C, Peter Joy (2014) investigate the effects and causes for the delay on the building construction projects delivery time. The main cause is found as the defect in the design and the procurement process. Jorge A. Vanegas and Augusto Opdenbosch (1995) described a methodology for simulating construction operations, which strengthens the design/construction interface. The methodology enables both designers and constructors to run interactive and real-time simulation of construction operations in a virtual environment, thus bringing the user closer to the real world than ever before during the design phase. Dossick and Neff (2011: 83), have found BIM to be an efficient tool for the information exchange of explicit knowledge. However, messy talk and informal, active and flexible conversations are still needed to exchange tacit knowledge in inter-organizational collaboration among architects, designers and construction professionals in building projects. The talk and informal conversations take place in project meetings. They bring up critical issues that require face-to-face discussion and co-design work. The aim of the meetings is to provide an arena for these discussions and through this arena to proceed with the project.

## III. METHODOLOGY

Its duration, cost and value can characterize the flow processes. The value is referred to the satisfaction of the requirements of the client. Only the activities that can be converted to form valueables for the client are the ones that add value to the product. Huovila et al. (1997) suggested the model shown in Fig [1] for the design process.

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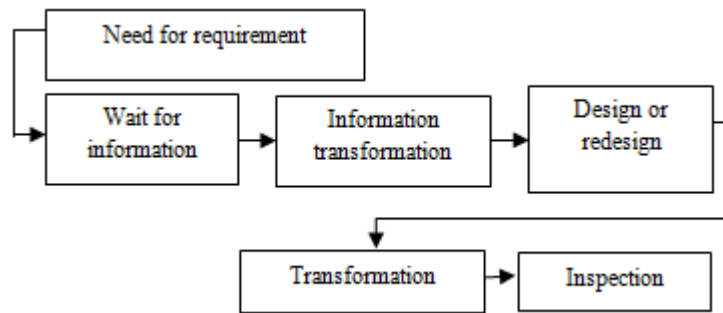


Figure1: Design flow

## Expert system

- Expert System (ES) in construction includes cost control, scheduling and time control, purchasing and inventory control as well as quality control throughout the entire planning, design and construction process.
- Expert system in general is an efficient computer program which provides the solution of problems based on task specific knowledge and inference techniques at the level of a human expert.
- ES are particularly useful in the decision making process where the various decision options are clearly defined but the method of choosing the option at best.
- It also provides pre-determined recommendations in a problem area.

## IV. PILOT STUDY

Based on the literature review carried out and discussion with practicing engineers and consultants the survey Questionnaire has been prepared. The major causes for discrepancy in design and construction interface identified from Pilot studies are as follows

### 1) Delay in preparing construction document

Construction documents are important for timely project commencement and accomplishment. Delay in their preparation can affect procurement and scheduling activities. Client may take time to fix the sub contractor for the work and also the contract documents bound to legal aspects and involves approval procedures hence preparing contract documents may be delayed sometimes which in turn affects design construction interface.

### 2) Lack of design data

A lack of data can result in misinterpretation of the actual requirements of a project. Considering all the relevant data and information in the design can help participants understand the actual situation. Where there is insufficient data, designers are compelled to develop designs based on their own perceptions, which clients may not deserve or which may result in rework.

### 3) Communication gap between contractor and designer

Communication is vital in a multi-player environment like construction. Strong and incessant communication is necessary for optimum coordination. Through better communication, both the constructor and designer can overcome various problems which occur at different phases of a project.

### 4) Lack of speciality construction manager

The construction manager is the professional who manages the construction phase. The construction manager carries out the construction phase in an organized way to eliminate the risks of delays and other problems. Consequently, inexperienced and unskilled manager may increase interface problems between the contractor and the designer.

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5) *Delays in procurement*

Delays in the procurement of construction materials or equipments have various adverse affects on other processes in the construction cycle. Occasionally, the procurement delay may cause an entire change or replacement of originally specified materials or equipment for the project. Therefore it may cause a need for project activities to be reworked.

6) *Materials approval delays*

Delays in the procurement of construction materials or equipments have various adverse affects on other processes in the construction cycle. Occasionally, the procurement delay may cause an entire change or replacement of originally specified materials or equipment for the project. Therefore it may cause a need for project activities to be reworked.

7) *Time limitation in design phase*

Time limitation may occasionally force the designer to wrap up the necessary design works at a lower quality. If time is not adequate, the design cannot be developed in proper way. This may cause misunderstandings between professionals.

8) *Lack of human resources in design section*

Quality work and timely schedule would be affected in the absence of adequate manpower support. A lack of human resources can lead to discrepancies between the designer and the contractor. This is because a delay in the design process or a poorly executed design can eventually affect a wide range of jobs in the supply chain.

9) *Errors in design*

Design errors can affect a project adversely depending on the timing of the occurrence of the errors. Even though it is impossible to create a perfectly error free design it can definitely be minimised. Design errors which are not rectified during the design phase, will eventually appear in the construction phase where the impact can be more severe than in the design phase.

10) *Change orders*

Changes are inevitable in any construction project. Needs of the owner may change in the course of design or construction, market conditions may impose changes to the parameters of the project, and technological developments may alter the design and the choice of the engineer. The engineers review of the design may bring about changes to improve or optimize the design and hence the operation of the project. Further, errors and omissions in engineering or construction may force a change.

11) *Lack of quality in design*

Design drawings are generally incomplete and they are not explicit, requiring a great amount of specifications. Specifications are difficult to handle and sometimes are ignored. Very often design documents have inconsistencies, errors and omissions, or simply lack of clarity in the presentation. This implies that those that should carry out the work do not have the necessary information or have the wrong information to do the job.

12) *Lack of design standards*

There is a lack of standards in the designs, and lack of suitability for the existing technology. In many projects of similar characteristics, or of the same type, the designs used are completely different with the consequent loss of efficiency in the construction phase.

13) *Lack of constructability*

An important proportion of the problems detected during construction is due to lack of constructability of the designs.

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## V. BEST PRACTICE MODEL

### A. BIM model

Building Interface Model (BIM) is a process involving the generation and management of digital representation of physical and functional characteristics of places. BIM are files which can be exchanged or network to support decision making about a place. BIM software is used by any who plan, design, construct, operate in various construction projects.

There are various type of BIM they are

- a. 4D - includes display the progress of entire project
- b. 5D - includes the progress and to that of related cost over time for entire project
- c. 6D - includes various details like maintenance/operation manuals, cut sheet specification, photos, warranty data, web links to product online sources, manufacturer information and contacts, etc.

### B. Design-build model

Design-build is a project delivery system used in the construction industry. It is a method to deliver a project in which the design and construction services are contracted by a single entity known as design-build contractor. Design build relies on a single point of responsibility contract and issued to minimize risks for the project owner and to reduce the delivery schedule by overlapping the design and construction phase of a project.

## VI. DISCUSSION

The various factors are analyzed based on the effect of the design in the execution stage. The factors are considered based on the expert advices and also through various literature journals. From a survey it is noted that 75% of problem in the execution stage is due to the lack of the design data and specifications. So it is taken into consideration for my study and to provide Expert System as a rectification method.

## VII. CONCLUSION

The main drawback is insufficient data in design field leads to the improper finishing of work and it also leads to the quality loss in construction. Thus in order to minimize the delays in construction work the above explained models are highly recommended.

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