

Quality Assessment for Design-Bid-Build Projects

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ABSTRACT: Since the infrastructure boom is seen since recently, civil engineers need to do continuous research on new advents and technologies, as well as improve the construction culture by eliminating major issues seen in the construction industry frequently. Major construction work carried out is executed using the project delivery method, Design-Bid-Build. Designer designing for the project, the owner contracting with the designer and contractor separately is the trend seen in almost all mega projects in the country. This paper deals with the major problems in construction qualities usually seen in Design-Bid-Build projects, and suggesting remedies for it by preparing an effective module for the same. Various factors affecting the quality has been studied and listed, and questions based on those factors have been prepared. The questionnaire remains the foremost and common tool to get responses from the clients and contractors since they are easily understandable to them, as well as saves considerable time. Suggestions and remedies for eliminating the critical issues which affects the quality of construction are given.

KEYWORDS: Design-Bid-Build; Design; Bidding; Construction; Interview; Quality; Survey

I. INTRODUCTION

For any construction project, the phases broadly classified are the design phase, tendering phase and construction phase. Ideally, these phases have to be done one after the other respectively. But as human beings, we tend to make a lot of mistakes and eventually there will be turning back and rectifying or changing the existing plans in every phase. The overall quality of the project will be affected by common flaws and changes in the phases seen in the design-bid-build projects. The major problems have been listed up and solutions for the same have been given.

The research was confined to the project delivery method, design-bid-build, since it is widely preferred in the construction industry. For the past half-century, the dominant design and construction process for most of the construction projects has been understood as a three-step process: architects and engineers design the entire project, bids are solicited from contractors, and contractors executes in practice.

The basic design-bid build process occurs like this: the owner hires an architect/ an engineering firm to design the project and place the project out for bid to contractors. The contractors participate in the competitive bidding process and the deserving contractor(s) with the lowest bid will be given the contract. The contractors perform the actual construction work. Even though a common project goal is shared, which is the overall completion of the project; participants differ in what they will gain from the construction process. The owner would probably agree that they would like to spend as little as possible to get their project completed. Designers are in business to provide a service to the owner; i.e. the design process, but their relationship with the contractors is usually not clear. The contractors attempt to provide the service as per the designer's plan, as efficiently as possible, for their own profit. Apart from these three primary stakeholders, there are many other parties involved in the construction process: sub-contractors and suppliers. Sub-contractors (fabricators, carpenters, masons, plumbers, electricians, etc) are important people since they are the ones who are specialized in one or more kind of work. The figure (Figure 1) shows the conventional design-bid-build model. The stakeholders involved in design-bid-build model, their relationship with each stakeholder, and the

flow of contracts is different from other delivery methods. The arrows in the figure represent the formal contractual relationship between the stakeholders.

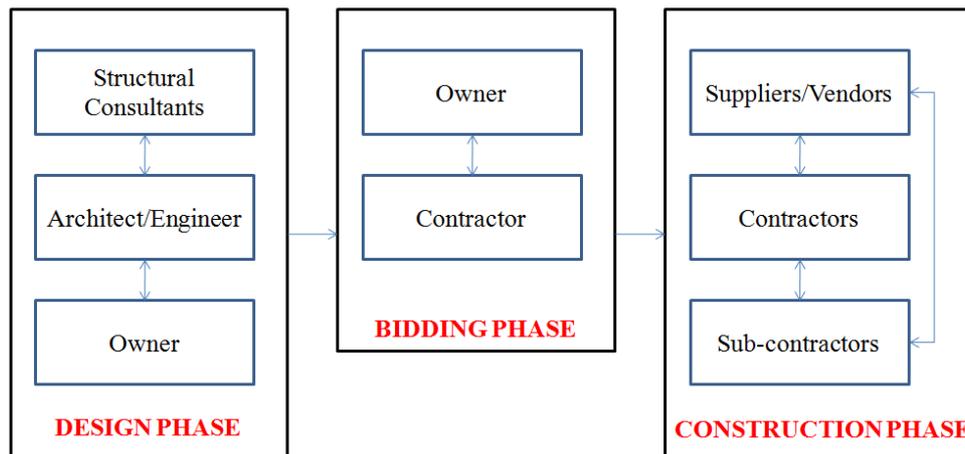


Figure 1: Model showing stakeholders involved in each phase in design-bid-build projects

