

A Comparative Analysis of Integrated Project Delivery in Construction Versus Traditional Methods

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Abstract: In this paper, different types of traditional project delivery methods in the construction industry were explored and a comparative analysis against Integrated Project Delivery (IPD) were performed. The advantages of IPD method for all parties, owner/engineer/architect/general contractor, were explored by reviewing the most recent literature. The literature suggests that IPD method should be the dominating project delivery method and diluting the conventional methods such as Design-Bid-Build due to more collaborative and mutually beneficial ways of doing construction; IPD is newer and a more comprehensive method to capture the intrinsic values of project collaboration. This paper presents a comparison of the commonly used methods of project delivery, Design-bid-build, CMAR, & Design-Build and addresses their advantages and disadvantages in differing project scopes and sizes. Several industry leaders with experience in the four types of project delivery addressed were surveyed. The survey results show an overwhelming desire for future projects to go toward IPD from the contractor/owner/RDP. The biggest obstacle facing a project from using IPD appears to be trust.

Key words: Integrated Project Delivery, Construction Manager at Risk, Design-Build, Design-Bid-Build

1. INTRODUCTION

For much of the 1900s, construction projects were completed by a Design-Bid-Build (DBB) delivery system. As competition and technology improve, the demand for faster completion of construction projects developed [1]. Due to this demand, a market has evolved for new project delivery methods that seek to control cost, quality, and safety while accelerating the design and construction process [2].

It is commonly said that insanity is repeating the same process over and over, while expecting a different result. Construction has devolved into insanity in its production and traditional contracts since the 1960s [3]. A study by the U.S. Department of Commerce and Bureau of Labor Statistics indicates that construction is the only non-farming industry to see a decline to productivity since 1964, and no meaningful change occurred during the past 10 years, whereas all others have increased by nearly 200% on average [4]. With the advancements in technology, speed of

communication, and materials of the last 50 years, this lethargy in construction is unacceptable. This paper reviews solutions of various alternatives to traditional construction contracts and defines best practices for various approaches in a way that offers solutions to the production, Request for Information (RFI), and the individualistic approach that is currently holding back the industry. The issues with traditional delivery systems cost owners money, time, and put them at greater risks than newer delivery methods.

Demand for accelerated delivery methods is not new; the Construction Manager at Risk (CMAR) delivery method has been used for more than forty years. More recently, Integrated Project Delivery (IPD) was developed. The IPD methodology is an approach to construction that helps increase production, reduce litigation, and benefit profit lines of all stakeholders in the designing and contracting of a new building or major project, as well as provide higher quality facilities faster and at no significant cost premium to the owner [5]. These alternative methods evolved to address the challenges presented by complex projects and the demand for quicker delivery. There is a significant reduction in RFIs for an IPD project versus a CMAR project, nearly 91% less RFIs, which can directly result in accelerating schedule and cost savings [6]. Compared to DBB, studies involving both IPD and CMAR delivery methods have reported faster completion of projects [7] and documented cost savings [8].

2. CURRENT ISSUES WITH TRADITIONAL CONTRACTS

The construction industry is dissatisfied with the outcomes of current project delivery systems such as DBB, CMAR, D-B, etc. IPD is a method to improve the triple constraint by aligning incentives and goals, early involvement, multiparty contract agreements and sharing risk/reward [9]. Clients attain more value due to less energy cost, reduced documentation, and increased speed-to-market, while contractors capture value through less rework, reduced conflict and cost reduction of at-risk work.

The main challenges which prevent construction stake holders switching to new delivery methods are cultural, technological, legal, and financial. Culturally, construction companies are rigid and reluctant to apply a different approach [9]. A solution to this would be training for the stakeholders to demystify the approach [10]. Humans are naturally resistant to change and the comfort with what has been done previously is one of those reasons. The transition from a conventional method to a new one is slow for contractors since unknown factors and hidden risks could affect the project schedule and budget. In a survey, it was shown that the intensive training system to make contractors more familiar with IPD helped the transition from DBB to IPD. Training may be a solution to the cultural barriers [12].

Table 1. The relationship with important factors to projects extracted from literature by surveying contractors for opinions [5] [12] [11] [14].

Contract Type	High Quality Product	Within Budget	Communication	RFI per \$1M
DBB	Poor	Change orders	Poor	9.9
CM @ Risk	Average	Most times	Average	9.9
Design-Build	Above Average	Sometimes	Above Average	9.9
IPD	Highest Quality	96%	Superb	0.1

Technology challenges usually comes down to control and cost of new users and software. Technological challenges could be liability, ownership, and interoperability to implement the integrated software in a project [1]. BIM software is a crucial part to the IPD process, thus

integrated software is essential to a successful project [13]. In the legal challenges, it frequently comes down to insurances and liabilities. A multiparty agreement, suitable to insurance companies can eliminate or mitigate the capability to build a lawsuit between parties is necessary [12]. Traditional models foster individual responsibilities which inhibit collaborations in favor of compensation. In the financial challenge, traditional models encourage a zero-sum game. For one party to make more, another must make less. IPD methods seek to increase teamwork by mutual compensation and incentives for the project team [9].

