

An Overview of Project Delivery Methods in Construction Industry

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Abstract— The selection of project delivery method is one of the factors that can influence the success of a construction project. Therefore, understanding each of the primary project delivery methods used in construction industry; Design-Bid-Build (DBB), Construction Manager at Risk (CM at Risk) and Design-Build (DB) are important before the decision-making. This paper is a theory based and the objectives are to develop a new definition of project delivery method by synthesizing the existing definitions and to describe the project delivery methods aforementioned. Their advantages, disadvantages and comparison in terms of delivery phase and performance are also presented. There is no project delivery method that appropriate to be used for any construction project therefore, the development of new ideal methods is important to achieve a successful construction project.

Keywords— *Project Delivery Methods, Design-Bid-Build (DBB), Design-Build (DB), Construction Manager at Risk (CM at Risk), Construction Industry*

1. Introduction

The project performance could be improved to the great extent by selecting the suitable project delivery method [1]. The selection of an applicable project delivery method was the foundation that dictated the successfulness of a project, however, it might also lead to failure under distinct situations [1]. The risks and uncertainties that might arouse in a project led to a complex decision-making process in selecting the appropriate project delivery method as the owner and stakeholders usually had slight information and insufficient project plans to make a judgment about the project [2]. Therefore, choosing the best project delivery method was one of the most crucial decisions to be made and it should be started with a good understanding on the available choices [3].

The project delivery defined roles and responsibilities of the

project stakeholders and it was a form of working relationship [4]. The different project delivery methods were differentiated based on the formation of contracts between the owner, designer and contractor as well as the technical relationships that developed gradually between each party inside those contracts [5]. There were three primary project delivery methods in construction industry; Design-Bid-Build (DBB), Construction Manager at Risk (CM at Risk) and Design-Build (DB) [1], [4], [5]. The CM at Risk and DB have emerged as alternative project delivery methods to DBB since more coordination between the project team members were required in technical demands of new and complex systems [6]. Their emergent was also due to the necessity of taking advantage of constructability and construction innovation, to enhance the cost and schedule performance or contingency of the project, or to reduce the claims and conflict between parties [2]. Even though using them on certain types of projects was believed able to offer a better performance [7], DBB was still the project delivery method that most widely used [7], [8].

The purpose of this study is to develop a new definition of project delivery method by synthesizing the existing definitions and to describe the project delivery methods aforementioned including their advantages, disadvantages and comparison in terms of delivery phase and performance.

2. Methodology

This study conducted a general literature review to gain knowledge on the project delivery methods. The search engine Google Scholar and online databases subscribed by Universiti Utara Malaysia were used in searching the literature by means of keywords such as project delivery methods, DBB, CM at Risk and DB. The additional sources

were discovered through the references of the identified literature.

3. Results and Discussion

In this section, results are presented and discussed.

3.1 Definition of Project Delivery Method

There were varying definitions of project delivery method existed within the construction industry and they were presented in Table 2. Based on the definitions of project delivery method, several elements were highlighted; (1) comprehensive process, (2) contractual relationships, roles and responsibilities of the parties involved and (3) throughout project life cycle. Therefore in this study, project delivery method will be defined as a comprehensive process in determining the contractual relationships, roles and responsibilities of the parties throughout the project life cycle.

Table 1. Definition of Project Delivery Method

| | Definition |
|-------------------------|---|
| Project Delivery Method | The sequence of project phases, parties involved in the project and implicitly assigned roles, and responsibilities to project parties [9] |
| | A comprehensive process of assigning contractual responsibilities for designing and constructing a project, which should include the definitions of project scope, contractual responsibilities, inter-relationships of the parties, and the processes for managing time, cost, safety, and quality [7] |
| | A comprehensive process including planning, design and construction required to execute and complete a building facility or other type of project [3] |
| | A system that determines the relationships between the different project stakeholders and their timing of engagement to provide a built facility [10] |
| | The process by which a construction project is comprehensively designed and constructed for an owner including project scope definition, organization of designers, constructors and various consultants, sequencing of design and |

| | |
|--|---|
| | construction operations, execution of design and construction, and closeout and start-up [5] |
| | The method for assigning responsibility to an organization or an individual for providing design and construction services [11] |
| | A system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a good or service [12] |