II. LITERATURE SURVEY

Contemporary design-bid-build model includes many firms on consultants in design as well as construction phase (Hallowell and Toole, 2009). The literature also says that increasing disintegration of design phase and construction phase seems to affect the lean processes and constructability. “*Barriers and benefits of quality management in the construction industry: An empirical study*” by Hoonakker et.al (2010), explains the problems in defining quality in construction. From the study, the contractors understand the potential benefits of quality implementation. Ahmed and Minkarah (1988) stated that type of job and need for work are considered to be the main factors which are prone to have direct affect on quality of a project, instead of assumptions such as profitability and competition. Yongcheng et.al (2013), in his article “*Empirical Study on the Relationship between Owner-Contractor Conflict and Schedule Performance in Design-Bid-Build Projects*” says that there have been found to be functional as well as dysfunctional outcomes of client-contractor conflicts. By studying the literature by the mentioned authors, some points are concluded, and some of the factors which were missing in these literatures have been found out which also affects the quality of construction.

III. METHODOLOGY

The research methodology included in this paper is a combination of the collection of data by conducting a quantitative survey and interviews. The questionnaire is used to evaluate the level of important factors that affect the quality of construction works and rank those factors. In addition, the questionnaire form separates into two parts. The first part includes the general information about the project and the type of project handled by the employee. The respondents were asked to assess the level of importance affecting the quality of construction works by using five-point scales from 1 to 5 (1-very low important; 2-low important; 3-medium important; 4 important and 5-very important). To achieve information that corresponds with the research objectives, this research conducted a structured interview with questionnaire at the same time.

To find out the importance of each question with the respondents’ responses for those questions, a structured weightage analysis was done.

The formula used for weightage analysis is,

$$\text{Structured weightage} = ((4A+3B+2C+D)/4n) *100$$

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- A= number of companies given performance level rating (4=ALWAYS)
- B= number of companies given performance level rating (3= frequently)
- C= number of companies given performance level rating (2=occasionally)
- D= number of companies given performance level rating (1= never)
- n=number of companies

IV. RESULTS AND DISCUSSIONS

The objective of this research was to identify and determine the relative importance of factors affecting the quality of construction works. According to the rates given by the respondents for the questions posed in the questionnaire, the weightage was calculated for each question. By understanding the criticality of each, solutions for more critical problems are given. The problems have been found separately for design phase, bidding phase as well as construction phase. Respective solutions for the problems found in most of the projects are listed down and suggestions to mitigate them have been given. Charts and diagrams were also made to understand the problems more easily. Interview was conducted for verifying the responses for the questionnaire. The interview was conducted with employees who have more experience in the field. More factors which affects the quality of construction was found out from the interviewed employees. Their suggestions to improve the problems they face were also asked.

Design Phase

The selection of a designer is one of the important factors in project's success, and it takes place when the project design criteria are done. The owner creates the design criteria which involve the purpose of the project, architectural goals, codes applicable and other requirements. The criteria govern the project budget. Designers are basically engineers or architects, and they will be involved throughout the completion of the project. The quality of their design, the time taken to finish the design, preparation of contract documents, and assistance with the management team is very important for the success of the project. Table 1 shows the major problems seen in the design phase which will affect the quality of construction. Since design phase is the first major stage in construction process, it should have minimal or no complications. The common issues found in design phase have been listed. Solutions for all the problems faced in the design phase are given in Table 2. Some of the problems have more than one solution to improve the quality. Solutions for all the problems mentioned in Table1 have been enlisted.

Table1: Major problems seen in design phase which affects the quality of construction

Problems seen in design phase
Lack of information
Lack of co-ordination between parties
Special technical requirements
Design quality
Design changes
Change control
Improper documentation

Table2: Solutions for the problems in design phase

Solutions for problems seen in design phase
Effective communication between parties
Designer should request for more information from the owner
Documentation should be kept clear and good enough to access it for everyone.
Explanation to owner about special requirements
Periodical meetings to communicate ongoing activities
Load calculations has to be done accurately for safe design
All changes in design should be communicated and recorded carefully.
Clarifying owner's requirements clearly and at the beginning itself

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Bidding phase

After the selection of the designer, contractor selection is the next important step which has to be taken by an owner for successful completion of the project. The owner calls for tender for the qualified bidders to compete among themselves, and the lowest bidder gets the contract and will be executing the project as per the plan. There are many constraints in bid phase too which questions the quality of the overall project. Factors which affects the quality of construction in bid phase has been listed in Table 3. Respective solutions for those factors are given in Table 4. The problems enlisted have been found out with immense research. By a thorough study of every step involved in bidding phase, and by studying the rules for bidding contractors, solutions have been given for eliminating common problems in bidding phase.

