

# **Post Completion Assessment of Construction Projects Procured under Design and Build Method in Education Sector of Pakistan**

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## **Abstract**

Design and Build (DB) procurement method provides an innovative and flexible solution for timely completion of construction projects within the agreed cost and at the desired level of technical performance. The concept is relatively new in the construction industry of Pakistan as most of the projects in public sector are currently executed at the traditional Design Bid Build (DBB) mode. In this research work, five major projects executed in the education sector of Pakistan have been analyzed to assess the time & cost variations, quality of the projects delivered, satisfaction level of the supervisory teams and end users with questionnaire survey from the major stakeholders. The analysis of results showed that the major achievement of the DB was time gain, as the projects were completed relatively faster. There was cost variation due to change in the specification and designs at later stage. The major cost variation has been observed in the sub structure. The overall variation in cost mainly falls within the permissible limit of 15%. The end users satisfaction was observed high as the timely completion facilitated them with suitable spaces for academic and servicing spaces. Design and Build is still in embryonic stage in Pakistan and many challenges in terms of suitable Design and Build teams, their technical evaluations, cost controls and risk assessment. At the end recommendations have been made to promote the DB procurement methods in Pakistan.

## **Keywords**

Design and build, Construction industry, Pakistan, technical performance.

## **1. Introduction**

According to Project Management Institute (PMI), procurement of products in service for the projects (PMBOK®, 2012). Procurement becomes inevitable in construction industry as the Just In Time (JIT) inventory management method cannot be applied here as the off the shelf products are rarely available for the construction. The acquisition of raw material, semi-finished and finished goods and big variety of service from unskilled, semi-skilled to highly skilled people. The art of successful implementation of the projects mainly depends on the success of project procurement process. The typical procurement process includes the generic stages like procurement planning, solicitation, evaluation of bids, approval and award followed by Contract Administration and Contract Closure.

There are many modes of project procurement and delivery in the construction industry. Traditionally the Design Bid Build has been employed for more than 150 years as the single largest project procurement method in the world. During execution of the construction project, the procuring agency has to decide about major factors. i.e. the procurement method and the relationship of the contractor and client with reference to payment (Inuwa *et al.* 2012) The selection of appropriate project procurement method depends on variety of factors such as time, flexibility, risk, price, competition and responsibility etc. ( Maizon *et al.* 2006). There are no unique set of guidelines which can help us selecting appropriate procurement method. According to Mastermann(1996), the project procurement strategies have been divided into four majors groups as detailed below:

i. Traditional Design Bid Build Method:

In this method, the design is separately done by the design consultant whereas, the client engages a major contractor to execute the project as per design and specification provided by the designers. The contract management in this method is relatively poor as it often leads to dispute, mistrust amongst parties, high cost, claims due design change and delays.

ii. Integrated Design and Build Method:

Here the responsibilities of design and Construction are entrusted to same entity or group. Hence the risks if design and construction are transferred to same. This leads to timely completion of the projects but the frequent changes in the design and specification can lead to many disputes and claims.

iii. Management Contracts:

Here construction management firm or person is hired to integrate with the client. The role of management consultants are mostly restricted to construction supervision. For execution of the project, the management consultants help in identifying and selecting the appropriate contractors. The design firm is also managed by consultants. The change in scope of work and high completion costs are very common problems with such methods, though good quality and timely completion of the projects are the common and apparent advantages of the method.

iv. Direct Labor:

Suitable for small and repair works, and small in house projects, where the client has experienced labor and supervisors. The direct labor and material method has been employed in the maintenance of roads and other infrastructure but unfortunately due to high staff, wastage and pilferage of material, the project overheads remained very high and beyond the affordable limits. This kind of procurement is used in emergency and disaster situations.

The success of Design and Build (DB) procurement method require better understanding of the scope of work and well defined roles as well contracts documents. Songer and Molenaar (1997) identified the following major critical factor for success of projects under DB procurement.

