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# An Investigative Analysis Of Skill Sets For Different Delivery Methods In The Building Industry

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# An Investigative Analysis Of Skill Sets For Different Delivery Methods In The Building Industry

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## Introduction

A project delivery method is a complicated process of planning, designing, scheduling and construction of a building or a project. A successful project is a result of numerous decisions which include the project's scope, project's timeline, project funding and the project's delivery method. The owner, architect and general contractor are the important players in any given project delivery method, variations in the contracts and communication between these three individuals or entities results in different delivery methods. Depending on the project's timeline, project funding and the scope of the project, owner decides a project delivery method that feels suitable for the owner.

Selecting a right project delivery method for any given project is one of the most important decisions made by an owner at the beginning of the project. Contractors and subcontractors play a prominent role in team coordination and quality assurance in any project using different delivery methods. Understanding a project delivery method and the risks involved with is an important task for contractors and subcontractors. Understanding the different delivery methods available is important in choosing the best method for any project. The primary objective of this paper is to provide some understanding of different delivery methods available. With perceived advantages and disadvantages; different skillset required; resources and technologies used; challenges and lessons learned of each delivery method, contractors and subcontractors can take informed risks in pursuing a project using different delivery methods.

## Background

Project delivery methods have gone through many iterations from the traditional master builder approach from renaissance period. In a master builder approach, a single person will be responsible for the duties of architect, engineer and contractor (Touran et. al 2009). Later, the division of these disciplines into architecture, engineering happened during renaissance period. This separation existed and continued throughout twenty century. There are four major project delivery methods that are available in the building industry include design-bid-build, design-build, construction manager at risk, and construction manager agent.

### *Design-Bid-Build*

Design-bid-build, or "hard bid" as it is often referred to in the construction industry, is the traditional project delivery method and involves three primary entities, through two separate contracts in three sequential project phases.

Design-bid-build is the most often used for of project delivery in non-residential construction in the United States. Owners using this delivery method often select the contractor based on the

lowest price bid. Under the design-bid-build approach, the owner has separate contracts with the designer and the builder. Thus, if a design error is found after the design is complete, the owner is liable to contractor to pay the changes and thereafter owner must legally approach design team for the compensation. While in theory this should be possible, in practice it is very difficult, because the owner must prove that the designer has liability based on negligence or another legal theory (Scott 2006). Figure 1 shows the different contract relations between owner, architect, contractor and subcontractors.

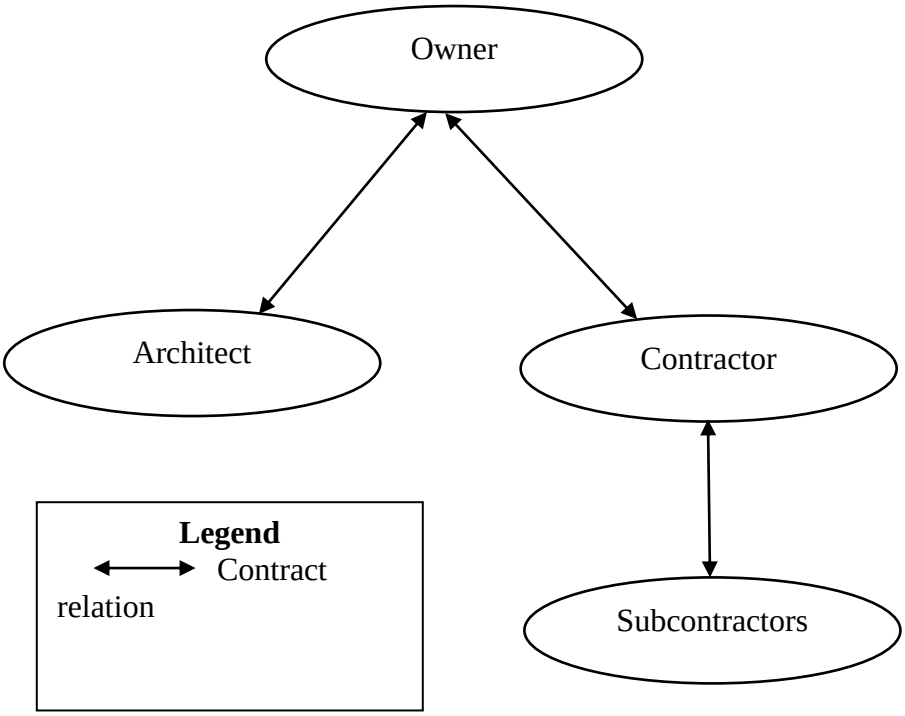


Figure 1: Design-bid-build delivery method contracts and flow of communication

The advantages and disadvantages of design-bid-build are as noted in the literature are as follow:

Advantages:

- Design changes easily accommodated prior to start of construction (Fernane 2011).
- Lowest bid contract results in maximum competition.
- Defined roles/responsibilities for the team.