Table 3: Major problems seen in bidding phase which affects the quality of construction

Problems seen in bidding phase
Incomplete bids
Flawed bids
Owners manipulating bid results
Insufficient number of bids
Owner wants to award to qualified or non-compliant bidder since it is a low bid.
Owner wants to add uninvited bidder after pre-qualification process.
Owner wants to open a late bid since the bidder the owner knows/ prefers that bidder, or very few bids are received.
Unit process are not specified or not evaluated properly by architects
Criteria for determining compliance of bids are not specified or clear.
Consequences for non-compliance are not clearly specified.
Methods to correct the informalities in the bid are not specified clearly.

Table 4: Solutions for the problems in bidding phase

Solutions to problems seen in bidding phase
Allow adequate tendering time and design time
Have a two-envelope selection process: a qualitative assessment, then a cost comparison
Use quality-based selection
Consider the team composition and previous experience working together.
Educate the procurement group on the client group's needs and the contractor's bidding process
Implement weekly progress reports and involve designers at various stages of a project
Ensure that risks are clearly defined and assigned
Use clear language in non-standard contracts and supplementary conditions.
Create a database of issues so that the industry can find solutions
Keep submission requirements simple and minimal
Only ask for what you intend to evaluate and provide for later submission of everything else.
Focus on those requirements that mitigate the potential for bid manipulation

Construction phase

For efficient and productive management of the construction process, the designer, the owner, and the contractor must establish a good decision making process and communication. Also, the contractor, sub-contractors, the vendors, and the workers should have a good communication between each other, and provide the desired output. There are a lot of construction problems seen in different construction sites. Some of the major problems seen in execution phase has been filtered, and has been tabulated below (Table5). It is often mistaken as the problems involved in the construction are mostly from the contractor's side. But, owners and designers also are responsible for some major problems seen in construction phase. Suggestions for mitigation of the issues seen in construction phase have been given in Table 6. There are numerous mistakes seen in construction phase, but Table 5 shows the common mistakes seen in construction site. Solutions given in Table 6 are not the only solutions given for the mentioned problems, but not the least either. By practicing these in site, major issues can be eliminated.

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Table 5 : Major problems seen in construction phase which affects the quality of construction

Problems seen in construction phase
Lack of labour
Delay in certification of bills from clients
Improper materials arrived
Lack of materials required for construction
Improper power supply
Mistakes and accidents during construction activities
Revised drawings leading to project delay
Contractors do not perform as expected
Resources are not used effectively
Technology is not used effectively
Construction errors such as mistakes in steel reinforcements and measurements in shuttering
Quality of skilled labour
Reworks are done such as concreting of structural members
Contractors are unable to read complex design plans.
Work is not done as per the schedule, leading to project delay

Table 6: Solutions for the problems in construction phase

Solutions to problems seen in construction phase
Careful supervision of all structural members by contractors as well as clients should be done in order to minimize rework.
Construction errors should be eliminated by rework rather than covering it up.
Critical areas should be checked carefully. It should be error free.
Implication of value engineering.
Regular supervision to the site is required.
Contractors should be selected based on their experience if the project is a complex one
Regular meetings and training should be given to labour for technology know-how
Hoists and lifts should be checked regularly
All the cutouts and openings should be done with proper care to avoid accidents and hence the project delay
HSE department should conduct safety programs for all labours and employees to minimize and avoid all possible accidents happening in the site

Quality of construction projects are influenced mostly by the barriers such as attitude of workers towards work, lack of skilled labors, problems with products, company turnover, lack of proper equipment, lack of supervision, working with new people or team, improbable deadlines, etc. The quality is best defined by whether the project meets customer demands, whether it meets design or code requirements, whether it needs any rework, whether it is able to guarantee that the finished product will not fail.

V. CONCLUSION

By analyzing the problems in different phases in design-bid-build projects, it can be concluded that by giving training and education for both management and employees, by clearly defining guidelines for customer satisfaction, by giving means and methods for continuous improvement, by clearly defining goals related to quality work performance, by having systems for collection and tracking of data for quality assurance, by reviewing and analyzing the process for identifying errors in the system on a regular basis, the quality of overall project can be minimized to a greater extent.

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