- Well defined scope
- Shared understanding
- Owner's construction sophistication
- Adequate and trained owner's staffing
- Established budget

The DB procurement method has been successfully implemented in the developed countries. However it has not been adopted on large scale in developing countries. The limited application of DB in such countries is mainly attributed to the limited capacity of the major stakeholders in the construction industry and lack of proper policy framework for its implementation (Reshaid and Kartan, 2005; Chan, 2010). Some of the benefits of DB method as reported by Cheung et al (2001) and Lim et al (2002) are given as follows:

- Competitive quality
- Short duration
- Smooth execution
- Favorable costs
- Best value for money
- Transfer of risk

Design in Build method can provide better procurement options in construction industry of Pakistan, but the application of DB is still limited here. Shah *et al* (2013) identified few major sectors in which DB can be employed in Pakistan. The existing construction project management environment in the public sector provides limited opportunities of innovative and modern procurement methods. Very few mega projects have been executed with DB method in Pakistan such as industrial sector, housing sector, education Sector; commercial buildings; infrastructure development and Highways sector.. The different variants of DB methods as identified by Mastemann(1996), provides options from complete conceptualization to need analysis, design, procurement and construction as well as maintenance which is often called Engineering-Procurement-Construction (EPC). The other option is Develop and Construct, where the conceptual design and requirements are given by the clients and DB team develop detailed design as well undertake construction ( Appiah *et al*, 2010). The various variants of DB are shown in Fig

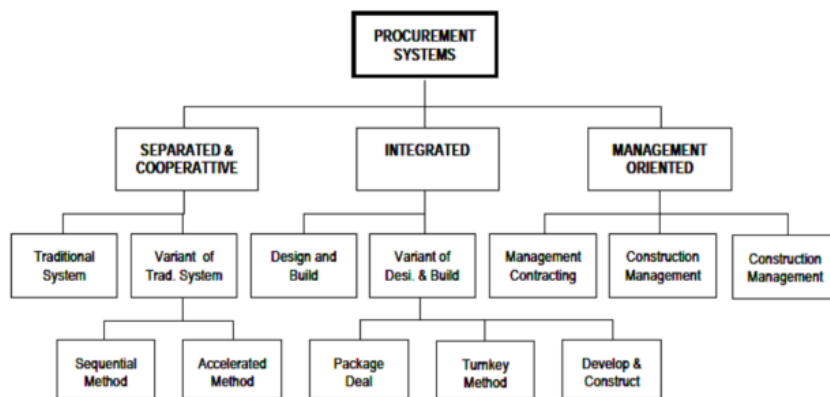


Figure 1: various methods of construction project procurement (Masterman,1996).

In this paper, the challenges and problems faced in the execution of construction projects on DB mode in the Education sector of Pakistan have been analyzed.

#### Back ground of the Allama Iqbal Open University:

Allama Iqbal Open University ( AIQU) Pakistan has been established under the Act of Parliament as one of the earliest Open and Distance Learning institutions in the world. Today AIQU provides education

opportunities to about a million students across the country from secondary to doctoral levels. The main campus and 40 outreach (Regional Campuses) through the country provide affordable, flexible and accessible education at their door steps of students. To ensure timely access of the students to quality education, construction of buildings for the regions were inevitable. These buildings are supposed to provide different academic and services spaces to the students around the year. AIOU was thus faced with the construction of more than 10 campuses in a short span of 4-5 years across the country at following places, where lands have been already acquired.

- i. Regional campus Abbottabad
- ii. Regional Campus Muzaffarabad Northern Kashmir.
- iii. Regional Campus Rahim Yar Khan
- iv. Regional Campus Bhawalpur
- v. Regional Campus Mianwali
- vi. Regional Campus Jhang
- vii. Regional Campus Multan (Phase-II)
- viii. Regional Campus Umarkot Sindh
- ix. Regional Campus Mithi Tharparkar
- x. Regional Campus Skardu

Historically the exiting campuses were constructed with the traditional Design Bid Build method since construction of the first Regional Campus in Lahore in 1995, followed by Multan in 1998, Karachi 2002, Mirpur AJK in 2000, Quetta in 2004, Peshawar in 2001, Faisalabad (2006), DG Khan (2010). The existing staff and stakeholders were more familiar with the traditional project procurement.

To achieve this challenge of fast project procurement, the following three prong strategy was adopted:

- Standardization of Campuses as per students, enrolment, geographic location, availability of lands etc. Four standard modules of Campuses were developed.
- Design and Build procurement Method by integration of Design and construction under the same contract
- Phase –wise modular construction to facilitate the shifting of the offices and functions in gradual manner so that initially the minimum facilities are developed in one year and the entire campus is completed in two years.