- Plans are fully developed prior to contractor bidding and award (Gransberg et. al 2006 and Loulakis 1999).

Disadvantages:

- Owner at risk to contractor for design errors (Fernane 2011).
- Lowest bidder may not understand the project scope, goals, and objectives.
- Requires significant owner expertise and resources.
- No contractor input in design, planning, or value engineering (Loulakis 1999).
- Owner control over general contractor's staff is limited (Gransberg et. al 2006)

***Design-Build***

Design-Build is a project delivery method in which owner holds a single contract with the design-builder (Lopez del Puerto et. al 2008). The design-builder is responsible for the design and construction of the project. Figure 2 shows the different contract relations between owner, architect, contractor and subcontractors.

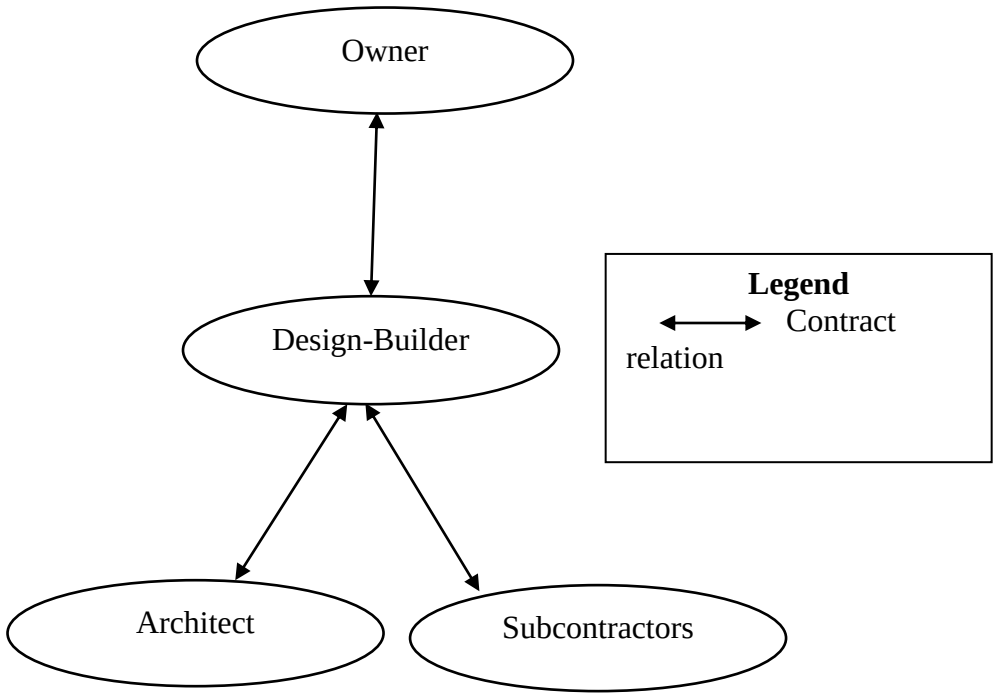


Figure 2: Design-build delivery method contracts and flow of communication

The advantages and disadvantages of design-build from literature are as follows:

Advantages:

- The guaranteed maximum price is established early and owner risk is controlled.
- The Design-build team is fully responsible to the owner for the delivery of a project.
- Opportunity for cost sharing.
- Construction often starts before design completion, reducing project schedule (Fernane 2011).
- Transfer of design and construction risk from owner to the DB entity.
- Enhanced constructability and innovation award (Gransberg et. al 2006 and Loulakis 1999).

Disadvantages:

- Minimal owner control of both design and construction quality (Fernane 2011).
- Designer and contractor does not represent the best interest of the owner.
- Process may not bring the best designer and the best builder together for the owner.
- Difficult to establish criteria for selection of design-build team.
- An overly involved owner can impede the design-build process (Tenah 2001).

***Construction Manager at Risk***

Construction manager at risk is a project delivery method in which owner hires the construction manager and architect separately. In this delivery method the construction manager hires the subcontractors and is responsible for completion of the project with type of contract chosen. Using an open-book approach to trade subcontractors, this delivery method rewards performance and can be less risky to the owner. With a construction management at risk project, the designer and construction manager are typically selected using a best value methodology and the subcontractors are selected based on the lowest bid. Figure 3 shows the different contract relations between owner, architect, construction manager and subcontractors.