3.2 Design-Bid-Build

This project delivery method was known as traditional method [1]. The project delivery process was separated into design, bid and build phases in a linear manner [4]. The contracts for design and construction were separated; owner-designer and owner-contractor [7]. This would reduce the interaction and data sharing between entities during the design stage [13]. The preliminary and detailed design for the project was done by a design firm engaged by the building owner [1], [4]. The contract was awarded based on the qualification of the firm to provide the design service before the construction phase [6]. The tender was advertised for prospective bidders once the design was completed [1], [4]. The total cost of construction was a determinant in the final selection of the contractor [7]. Typically, the lowest bid contractor would be selected to build the project [1], [6].

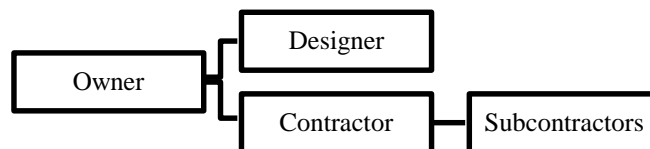


Figure 1. Design-Bid-Build [4]

There was no real integration between designers and contractors and they tended to work in an isolated silo [14]. The designers were forbidden from being involved in construction method meanwhile, the contractors were excluded from design responsibility [15]. The lack of interaction was due to the nature of the traditional construction process conducted in sequential manner and constructed by segregated entities during the phase of design and construction [16]. This had resulted in recurrent claims, argument between project team members and cost and time overrun [6].

This method rewarded individual success but disregarding the impact on project outcome and it was a system that created difficulties and impossibility for project optimization [15]. There were several problems arose in this method; (1) the project could be expensive due to the

none of significant development made for the design plans, (2) owner could not consider to change user functions as the design plans were locked before the procurement of the contractor and (3) slight last minute changes in plans usually would cause conflict between all parties [17].

The construction work process specifically in the design and construction phase and the construction structure were highlighted as the areas that led to the fragmentation within the construction industry and could be minimized through integration [18]. Fragmentation such as separation of experts, absence of collaboration between plan and development and a serial manner process had been discovered as problems aroused from traditional project delivery practices [18].

3.3 Construction Manager at Risk

The commitment from CM at Risk was required in this project delivery method in order to deliver the project within a specified schedule and price, either a fixed lump sum or guaranteed maximum price (GMP) [3]. There were three linear phases in the project delivery process; design, bid and build however, it was faster compared to the traditional method [3]. The CM at Risk usually was assigned to the contractor [6] and had two different roles; (1) as a consultant to the owner regarding construction and cost during the pre-construction phase and (2) as a general contractor in the construction phase [4]. This method allowed for team integration as the CM at Risk integrated with the designer at the early stage of design phase even though the owner had separated contracts with CM at Risk and designer [4]. The contractor's perspective and input would benefit the owner in developing the correct estimation of construction cost, scheduling, assessing the designer's plan for construction, procuring and negotiating tenders and coordinating numerous aspects of the work [6].



Figure 2. CM at Risk [4]

However, the owner would be responsible for the resolution of project issues such as disputes relating construction quality, design completeness and impact towards schedule and budget due to the lack of direct contractual relationship between the contractor and designer [3]. The owner also confronted troubles due to the reduction of in-house project management teams, costly disagreement between the designer and contractor and different level of owner experience [6]. The integrated relationship between contractor and designer during the pre-construction phase

would not guarantee the same cooperation in construction management process [4].

3.4 Design-Build (DB)

In DB method, a single entity signed a single contract with the owner for the performance of design and construction services [6]. The entity could be integrated design-build firm, contractor led, designer led, joint venture or developer led [3]. This method encouraged team collaboration and enable early involvement of contractor to give input and took part in the budgeting, programming, financing, assessed the design for constructability and cost of construction [6].