The goals of all parties involved in a construction project can align with clear statements of desired outcomes and early communication. The owner wants quality in a timely manner, built at a reasonable price. The A&E designers want to design a quality product, meeting the client's needs, for a reasonable fee. The contractor wants to build a quality project, to the correct specifications, for a reasonable fee. Using Ashcraft Jr. [13] model of structural hierarchy, working from the desired outcomes to the processes and behaviors to meet those outcomes and navigating the four biggest challenges facing current project delivery methods outlined [9], IPD can satisfy all participants.

3. WHAT IS IPD?

Integrated Project Delivery is a system in the field of Construction Project Delivery which helps to align the interests, aims, and objectives of various stakeholders while making key participants' part of the earlier steps. This procedure is unique in that it employs the use of rewards and incentives as a key element to encourage collaboration among all participants. Limited research has shown the performance differences of IPD projects and compared them to projects carried out through design-bid-build and construction management at-risk systems. In carrying out the comparative paper, literature related to IPD and other conventional delivery methods such as DBB and CMAR were investigated [11].

The key stakeholders each enter a single, multi-party contract; namely, the client, architect, engineer(s), and general contractor, but could include the subcontractors and other financial partners. The stakeholders collaborate to optimize specific activities in the project like setting goals, budgets, risk-sharing, and compensation channels are agreed upon.

IPD has three phases: the definition, design, and construction phases. These phases can be refined as conceptualization, design, implementation, and construction stages that have evolved from the conventional traditional methods. In the first stage, the project team will have to come up with a plan for allowing them to meet the demands of their clients, assess the feasibility of the project, and come up with a schedule to show the scope, cost, and performance metrics for the projects and ways of appraisal [14].

The conceptualization step or phase of IPD is most crucial for the success of the entire process and involves all participants meeting to assemble to analyze every issue relying on each stakeholder's area of expertise. In the design process all the ideas and any evaluation carried out are integrated into this stage including construction methodologies and practices to help determine critical path. The goals and regulatory consideration of the project will be debated, while the ways of developing and optimizing the costs are handled in this stage [14]. Information gathered from all members of the project team are modelled to determine conflicts and points where inefficiencies may exist. The use of software in this stage allows data development in the design stage to be forecasted and can show the performance and outcome of the project in the future. It is in this stage that the feasibility of the project is well evaluated and discussed. The final stage is the implementation or construction process for the project. The effectiveness of the previous steps is the determinant factor in controlling delays, waste, and scheduling of activities. The construction phase is the most expensive part of any project, so front loading the work and involving the general

contractor helps to reduce the unforeseen costs and RFIs that drive up the costs. This process allows the construction industry to follow the old adage, “Plan your work; work your plan”.

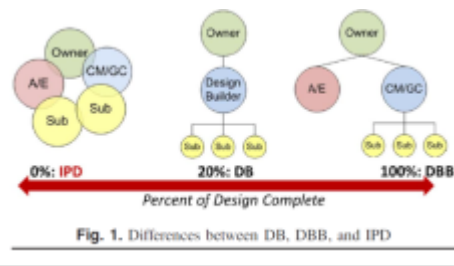


Figure 1. Timing of team entry by percent of design complete [5]

In IPD the design is created to the budget [13]. By designing the project after the budget is set with the input from all team members, the project will be more likely to fall within the parameters set instead of over-designing. As seen in Figure 2, Ashcraft [13] explains that the best process begins with determining the desired outcomes each party looks to achieve and working from there to establish the processes and behaviors needed to achieve those outcomes. The general hierarchy of the IPD method displays that seeking desired outcomes for each party and then working to establish processes and behaviors with that end in mind is what is needed to reach the goals.

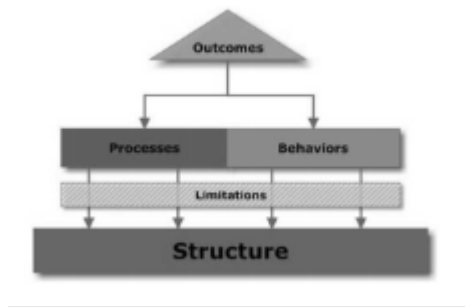


Figure 2. Hierarchy of the IPD method [13]

4. COMPARATIVE ANALYSIS OF IPD OVER TRADITIONAL CONTRACTS

In this section, the paper will delve into the current literature and research to demonstrate the advantages that IPD holds over other project delivery methods. IPD is shown to work very well in most project types with a near 100% success rate when all parties can rely on and trust members of the contract.

