

Construction Procurement Practice: A Review Study of Integrated Project Delivery (IPD) in the Malaysian Construction Projects

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Abstract—Integrated Project Delivery (IPD) is a project method like none other since it emerged as a method that emphasizes on the integration of all aspects involved in the construction project. This paper is theory based and the objectives are to explore the concept of IPD by synthesizing the existing definitions, describing its principles, comparing its delivery phase with other primary project delivery methods, namely Design-Bid-Build (DBB), Construction Manager at Risk (CM at Risk), and Design-Build (DB), and describing the challenges of its implementation under several issues, such as organizational, financial, legal, and technological aspects. Even though in principle, carrying out IPD is able to bring success to a construction project, its implementation in the construction industry is challenging. Therefore, this study has suggested that the development of new ideal project delivery methods is a necessity in order to overcome the existing issues in project delivery methods, toward achieving project success.

Keywords— *Project Delivery Methods, Integrated Project Delivery (IPD), Construction Procurement Practice, Construction Projects, Construction Industry*

1. Introduction

Procurement was a significant factor in overall success of a project and it was a process used to accomplish construction project within the budget, time duration and required quality by deciding the overall project framework, responsibilities structure and authorities of the project main parties [1]. In recent years, the improvement of traditional project delivery method was done in several countries through development of new project delivery methods such as Integrated Project Delivery (IPD) [2]. The traditional delivery method had many flaws which became more obvious as the level of project complexity increased [3] and isolation of

professionals and process were fragmentation problems that associated with this method [4][22].

The IPD was developed to overcome the problems in common procurement methods such as failure in aligning schedule and budget [1] that led to reworks [4] and time and cost overrun [4]–[6], inadequate details in construction drawings [1], materials wastage [1], [4], lack of communication and coordination [4], [5], increased errors and disagreement [5], [6], competitive bidding strategy and fixed price contracts [7]. Successful project outcomes could be achieved by utilizing IPD as it reduced the overall project cost and time delivery, increased the workmanship quality and succeed in satisfying sustainability and project life cycle goals [8].

IPD employed contracting approach that based on relational and value by forming a virtual organization where the interests of the main project participants were in line with specified project objectives [8]. Throughout the process of design and construction, both collaboration and development are fostered between the numerous team members through a shared budgetary investment in the project outcome [8]. IPD emerged in current years as a method with capability to reformed the project delivery and by focusing on the comprehensive improvement and integration of processes, tools and people in a system this method was like no other [6]. In spite of its potential, the implementation of IPD was in the early stage [6].

The purpose of this study was to develop a new definition of IPD by synthesizing the existing definitions, describing its principles, comparing its delivery phase with other primary project delivery methods namely Design-Bid-Build (DBB),

Construction Manager at Risk (CM at Risk), and Design-Build (DB) and describing the challenges of its implementation.

2. Methodology

This study conducted a general literature review to gain knowledge on IPD. In searching the literature, the search engine Google Scholar and online databases subscribed by Universiti Utara Malaysia were used by means of keywords such as IPD and project delivery methods. The additional sources were discovered through the references of the identified literature.

3. Results and Discussion

3.1 Definition of Integrated Project Delivery

The definition of IPD in construction industry has been defined differently by different researchers. The existing definitions of IPD in terms of delivery method are presented in Table 1. Based on the definitions of IPD, three elements were highlighted; (1) collaborative project delivery or process, (2) integrates all project members and (3) achieve specific shared goals. Therefore in this study, IPD was defined as a collaborative project delivery or process that integrates all project members to achieve specific shared goals.

Table 1. Definitions of IPD

	Definition
Integrated Project Delivery	A system that determines the relationships between the different project stakeholders and their timing of engagement to provide a built facility [9]
	A highly collaborative process that integrates the expertise of project teams during the early project stages [10]
	A business model for design, execution, and delivery of buildings by collaborative, integrated and productive teams composed of key project participants [11]
	A collaborative project delivery method using relational contract principles to harness all of the strengths and capabilities of the owner, designers, and constructors and focus them on

	one goal: the efficient delivery of the project as a whole [12]
	Collaborative teams (including A/E/C firms and the owner) working in a contractually connected manner, generally within a risk or profit sharing format [13]
	Project delivery method that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction [14]

3.2 Integrated Project Delivery Principles

IPD was a business modification that integrated the project team and aligned all the interest towards one effective project [6]. The purpose of the project team integration was to carry out the whole project to a certain extent that gave the owner what they valued [15][23][24].