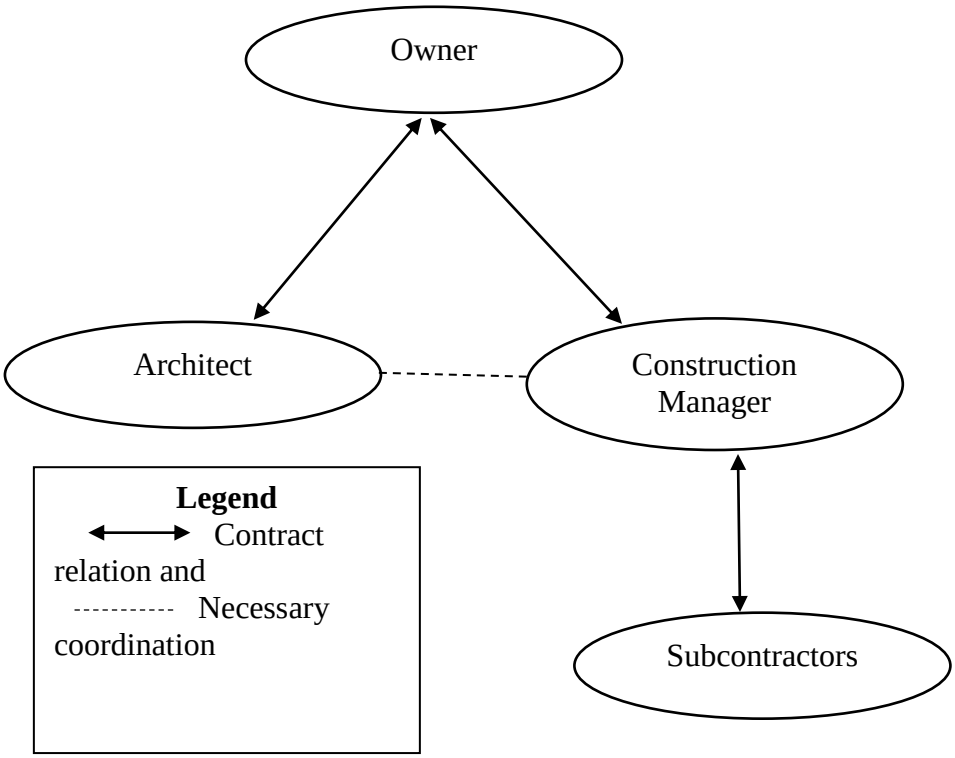


Figure 3: Construction manager at risk delivery method contracts and flow of communication

The advantages and disadvantages found in the literature for construction manager at risk are as follow:

Advantages:

- Increases the speed of the project and can also strengthen coordination between the architect/engineer and the construction manager.
- Ensures high quality at low cost (Gransberg, and Shane 2010).
- The owner may be involved in subcontractors selection.
- Early construction manager involvement to control budget and schedule.
- Utilize Building Information Modelling (BIM) to ensure constructability of the design while minimizing cost and schedule (Fernane 2011).

Disadvantages:

- Design team may not take input from construction manager during design.
- The owner may be financially liable for exclusions and inconsistencies in the contract documents**.**
- The construction manager can assume design liability via review comments, unintentionally.
- Since the guaranteed maximum price is settled before design begins, it is difficult for owners to know whether they received the best possible bid; this fact also lowers competition in pricing contractor overhead, fee, and subcontract costs (Gransberg, and Shane 2010).

***Construction Manager Agent***

Construction Manager Agent is an alternate delivery method to construction manager at risk in which the construction manager is responsible to the owner and acts in the owner's interest. The construction manager offers advice on project delivery but has no financial guarantee of responsibility to the owner. Using a construction manager agent delivery, the owner holds the contracts with subcontractors and assumes the risks of delivery including cost and schedule. Construction manager agent is very similar to construction manager at risk in actors and set up, however, instead of the construction manager retaining the contract with the general contractor or subcontractors, the owner holds this contract. Thus, much of the risk that was transferred to the construction manager in construction manager at risk, is placed with the owner. Figure 4 shows the different contract relations between owner, architect, construction manager and subcontractors.