To determine if something is successful, there needs to be a way of quantifying the various projects with differing scopes and limitations. To determine if IPD is a more successful method of conducting construction projects, Asmar [5] developed statistical methods of measuring project success. Using univariate data analyses, such as t-tests and Mann-Whitney-Wilcoxon tests, to evaluate IPD performance against similar projects that used Design-Build, DBB, or CMAR delivery methods, Asmar [5] showed that IPD achieves significant improvements in 14 metrics over six performance areas, including quality, schedule, project changes, communication, environmental, and financial performance. IPD is based on a mutual risk and reward system that fosters collaboration and innovation for higher quality that every team member can celebrate. One trust-driving element is the multi-party contract which makes litigation or building a lawsuit against another part of the team unnecessary, allowing the team members to not be guarded or have a fear

of admitting to a mistake that could have been pushed down the ladder and caused far more problems.

IPD has demerits which limit its application in construction projects. Trust relationship for the members may be limited due to a large team. The team leader must develop trust since it will not be inherent between owners, architects, engineers, and general contractors. Financing for IPD projects may be more difficult than when traditional construction methods are used, as many of the financing leaders who are not aware of the concept and workings of IPD projects are unwilling to lend money for them [15].

DBB is one of the traditional methods of project delivery and according to Perlberg [16], it is the most widely used concept or technique in executing construction projects. This method is simple; the project owner will hire a designer to come up with plans for the project under consideration. The designer seeks a professional consultant who reports to him or her. After the drawings are complete, the project owner gets bids from various construction companies willing to take over the proposed project and build it to designer's specifications. The owner of the project will select the best bidder according to cost and possibly other terms [17]. Through this method, the designer can have subcontractors who will report to him directly. The project will be commenced based on the plans/specs of the designer. This conventional method will make use of a project manager to act as the proxy of the project. DBB ensures one task is done in linear fashion with no overlap and will start after the owner has selected the designer.

The limitations of DBB Projects include the limited capacity of projects to work on. For example, simple projects that are predictable and flexible on completion can make use of this technique. DBB is rarely used for large or private projects but is commonly used by public entities [18]. The industry has driven this simple system because of the ease of implementation. All stakeholders have a clear understanding of roles and those who are inexperienced can easily follow the steps of the method.

Demerits of using DBB as a project delivery method include higher owner risk. Management of DBB contracts can be a challenge, as well as lack of collaboration, and it lacks the advantage of the expertise of the contractors and subcontractors [18]. Delays persist as the work starts after the design process has been completed by the architect and/or engineer and given to the contracted company.

Construction manager at risk (CMAR) is a method in the construction industry where the construction manager has the full commitment to delivering the project within a given Guaranteed Maximum Price (GMP) based on construction documents and other specs. CMAR is the consultant to the owner and responsible for executing all the phases of the project [19]. The CMAR is responsible for controlling the cost of GMP and ensuring it does not exceed the set GMP as per the order of financial liability. Among the advantages associated with this method include increased flexibility and adaptability of the changing environment, allowing the CMAR to adjust cost, quality, schedule considerations. Furthermore, as the client, you can adjust the pricing before completing the project.

This method is suited for projects that are difficult to construct in the beginning and the chances of them changing are very high. CMAR is an effective method if the project has technical complexities and undergoes several phases before completion and construction can start before the entire design is complete [20]. The drawbacks associated include the risk of the construction manager running out of funds, which is common. Compensations in quality can occur to meet the set GMP that is established before the design starts. In this method, the client is at risk of exclusions and other shortcomings due to contract documents from the contractor. RFIs, change orders, and reworks are common in a situation when the GMP is set before the construction phase begins [21].

Risk aversion in design and construction services is rampant to the point that every tier in the ladder tries to push risk down until the risk is assigned to those least able to bear it. The fear of being saddled with risk dilutes innovation and makes the industry stale with RFIs and legal redundancies that slow projects and increase financial damages. From the analysis and comparison of three techniques used in construction, various conclusions can be made. The use of IPD is based on the concept of collaborative mentality and trust. DBB tries to employ the same mechanisms but at a smaller degree and less effectively, but more importantly, creates a culture of blame rather than risk-sharing and collaboration. In IPD the steps of executing the project are motivated through incentives offered to all the participants and who work towards successful achievement of all the goals and objectives of the project. In CMAR responsibility falls on the construction manager and the concept of risk-sharing does not apply. Among the three methods, the method with the highest risk level for the client is CMAR followed by DBB, and finally the IPD. Among the three methods, the differences arise through how responsibilities are shared for major tasks and regulations.