For construction of Campuses under DB method (Development and construction), the following process was adopted:

- Conceptual plans and Bill of Quantities was developed for different tiers/module of the buildings.
- The base line estimated cost was worked for each tier of building based on market analysis and Engineer's estimates.
- The following additional responsibilities were included in the Standard Bidding Document:
  - o Geotechnical Investigation to determine safe bearing capacity for design of the buildings
  - o Preliminary and detailed design of the buildings as per approved standards. However the designed covered areas was restricted to the approved scope of the building with variation of 10%.
  - o The revised cost estimates were required to be worked out before execution to ensure that the project will be completed within the 15% of the approved cost.

All such changes were to be dully approved by the employer.

#### **Research objectives:**

The main aim of the research was to assess construction projects completed under DB method in Allama Iqbal Open University Pakistan at Main Campus and Regional Campus across the country for timely

completion, cost variation and quality of the projects delivered. Further objectives of the research are given as:

- Evaluate the success of projects completed under DB methods to achieve the targets of cost, schedule and technical performance (CST)
- Compare the traditional DBB and modern DB methods based on the stakeholders' response.
- Assess the problems faced in the execution of projects at the main campus and regions under DB method
- Recommend solutions for the successful delivery of projects under DB

### Research Methodology:

For assessing the success of DB procurement method adopted for the construction projects of AIOU, a questionnaire survey were administered amongst the major stakeholders in the construction projects including contractors, site Engineers, senior managers and designers. A total of 50 questionnaire were sent to randomly selected respondents and 35 were received back. Hence the response rate was 70%. The questionnaire was comprised of 20 questions relating to various aspects of projects and its relevance to DBB and DB methods. Likert Scale was used to quantify the response. For analysis of data collected, SPSS was used. Personal interviews were also held with middle level and senior level managers to assess the challenges faced by the organization and recommend viable solutions.

### Results and Discussions:

The results received through questionnaire survey were ranked on the basis of Relative Frequency Index (RFI). Based on the values, the top 10 highest responses are given in the following Table 1.

Table 1 The ten highest responses based on Relative Importance Factor about the various aspects of DB and DBB methods

| Rank No | Response   | RFI  |
|---------|--|------|
| 01      | In Modern Design and Build System where same entity is responsible for design and construction both, the risk of design and building is transferred to one person/group.                         | 4.22 |
| 02      | In Modern Design and Build System where same entity is responsible for design and construction both, quality is improved through better coordination   | 4.19 |
| 03      | Appropriate Regulatory body is required for the success of Design and Build Method   | 4.16 |
| 04      | The existing knowledge of your staff for the Design and Build is low and their training is required  | 4.09 |
| 05      | The monitoring in traditional Design Bid Build system involving design and construction separately takes is difficult as it involves two different entities.                                     | 4.03 |
| 06      | The level of risk is higher in traditional Design Bid Build system involving design and construction separately as the identification of responsibilities is difficult in such system in general | 4.00 |
| 07      | The traditional Design Bid Build system involving design and construction separately takes more time   | 3.94 |
| 08      | Design and Build require more detailed contract documentation and the existing bidding document of PEC does not cover it   | 3.94 |
| 09      | The monitoring staff feel more comfortable with Design Bid Build System  | 3.91 |
| 10      | In Modern Design and Build System where same entity is responsible for design and construction both, the time is saved   | 3.88 |

On the basis of the Relative Frequency Index, the following results have been achieved:

- i. Majority of the project staff believe that the risk of design and construction is transferred to the one entity and as a result, they feel more secured.
- ii. The quality of projects has been improved in majority of the project executed under DB method.
- iii. There a need for strong regulatory body for the implementation and control of DB procurement methods. The project executing staff is not familiar with the DB procurement methods and its

requirements. Proper trainings and capacity building of the staff is required to implement the DB procurement.

- iv. Monitoring of the traditional Design Bid Build is supposed to be difficult as compared to Design and Build method as requires coordination with two different entities. Sometimes, their geographical distance makes this monitoring relative difficult.
- v. The risk in traditional Design Bid Build is relatively more as compared to Design and Build method.
- vi. The Design Bid Build procurement takes more time relatively.
- vii. The exiting PEC bidding documents are not sufficient to guide for the effective procurement of construction projects under DB methods. The terms of the contract and bidding documents need to be revised as per guidelines of FIDICC.