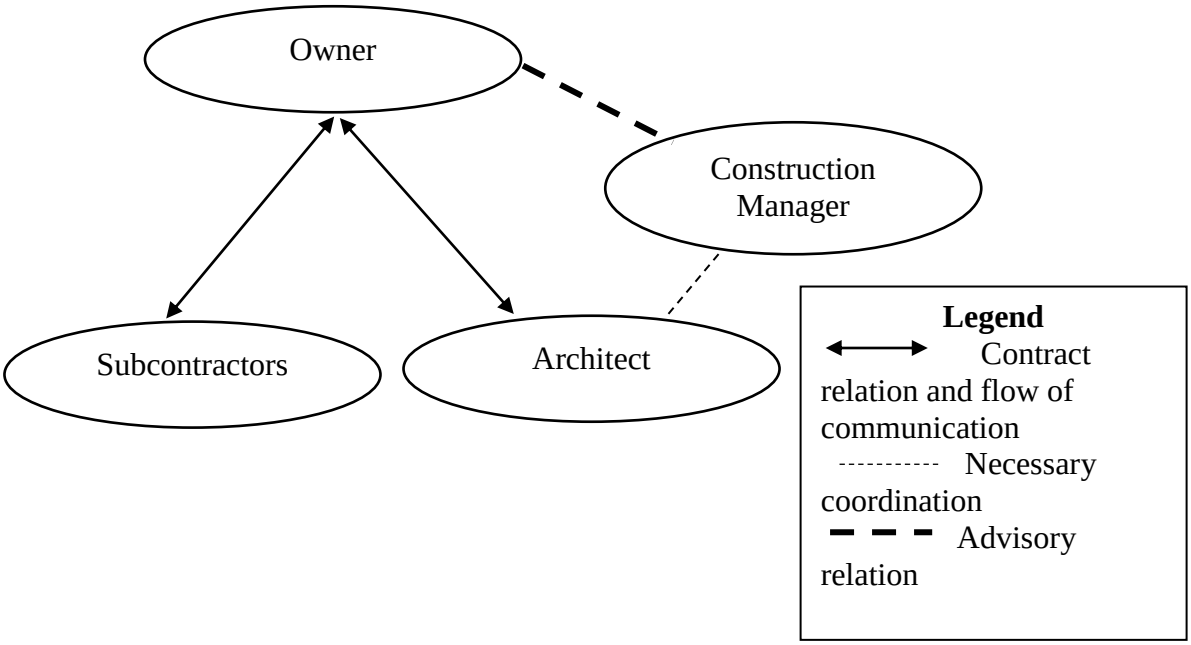


Figure 4: Construction manager agent delivery method contracts and flow of communication

The advantages and disadvantages of construction management agent from literature are as noted below:

Advantages:

- Construction Manager and Architect selection based upon qualifications
- Projects can be delivered at accelerated/ “fast-tracked” schedule (Fernane 2011).
- Owner can select subcontractors (Mahdi; and Alreshaid 2005).

Disadvantages:

- Construction manager has no contractual responsibility/control with subcontractors.
- Final price not established until bids are received.
- Owner must manage multiple contracts (Fernane 2011).

- Higher owner risk since the owner holds contracts (Mahdi; and Alreshaid 2005).

**Literature Review**

Design-bid-build, design-build, construction manager at risk, and construction manager agent have their own advantages and disadvantage on different construction projects. Comparison between different delivery methods across public (Carpenter, and Bausman 2016), private (Ibbs et. al 2003), and military projects (Hale et. al 2009) were done. Some researchers compared design-build and construction manager at risk in highway projects (Gransberg, and Shane 2010). Most of the researches has been comparing different delivery methods relied on empirical studies, surveys, and case studies. The review of these papers provided an insight of understanding different methods and comparison factors used.

A comparison of design-bid-build and construction manager at risk delivery methods for public schools was conducted (Carpenter, and Bausman 2016). These researchers focused on the project performance in the basis of cost metrics, time metric and quality metrics. The final objective of this research was to determine and define the performance differences among design-bid-build, and construction manager at risk. The data for this study was collected from the south eastern public schools in the United States. This data used the construction documents from 137 public schools. These 137 projects were proportionally chosen from South Carolina (24), Florida (30), North Carolina (43), and Georgia (40) out of South Carolina (109), Florida (239), North Carolina (195), and Georgia (286) respectively. All costs were normalized to 2012 U.S. dollars using historical cost index. This research concluded that design-bid-build was significantly superior over cost metric whereas construction manager at risk provided higher levels of product and service quality. However, evidence was not obtained to support the superiority of either of the two delivery methods in terms of project performances.

A research compared design-build and design-bid-build project delivery performances to see if one project delivery method is superior. The performance of design-bid-build and design-build projects at U.S. Naval Facilities Navy Bachelor Enlisted Quarters built was compared (Hale et. al 2009). This research compared 39 design-bid-build projects and 38 design-build projects in terms of total project duration, project time growth, cost growth, and cost per bed. The final objective was to test the hypothesis that design-build is a superior project delivery method when compared to design-bid-build. This study concluded that the design-build projects will take less time to complete and have less time and growth when compared to design-bid-build.

A comprehensive analysis of 67 global projects from the Construction Industry Institute's database concludes that the design-build projects may not provide all the benefits to project performance (Ibbs et. al 2003). Though timesaving was an advantage in design-build projects there are no definitive additions to cost and productive changes. The results of this study suggest

that the project management expertise and experience of the contractor may have a greater impact on the project performance.

A research for selecting the proper project delivery method using analytical hierarch process examines the compatibility of various project delivery methods with specific types of owners and projects (Mahdi, and Alreshaid 2005). The main objectives of this research were to determine the different factors influencing owner decisions, and projects. Using analytical hierarchy process researched rated different delivery methods using all the factors involved. The analysis reveals that the design-build is the most appropriate option when considering all factors. Construction management agent alternative comes in at the second level of importance. Design-bid-build and construction management at risk recorded the same level of importance (lowest level).