The project team must concede upon what the 'whole' was for optimizing the whole and also agreed with the project goals that have been developed earlier [15]. Observing project as a single group committed to achieve shared goals was required in close collaboration [16]. Whatever the goal was, it ought to be obviously described and achievable [17]. Collaboration required participation of the project team members in resolving issue and it was a process that gave chance to the project team to impart and learned from each other's expertise, experience and performance [17]. The involvement of owner, contractors and key trade contractors could diversified the team and it was the best way to influence the design and obtained better project value [8].

In order to collaborate, members had to feel the possession over the project and ultimate objectives [15]. The joint ownership and collaboration between main participants and owner could be established through alignment of goals [8].

The project teams were typically formed for more intense collaboration around integrated building components, systems and equipment and they capable to impact project decision by giving particular data about constructability, effectiveness of cost and labor, life cycle expenses and sustainability [8]. Collaboration could be achieved when individuals undoubtedly shared data, found proper times and spaces to impart, understand the interaction of their diverse design processes, got their billing departments worked in compatibility and got numerous different systems integrated together across organization lines [15].

True collaboration occurred when individuals trust, respect and not taking advantage of each other and together, better solutions or results could be accomplished [18]. The project team focused on approaching each other with respect and considered every expert's information since inventive solutions could originate from any team member, so roles were not as entirely described as on traditional projects yet rather appointed to the best qualified individual [15].

Trust component was taken to a higher level in IPD and the owners must trust that they had the support of those whom were liable, capable to choose a team that would treat them equitably and brought into line the objectives appropriately to guarantee the success of the project [19]. Trust must be a consistent idea going through the whole project and provided a basis to collaboration as trust is basically a choice every project team member made each day, to confide in other members [17]. The fundamental to interdisciplinary teams such as in integrated design teams was trust, as none of the members got the expertise to confront all challenges of the project design. In general, interactive team processes such as collaboration was a key factor relating trust to perform in teams [20]. Collaboration that based on trust occurred when individuals focus on project outcomes compared to their individual goals [18].

Transparency was required in trust since communication among the team was not constrained to traditional silos [15]. All types of data lived in a focal location so that the exact and current data could be assessed by all team members and funding in technology compatibility was crucial to enable the accessibility [15].

Safe project environment was also required in trust, so that the team members were secured to test and recommended advancements without afraid of making mistake [15].

Individuals from an IPD team regularly concurred in different approaches to share risk and oversee it, instead of shifting it among each other and this led to a less risky project in general and a more evenhanded way to deal with risk management since all team members had a financial stake viably distinguishing and moderating risks [17]. Risk or reward sharing structures were set up to cost or advantage the team members in accordance with the project outcomes instead of individual firm commitments [15]. Pooling some amount of the project team member's profit at risk, and/or pooling contingency funds and shared any remaining amount after project accomplishment were three typical approaches used in sharing the cost savings or cost overruns against an evaluated cost of work [17].

Integration of systems together crosswise over organization lines turned out to be substantially simpler with utilization of great technology [14]. Technology such as Building Information Modeling (BIM), cloud servers, teleconference devices and others were significant to projects that required

high level of integration [15]. A collaborative atmosphere through alignment of objectives of all team members and encouraged them to work closely together work during all stages of a project was required for the extensive used of BIM [21].

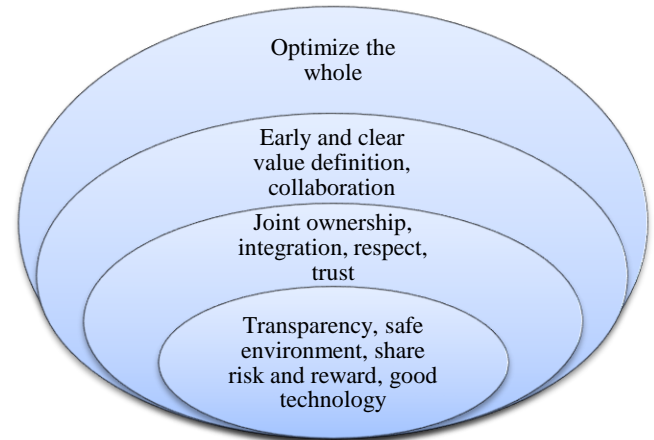


Figure 1. IPD Principles [15]

3.3 The Delivery Phase of Project Delivery Methods

The comparison of delivery phase between IPD and other primary project delivery methods; Design-Bid-Build (DBB), Construction Manager at Risk (CM at Risk), and Design-Build (DB) are presented in Table 2. Compared with the others, IPD allowed the team for earlier design decision-making, optimization of the design and enable the team to sequence the design effort due to the advantage of the having expertise in construction aspects in terms of cost, scheduling, material performance and availability, means and methods, etc. throughout the design process together with the utilization of BIM tools and processes [15].