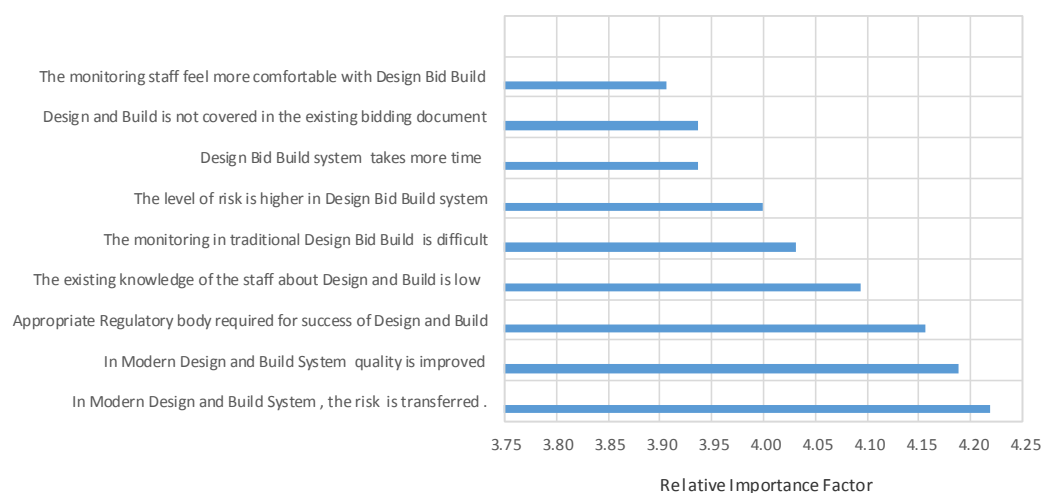


Fig 1. Details of ten highest responses based on Releative Imprtnce Factor

#### Feedback of Project Monitoring staff on Design and Build Projects:

Detailed interview was also held with the project monitoring staff engaged in the Design and Build based project execution as the following construction sites:

- Regional Campus Abbottabad
- Regional Campus Rahim Yar Khan
- Regional Campus Bhawalpur
- Regional Campus Multan
- Regional Campus Mianwali.

Based on the detailed discussions with the project staff, the following additional points were communicated:

- i. The conceptual plan and preliminary cost estimates doesn't cover the unforeseen site conditions, particularly the sub structure. In one of the projects at Abbottabad Pakistan, problems were faced when the assumed foundation based on individual footing and column did not work as the subsoil was water logged and additional efforts were required for stabilizing the soil. The foundation was revised as mat foundation, which increased the cost of substructure five

times. This affected the overall scope of the project. Hence scope variation was witnessed in the project.

- ii. The success of the Design and Build would also depend on training and capacity building of staff in Engineering and support departments, particularly the finance department who are more familiar with the traditional Design Bid Build system.
- iii. Frequent change in the conceptual design has been witnessed in most of the cases, thereby leading to extensive variations and change orders. This can be covered through better coordination with the users while developing the conceptual plans.
- iv. Continuous cost monitoring of Design and Build projects is essential to avoid cost variations. The project is required to be completed within 15% of the approved cost and any variation beyond this point would require revision of project which is not appreciated always.
- v. The quality of the Design and Build based projects in terms of their architectural value, flexibility, end use satisfaction and services was observed as higher than the traditional Design Bid Build System.
- vi. The In House monitoring role of staff is very important in the Design and Build projects. Hence the knowledge of the client and its Engineering staff about the cost estimation, project monitoring and controlling is critical for the success of Design and Build based project procurement.
- vii. The project execution and monitoring staff has been engaged with the traditional Design Bid Build procurement methods for more than three decades, hence transition to Design and Build method was relatively uncomfortable

#### **Recommendations:**

- Design and Build offers many opportunities for construction projects in public sector of Pakistan, particularly in higher education projects, as the nature of facilities and requirements are generally more standardized for universities and higher education institutions. Conceptual designs can easily developed for such facilities as more standardized.
- The existing Pakistan Engineering Council Standard Bidding Document for Design and Build requires to be revised as per local requirements and incorporating the standards Clauses of the FIDICC.
- More research studies may be initiated at the graduate level to sort out the problems faced in implementation of Design and Build procurement methods.
- Capacity building of relevant staff involved in the execution of the construction projects is required under Continuous Professional Development (CPD) program of PEC.
- Technical evaluation of Design Build teams, is a daunting job as there are very few good design build teams in the construction industry of Pakistan. Only few organizations have the capacity to integrate the design and build, hence these firms would tend to monopolize the construction market in Pakistan in short term.
- Many international donors like World Bank, Asian Development Bank and US AID now require integrated project delivery under Design and Build method. Hence there is need to develop contractors for Design Build project delivery and associated statutory requirements

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