A research for comparative analysis of project delivery systems cost performance in Pacific Northwest public schools empirically compares cost growth performance of the construction manager at risk and design-bid-build methods in Pacific Northwest public school projects (Rojas, and Kell 2008). Data were collected from state records and previous studies on 297 completed schools in Oregon and Washington. The main object of this research was to compare construction manager at risk and design-bid-build in terms of change order growth, and project cost growth. The analysis of the data shows no statistically significant difference between construction manager at risk and design-bid-build in change order costs, A significant difference in cost growth between construction manager at risk and design bid build projects during buy out, making construction manager at risk projects less efficient at controlling cost growth at buy out. These results contradict the expectations of the construction manager at risk delivery method.

Table 1 summarizes the findings of previous literature and demonstrates design-build can be superior to design-bid-build in comparison to schedule and change growth. However, another study (Ibbs et. al 2003) suggest that design-build man not be effective and suggests that the experience of the contractor may have greater impact on the project performance. There are no or very few studies comparing all the four delivery methods regarding contractor and subcontractors project experiences, lessons learnt, and biggest challenges faced.

Table 1: Literature review summary

| Name of the research | Conclusion |
|---|---|
| Carpenter, and Bausman (2016) | Evidence was not obtained to support the superiority of either of two delivery methods in terms of project performances. |
| Hale, Shrestha, Gibson, and Migliaccio (2009) | Design-build projects will take less time to complete and have less time and growth when compared to design-bid-build. |
| Ibbs, Kwak, Ng, and Odabasi (2003) | Project management expertise and experience of the contractor may have a greater impact on the project performance. |
| Mahdi; and Alreshaid (2005) | Design-build > Construction manager agent > design-bid-build = construction manager at risk for the factors influencing owner's decision of selecting project delivery method |
| Rojas; and Kell (2008) | No statistically significant difference between construction manager at risk and design-bid-build in change order costs, A significant difference in cost growth between construction manager at risk and design bid build projects during buy out, making construction manager at risk projects less efficient at controlling cost growth at buy out. |

## Research Objective

This research focus on project experiences, skill set needed, technologies used, lessons learned, and challenges faced by contractor and subcontractors using all four delivery methods in building projects.

## Methodology

To help understand the perspectives of contractors and subcontractors, a semi structured questionnaire was developed. A semi structured questionnaire is a mix of structured and unstructured questionnaire. Some of the questions and their sequence are determined in advance, while others evolve as interview proceeds (Louise et. al 1994). This questionnaire was inspired and modified from the research on highway project (Gransberg; and Shane 2010). This new semi-structured questionnaire was institutional review board (IRB) reviewed and exempt. A pilot study using this questionnaire was conducted on the Iowa State University projects. Contractors and subcontractors who have worked utilizing different delivery methods in the building industry, were identified as the potential participants.

The emails and list of contractors and subcontractors was gathered from Google and Top 400 ENR contractors and subcontractors in building industry. Eighty contractors and 120 subcontractors were asked to participate in this research via a recruiting email. Ten contractors and eight subcontractors responded interested in the research and asked for questionnaire and participation time. After providing the necessary information, two contractors and three subcontractors participated in the research. One contractor participated in a phone interview while others participated in an in-person interviews. The average industrial experience of the contractors was 15 years while the average industrial experience of the subcontractors was 37 years. The contractors have worked with at least two of the four different delivery methods. One of the subcontractor only worked with design-bid-build. The demographics of the participants such as number of years in industry, different delivery methods used, average project size worked on are shown in table 2.

After completing the data collection, the researcher coded the recorded phone call and took notes during in-person interested. The gathered data was analyzed and is the focus of the data analysis on experiences on different delivery methods, lessons learned on different delivery methods and the factors important in choosing a delivery method.

Table 2: Demographics of participants

| Name: | Contractor 1 | Contractor 2 | Subcontractors 1 | Subcontractors 2 | Subcontractors 3 |
|---|---|---|---|---|---|
| Job Title: | Project Manager | Senior Project Manager | owner | Director of operations | President |
| Number of years in Industry: | 8 | 20 | 40 | 25 | 45 |
| Types of projects worked on | Commercial, renovations, industrial | Industrial, agricultural, federal | Fertilizer, grain, commercial | Industrial, transportation, commercial | agricultural, commercial, residential |
| Delivery methods used: | Construction manager at risk, construction manager agent, design-bid-build, design-build | Design-bid-build, design-build, construction manager at risk | Design-bid-build | Design-bid-build, design-build, construction manager at risk | Design -bid-build, design-build, Construction manager at risk |
| Type of company | General contractor | General contractor | Electrical subcontractors | Earthwork subcontractors | Concrete subcontractors |
| Type of interview | Phone Interview | In-person Interview | In-person Interview | In-person Interview | In-person Interview |

## Findings and Discussion

The cumulative responses of all five interview are analyzed and another analysis of contractor's cumulative reposes and subcontractor's cumulative responses analyzed. There is a definite difference in understanding a delivery method between contractors and subcontractors. The researcher focused on reasons that their company choose any delivery method, skill set needed, challenges faced, lessons learned in all the delivery methods.