Figure 3. Design-Build [4]

The designer was not directly contracted with the owner, therefore owner had limited control or influenced on the final design quality [4]. In the early design phase the criteria of the design were mostly cost-driven in the context of quality and scope [4]. This had caused difficulty to the owner in verifying the best value or performance criteria achieved by the project throughout the design process [4]. There were lack of verification and some of the designs and construction related issues in the project remained undisclosed [6].

3.5 The Delivery Phase and Performance of Project Delivery Methods

The comparison of the delivery phase and performance of project delivery methods are presented in Table 2 and Table 3 respectively.

Despite the fact that there is no particular project delivery method better than others and applicable for all projects, there will be one method that most appropriate to be used and selected for each project. Generally, CM at Risk and DB indicate better performance compare with DB and the reason behind this is that both methods nurture team integration starting from the early stage of design phase. However, DBB is still the most used method for delivering projects due to the fact that integrating the project team members is challenging. The different interests between multiple parties during the design and construction phases have made the communication and decision-making complicated [7]. It was even worst when they always wanted to secured the benefits that able to maximize their profits regardless of the benefits of others, therefore they did not have motivation to volunteer working together as a team [20]. Even though, alternative methods such as CM at Risk and DB were attempted to improve the extent of data

Table 2. The Delivery Phases of Project Delivery Methods [19]

| Delivery Phases | Project Delivery Methods | | |
|--------------------------|---|---|--|
| | DBB | CM at Risk | DB |
| Design | | Early integration of contractor and designer | Involvement of contractor at the beginning stage of design |
| Construction | Maintain possible solutions for project by performing field engineering tasks | Establishment of guaranteed maximum price, more accurate and timely delivery as the liability was on the contractor | Acceleration of schedule, reduction in number of change orders and encouragement towards innovative design solutions |
| Operation or Maintenance | | | Flexibility in contract documents due to numerous different variations |
| Deconstruction | | The owner was presented with possible value engineering by contractor to minimize environmental impact | |

Table 3. The Performance of Project Delivery Methods [6]

| Performance | Project Delivery Methods | | |
|---------------------------|--|---|---|
| | DBB | CM at Risk | DB |
| Cost | Lower ranked compared to the others as problems in design led to the trend of intentional under bidding thus, increased the total cost of project due to change orders | Higher cost accuracy due to GMP | Well performed on cost front |
| Schedule | Initial decision deadlines were taken less seriously by the stakeholders because changes can be made later | Well performed on schedule due to the capability to procure long lead item early in the project | Most efficient as parallel phasing was possible |
| Quality | Good quality project due to the presence of independent advisors and expanded design phase | Most efficient as the quality of project was met or exceeded due to the help of independent construction professional expertise during design phase | Well performed as contractor participated during the design phase however the quality of project might get affected due to the dependency of the contractor |
| Administrative Burden | Administratively burdened as multiple bid packages need to be developed and issued, received and evaluated proposals, negotiated the contracts and overseeing its implementation | Administratively burdened as there were multiple contracts | Less administrative burden as there were lesser contracts and lines of communication |
| Coordination and Teamwork | Fragmented and teamwork was not promoted | Coordination was improved due to early involvement of construction manager | Coordination and teamwork were promoted |

sharing between project team members by overlapping the design and development stages at the early process, the owners were still disappointed with the project delivery processes that fragmented and ineffective [13]. Therefore, the new methods that that would be the alternatives to the traditional project delivery system should be built based on trust, partnership and collaboration in an approach to avoid from disagreement between project team members thus, delivered an effective construction services to the clients [21].

4. Conclusion

The selection of an appropriate project delivery method can lead to the success of construction project. However, deciding which one is difficult as each of the primary delivery method has its own disadvantages that somehow can be the reason that contributes to the project failure. None of these primary project delivery methods can be considered as ideal and appropriate to be used to any kind of construction project, as every project is being the only one of its kind. Therefore, the development of new ideal project delivery methods is a necessity to resolve the weaknesses of the existing project delivery method in all aspects towards achieving successful construction project.

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