3.4 Integrated Project Delivery Challenges

The challenges of IPD implementation especially in public sector were categorized under organizational, financial, legal and technological issues.

3.4.1 Organizational Issues

IPD was believed should be reserved for larger and complex projects as significant investment in initial cost and additional design efforts were required as well as the increment of owner involvement [6]. The IPD was practical for repeated projects compared to the distinctive once since the project team members could reuse and continuously upgrading the design development and extended knowledge from previous projects experience [8]. Therefore, for the upcoming projects the cost and time would be significantly reduced due to the existence of standard form consensus, successful business models, plan, management and project teams [8].

The adaptability of organizations with their limited authority led to the reluctance of the industry to change from traditional project delivery method [10]. It became

Table 2. The Delivery Phase of Project Delivery Methods

Delivery Phase	Project Delivery Methods			
	DBB	CM at Risk	DB	IPD
Conceptualization				Early integration of owner, designer and contractor to determine what is to be built; obtaining input and development of initial cost structure and preliminary schedule
Design		Early integration of contractor and designer	Involvement of contractor at the beginning stage of design	All design decisions are required to ensure that unnecessary changes during construction are finalized and design is fully and unequivocally defined
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	Fast-track delivery, elimination of expensive changes and rework
Operation or Maintenance			Flexibility in contract documents due to numerous different variations	Arrangement of pain-gain-sharing will be resolved
Deconstruction		The owner was presented with possible value engineering by contractor to minimize environmental impact		

more serious due to lack of awareness regarding the new processes, incompetent communication about the effectiveness of the processes and also fear of the risk and liability involved [8]. The challenge was to encounter the idleness and to vary the mentality built on the traditional hierarchy [10]. The utilization of IPD challenged the cultural paradigms, required more collaboration between project participants and required thorough changes in workplace organization, atmosphere and relationships. Therefore, to accommodate the new more collaborative business practices the relationship and work processes need to be changed [6].

3.4.2 Financial Issues

Setting the compensation and incentive structures comparable to the distinctive projects and participants were the challenges in financial barriers [10]. The morale of the project team members might be reduced if the incentive program was not thoroughly evaluated, thus their efficiency would be affected [3]. The risks and rewards sharing were the other challenges that need to be overcome as a key component of IPD was aligning the commercial interests [7].

3.4.3 Legal Issues

For public projects, the selection of the contractors was through open completion and based upon the most minimal bids, so the design documents should be completed before the selections as mandated by the construction services laws [6]. Therefore, all the project team members were not collaborated at the early stages and the authority was not evenly dispersed [3]. The value-driven selection criteria however, could be obtained through a public law designated for design-build delivery and the potential of the parties to take legal action against one another in some IPD contracts could be eliminated or reduced to increase collaboration [10].

Other than that, the sharing of risks and rewards were discouraged in the traditional project delivery method since the contractors will be protected against any blame on design as long as it was developed conforming to the plans and details as guaranteed by the owner [6]. If there was any postponements, cost overruns or some other issues emerged on the construction site, the designers and contractors attempted to shift the blame of the issue to the other party [6].

3.4.4 Technological Issues

The internal and external informational management needs could be maintained by using an efficient IT infrastructure, thus sufficient IT infrastructure support was required in an organization [6]. It was extremely important to decide information management protocols as digital information was shared between project participants and these protocols should be established at the beginning of the project in order to decide over legal ownership, liability concerns [6]. Different firms used different IT systems to cope with their necessities and availability and consequently might lead to interoperability problems due to information format and structures inconsistency [6].

4. Conclusion

The selection of an appropriate project delivery method can lead to the success of construction projects. However, deciding which one is difficult as each primary delivery method has its own disadvantages that somehow can be a reason that contributes to project failure. None of these primary project delivery methods can be considered as ideal and appropriate to be used for all kinds of construction project, as every project is unique and 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 methods in all aspects towards achieving construction project success.

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