All five participants have worked using design-bid-build delivery method at some point in their career. Four participants worked using design-build and construction manager at risk. Only one participant worked using construction manager agent

Tables 3, 4, and 5 shows top three to five most significant reason for choosing to work using design-bid-build, design-build, and construction manager at risk respectively.

Table 3: Top 3-5 most significant reason for choosing to work using design-bid-build

| | **Contractor 1** | **Contractor 2** | **Sub-Contractor 1** | **Sub-Contractor 2** | **Sub-Contractor 3** |
|---|---|---|---|---|---|
| Reduce/compress/accelerate project delivery period | ☐ | ☐ | ☐ | ☒ | ☐ |
| Establish project budget at an early stage of design development | ☐ | ☒ | ☐ | ☐ | ☐ |
| Constrained budget | ☒ | ☒ | ☒ | ☐ | ☒ |
| Get early construction contractor involvement | ☐ | ☐ | ☐ | ☐ | ☐ |
| Encourage innovation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Facilitate Value Engineering | ☐ | ☐ | ☒ | ☐ | ☐ |
| Encourage constructability | ☐ | ☐ | ☐ | ☐ | ☐ |
| Encourage price competition (bidding process) | ☒ | ☒ | ☐ | ☒ | ☒ |
| Compete different design solutions through the proposal process | ☐ | ☒ | ☐ | ☐ | ☐ |
| Redistribute risk | ☒ | ☒ | ☐ | ☒ | ☐ |
| Complex project requirements | ☒ | ☐ | ☒ | ☐ | ☐ |
| Flexibility needs during construction phase | ☐ | ☐ | ☒ | ☐ | ☒ |
| Third party issues (permits, utilities, etc.) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduce life cycle costs | ☐ | ☒ | ☐ | ☐ | ☐ |
| Provide mechanism for follow-on operations and/or maintenance | ☐ | ☐ | ☐ | ☐ | ☐ |
| Innovative financing | ☐ | ☐ | ☐ | ☐ | ☐ |
| Encourage sustainability | ☐ | ☐ | ☐ | ☐ | ☐ |
| Project is a revenue generator | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduced Company staffing requirements | ☐ | ☐ | ☐ | ☐ | ☐ |
| Reduced Company review/inspection requirements | ☐ | ☐ | ☐ | ☐ | ☐ |
| Other (explain below) | ☐ | ☐ | ☐ | ☐ | ☐ |

Table 3 indicates about the different reason that the contractors and subcontractors would choose to work on design-bid-build projects. The results show that contractors agreed that constrained budget, to encourage price competition, and to redistribute risk are reasons to work on design-bid-build. While the subcontractors did not have same reasons to work on design-bid-build but the major factors for them to work on design-bid-build are to encourage price competition, and to facilitate flexibility during construction phase. Both the contractors participated in this research said that redistributing risk is one of the reasons that they would choose to work with design-bid-build contradicts the general expectations from that delivery method.

Table 4: Top 3-5 most significant reason for choosing to work using design-build

| | **Contractor 1** | **Contractor 2** | **Sub-Contractor 2** | **Sub-Contractor 3** |
|---|---|---|---|---|
| Reduce/compress/accelerate project delivery period | ☒ | ☒ | ☐ | ☐ |
| Establish project budget at an early stage of design development | ☒ | ☐ | ☒ | ☐ |
| Constrained budget | ☐ | ☐ | ☐ | ☐ |
| Get early construction contractor involvement | ☒ | ☒ | ☐ | ☒ |
| Encourage innovation | ☐ | ☐ | ☒ | ☐ |
| Facilitate Value Engineering | ☐ | ☐ | ☐ | ☒ |
| Encourage constructability | ☐ | ☐ | ☐ | ☐ |
| Encourage price competition (bidding process) | ☐ | ☐ | ☐ | ☐ |
| Compete different design solutions through the proposal process | ☐ | ☐ | ☐ | ☐ |
| Redistribute risk | ☐ | ☐ | ☒ | ☒ |
| Complex project requirements | ☐ | ☒ | ☐ | ☐ |
| Flexibility needs during construction phase | ☐ | ☐ | ☐ | ☐ |
| Third party issues (permits, utilities, etc.) | ☒ | ☐ | ☐ | ☐ |
| Reduce life cycle costs | ☐ | ☐ | ☐ | ☒ |
| Provide mechanism for follow-on operations and/or maintenance | ☐ | ☐ | ☐ | ☐ |
| Innovative financing | ☐ | ☐ | ☒ | ☐ |
| Encourage sustainability | ☐ | ☐ | ☐ | ☐ |
| Project is a revenue generator | ☒ | ☐ | ☐ | ☐ |
| Reduced Company staffing requirements | ☐ | ☐ | ☐ | ☐ |
| Reduced Company review/inspection requirements | ☐ | ☐ | ☐ | ☐ |
| Other (explain below) | ☐ | ☐ | ☐ | ☐ |

Table 4 shows the different reasons for all the participants to work on design-build delivery method in general. The results indicate that the common reason for all the parties involved to work on design-build is early involvement. Results suggest contractors agree that design-build is an accelerated project delivery method that can reduce the overall project schedule.