5. SURVEY OF WORKING PROFESSIONALS

A survey was sent to thirteen working professionals in the A/E/C industry and those who were involved in project ownership. The professionals ranged from project managers, company presidents, engineers, and project owners. In the responses, it was noted the most common project delivery method they dealt with is DBB or “traditional” as they called it. All the respondents had experience with IPD on multiple projects, and other project types discussed in this paper. The survey consisted of written responses and asked the participants to grade their experience with IPD on a scale of 1-10.

The largest benefits seen by the professionals on IPD projects versus other delivery methods, excluding costs were an increase in quality and higher team satisfaction with the overall project. All respondents indicated a significantly high level of trust is required, nearly a “leap of faith”. Trust is identified as the highest requirement for embarking on an IPD contract. The trust is required to have effective team collaboration, because if any one member of the team becomes self-centric, it could derail a portion or all of the project. The most common challenges mentioned about IPD projects are the perceptions of having “never done that before” and educating the team on how it works. One professional stated, “Not everyone is equipped to participate in an IPD project because it requires the best staff of each company in order to be successful.” Getting owners to take on that 1st IPD contract is the biggest hurdle, because they generally use IPD after they recognize the success.

For assembling a team on an IPD project, the professionals agreed, “It is most effective to pick each team player one by one. The best (IPD) projects began with the client and a trusted Lean Leader (partner) to start the process. The partner helps select teams with the owner beginning with the architect and then the General Contractor followed by trade partners and engineer/consultants. It builds comradery as each new member of the team participates in the selection of the next partner.”

During the survey, respondents were asked to give scores (1-10, 1 being a “horrendous mess of a project” and 10 being “their idea of a perfect project”) in the six areas of measurement for each project type based off their own experience and then rank the projects type at the end (1-4, with 1 being best and 4 being worst). The six qualities of project performance had a maximum score of 60.

Table 2. The average response scores for project type in each category measured

Project type:	AVERAGE RESPONSE SCORES			
	D-B-B	CM@R	D-B	IPD
Quality	3.6	4.0	6.8	9.5
Communication among stakeholders	3.0	4.8	7.0	9.5
Schedule	2.6	4.3	7.0	9.3
Project Changes	2.3	3.5	7.0	9.4
Workplace environment	3.1	4.3	6.8	9.4
Financial Performance	3.1	4.3	6.9	8.8
TOTAL	17.8	25.0	41.4	55.8

After those surveyed scored each project type in all six categories, they were asked to rank how they believed each project type related to each other. The unanimous number 1 project type was IPD, in addition, design-build earned a unanimous number 2 project type.

Table 3. Project types ranked and averaged, lower score is better

Ranking	AVERAGE RESPONSE RANK
IPD	1.000
Design-build	2.000
CM@Risk	3.375
Design-bid-build	3.625

6. CONCLUSION

Based on research gathered and anecdotal evidence from A/E/Cs and owners of projects that used IPD method in their projects, the results show that when all stakeholders are involved and trusting, the project runs more smoothly versus DBB and CMAR. This is due to the early identification of potential problems and “hive mind” thinking created by aligning stakeholders. The project team seeks to find the best results before the problems spin out of control or are pushed down to someone less capable of handling them. IPD is capable of keeping a project within specified budgets, delivered when expected, and of higher quality than other delivery methods when used. IPD is recommended to be used on large, complex, or technical projects, as well as mid-sized and moderately intricate projects. Projects such as new technology buildings, hospitals, stadiums, airports, and land reclamation and development, where several disciplines are overlapping and working together are ideal for IPD and its process! Current research shows that IPD is capable of out-performing other project delivery types when all parties buy into the methodology.

IPD offer a “best fit” delivery method for value creation for many projects. Literature suggests that knowledge of how IPD works, mutual trust, and culture are the biggest obstacles to entry. A survey of working professionals in the fields of engineering, general contractors, owners, and architects, who have worked on all the various project types and IPD, confirmed that mutual trust and fear of the unknown to be the hurdles that are the hardest to get past for an owner or party member with no IPD experience. If a project owner, designers and contractor are able to establish mutual trust working towards project completion rather than turn to a self-centric approach, then the project is generally successful and the team members report a high quality of work and personal life. Furthermore, once a client has a successful IPD project, then based on the survey they are more likely to repeat using that project delivery method on future endeavors. Falling short of IPD, there is a strong desire from the professionals for Design-Build to be the secondary choice for creating a quality project within budget and ahead of schedule.

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