Table 5: Top 3-5 most significant reason for choosing to work using construction manager at risk

| | **Contractor 1** | **Contractor 2** | **Sub-Contractor 2** | **Sub-Contractor 3** |
|---|---|---|---|---|
| Reduce/compress/accelerate project delivery period | ☐ | ☐ | ☐ | ☐ |
| Establish project budget at an early stage of design development | ☐ | ☐ | ☐ | ☐ |
| Constrained budget | ☒ | ☐ | ☐ | ☐ |
| Get early construction contractor involvement | ☐ | ☐ | ☒ | ☒ |
| Encourage innovation | ☐ | ☒ | ☐ | ☒ |
| Facilitate Value Engineering | ☐ | ☒ | ☐ | ☐ |
| Encourage constructability | ☒ | ☐ | ☐ | ☐ |
| Encourage price competition (bidding process) | ☐ | ☐ | ☐ | ☒ |
| Compete different design solutions through the proposal process | ☒ | ☐ | ☒ | ☐ |
| Redistribute risk | ☐ | ☒ | ☒ | ☒ |
| Complex project requirements | ☐ | ☐ | ☐ | ☐ |
| Flexibility needs during construction phase | ☒ | ☐ | ☐ | ☐ |
| Third party issues (permits, utilities, etc.) | ☒ | ☐ | ☐ | ☐ |
| Reduce life cycle costs | ☐ | ☐ | ☐ | ☐ |
| Provide mechanism for follow-on operations and/or maintenance | ☐ | ☐ | ☐ | ☐ |
| Innovative financing | ☐ | ☒ | ☐ | ☐ |
| Encourage sustainability | ☐ | ☐ | ☐ | ☐ |
| Project is a revenue generator | ☐ | ☐ | ☐ | ☐ |
| Reduced Company staffing requirements | ☐ | ☐ | ☐ | ☐ |
| Reduced Company review/inspection requirements | ☐ | ☐ | ☐ | ☐ |
| Other (explain below) | ☐ | ☐ | ☐ | ☐ |

Table 5 enquired about the different reason that the contractors and subcontractors would choose to work on construction manager at risk projects did not yield any definitive answer from the participated contractors or subcontractors.

Tables 6, 7, 8, and 9 show the different skill set needed, technologies needed, challenges faced, and lessons learned by the contractors and subcontractors for different delivery methods respectively. The number in parenthesis indicates the number of responses that expresses the same idea.

Table 6: Skill set needed by the contractors and subcontractors for different delivery methods

| Design-bid-build | Design-build | Construction manager at risk |
|---|---|---|
| Negotiation skills are important for all the parties involved. (4)<br><br>Accurate and clear design are necessary for easier documentation and construction phases. (3) | Contractor should be able to understand the owner requirements while thinking constructability. (2)<br><br>Subcontractors should have a better understanding of the process as they are brought early on into the project. (2)<br><br>Invited subcontractors should understand that the early involvement is not a project award. They must be competitive and show credibility in their bidding to be selected for project award. (2) | Tracking costs is important. (4)<br><br>Scope documents needs to be accurate to establish an early guaranteed maximum price(GMP). (4)<br><br>Risk assessment is important. (3) |
| Number of participants: 5 | Number of participants:4 | Number of participants: 4 |

Table 7: Technologies needed by contractors and subcontractors for different delivery methods

| Design-bid-build | Design-build | Construction manager at risk |
|---|---|---|
| A good estimator and estimating software is an important technology needed by both contractors and subcontractors. (5)<br><br>As these projects are budget constrained no expensive technologies and software are used. (3) | Building information modelling (BIM) and virtual design construction (VDC) and important for the integration of architect team and contractors. (2)<br><br>Quantity take off software and project integration software are essential for the integration of contractors and subcontractors. (4) | Building information modelling (BIM) and virtual design construction (VDC) and important for the integration of architect team and contractors. (2)<br><br>Quantity take off software and project integration software are essential for the integration of contractors and subcontractors. (2)<br><br>Risk assessment software. (2) |
| Number of participants: 5 | Number of participants:4 | Number of participants: 4 |

Table 8: Challenges faced by contractors and subcontractors for different delivery methods

| Design-bid-build | Design-build | Construction manager at risk |
|---|---|---|
| To help and win the project subcontractors often under estimate the bid package and struggle delivering within budget and time. (2)<br><br>No proper owner involvement in the dispute resolution matters. (3)<br><br>Constant changing prices of raw materials is a big problem for subcontractors. (2) | Maintaining coordination and constant communication is a big challenge in this delivery method. (3)<br><br>Information needs to be transparent between architect, contractor and owner. (2)<br><br>Design and construction documents lack clarity for subcontractors accurate pricing. (2) | Managing scope documents and construction documents. (2)<br><br>Risk determination. (2)<br><br>Time and money management is a big challenge in this delivery method. (3) |
| Number of participants: 5 | Number of participants:4 | Number of participants: 4 |

Table 9: Lessons learned by contractors and subcontractors for different delivery methods

| Design-bid-build | Design-build | Construction manager at risk |
|---|---|---|
| Tracking of costs all throughout the project is important. (4)<br><br>Open and transparent communication between contractor and subcontractors is key factor in the success of design-bid-build. (2)<br><br>Providing better quality according to owner's requirements and saving money is the essential. (2)<br><br>Good superintendent who can understand the project roles and scope of the project will yield a better relation between subcontractors and contractor. (2) | Collaborative relationship between designer and the builder helps in situations. (2)<br><br>Getting the bridging documents correctly will help set a budget on the bid package early on. (2)<br><br>Always be willing to suggest and price for alternate materials. (4) | Contractor must be aware of the changing nature of the risks. (2)<br><br>Difficult to establish a guaranteed maximum price. (2)<br><br>This delivery method allows the room for innovative ideas and alternate materials. (3) |
| Number of participants: 5 | Number of participants:4 | Number of participants: 4 |

After investigating and reviewing table 6, table 7, table 8, and table 9 contractors and subcontractors need risk assessment software while using construction manager at risk delivery method. Subcontractors should have a skill set of better understanding of the design-build process as they are brought early on into the project. Subcontractors are facing challenges in design-bid-build in terms of lack of clear scope documents and better communication from design team. Subcontractors should always be willing suggest and price for alternate materials is one of lessons learned by the subcontractors using both design-build and construction manager at risk delivery method.

From the semi-structed interview the different views of the contractors and subcontractors are captured. One contractor colludes and states that "design-build is best for spread(flexibility) and quality stand point but design-bid-build will be best for cost stand point". One subcontractors colluded the interview stating, "the relationship and trust of subcontractors on contractors is more in design-build". When asked about how far down the hierarchy does the delivery method impact? A subcontractor replied "It depends on each of the different type of delivery method used for a project. It might be one person or the whole group affected due to an error. From the Owner to the daily wage worker."

**Construction Manager Agent**

Only one contractor has the experience on construction manager agent among the 5 participants. None of the subcontractors that the researcher interviewed never utilized this delivery method. There no significant data to conclude anything about construction manager agent. So, researcher stated and used the data that was found during literature review.

**Conclusions**

While each delivery method has its advantages and disadvantages, contractors and subcontractors should take extra care in the type of contract that they are entering and the requirements from the project. Contractors and owners should identify the skill set needed, technologies needed for the project to choose the correct delivery method. Challenges faced; and lessons learned will serve an important tool for contractors and subcontractors to maximize the advantage and minimize the disadvantage of any delivery method. By analyzing all the delivery methods, the following conclusions are drawn:

- Identifying different risks involved and managing risks is important in construction manager at risk.

- Subcontractors should take advantage of construction manager agent delivery methods as they will get paid faster (From the literature review).

- Engaging subcontractors and contractors early on the project will add a lot of value to the team. Having every player in the project at the design phase will provide room for innovation and value engineering early on.

- Design-builder qualification plays a prominent role in success of a project and design-build process itself.

**Limitations**

While the average experience among the participants is significant the number of participants involved in this research is limited. Lack of interest among the building industry to participate in the lengthy interview process resulted in fewer interviews than expected. The information presented is based on what is identified in the literature and the views of the people interviewed, the researcher did not conduct case studies or use other means of data collection to collect other information to support or refute the views expressed in the interviews. Participating subcontractors in this research did not have any experience on construction manager agency delivery method which limits the ability to draw any conclusions about this delivery method.

**Future Research**

With the limited amount of participation, the conclusions are drawn in the building industry, the research can cast a wider net and investigate a building type to determine the best delivery method for that building type. More participation of contractors and subcontractors will yield a better understanding of the industry. This research should be conducted public funded projects to understand the roles of subcontractors and contractors in public funded project and suggest a better delivery method.

Subcontractor saying that they trust contractor more in design-build spark a curious doubt.

- Whether design-build delivery method is optimal for owner in means of cost savings?

- Whether subcontractors are exploiting the frequent design changes in design-build to provide inflated estimates?

More in depth research should be conducted among the build industry on the design-build should be done explore the above-mentioned questions.

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