INTEGRATED PROJECT DELIVERY: A REVIEW OF LITERATURE

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ABSTRACT:

This paper is an attempt to explore the available literature pertaining to Integrated Project Delivery. Project delivery systems are considered one of the most important factors influencing project success. Projects must meet budget, schedule, safety, and quality goals to be regarded as a success. IPD is a new approach to deliver projects in a more collaborative manner as compared to traditional approaches. IPD has been gaining a lot of attention in the construction industry lately. The integration is the key in this delivery method that is achieved by multiparty agreement. This method can contribute to enhancing cost and schedule predictability, as key project players get involved early in the process. IPD uses ideas from integrated practice and lean construction. This is an area where shared risk and shared reward among the team will result in a movement toward an orchestrated delivery process.

KEYWORDS:Integrated Project Delivery (IPD), Building Information Modeling (BIM), Target Value Design (TVD), Energy-related Risk Management (ERM)

INTRODUCTION:

IPD is a project delivery approach that integrates people,system,business structures and practices into a process that collaboratively harnesesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication and construction [1]. Cost and schedule are two of the most important project components in the construction industry. Decision makers must have a clear understanding of how risks impact each delivery method to select the most suitable delivery method for their projects. Decision makers are often faced with deciding between a project execution strategy that emphasizes either cost or schedule. IPD is a fundamental step forward in how the parties interact and are bound together. The integrated delivery model indicates that with full collaboration and participation of contractors, estimators, designers, and the owner in an ongoing information sharing process, not only can time be saved, but the ultimate value of the project can be greater than that possible under the traditional process. In IPD, the owner, architect, and construction manager/general contractor work together and share the risk and rewards. The best approach to ensuring the reliability of workflow is to clearly schedule the work, gain commitments to the schedule from the participants and measure compliance to those commitments. Overall, the implementation of IPD in a project is expected to enhance team performance [2] and project outcomes [3][4], eliminate barriers that might impede information sharing in teams [5], and improve team trust [6]. IPD has exhibited some level of success in construction: “Projects in the US and UK that used IPD with TVD were brought in as much as 19 percent below market cost and expected costs actually fell as design and construction progressed”. Studies discussed potential benefits of integrated delivery andshowcased a handful of successful IPD cases [7].

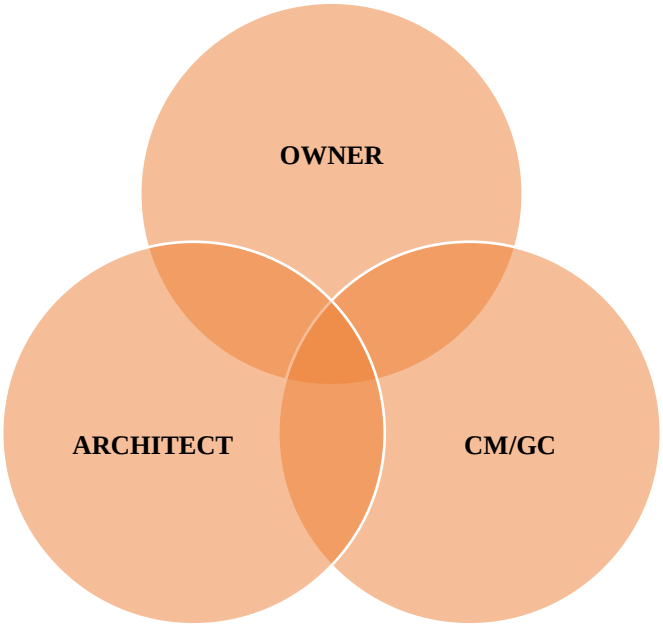

Figure 1: Early involvement of key participants (Source: www.LeanIPD.com)

PRINCIPLES OF IPD METHOD:

Key principles that must be understood by allparticipants using IPD are:

a. Mutual Respect and Trust
b. Mutual Benefit and Reward
c. Collaborative Innovation and Decision Making
d. Early Involvement of Key Participants
e. Early Goal Definition
f. Intensified Planning
g. Open Communication
h. Appropriate Technology
i. Organization and Leadership

With closer collaboration and trust, the future of project delivery promises alignment of common goals, better documentation with fewer gaps, more efficient and faster speed of the design process through construction, and higher overall value of the resultant project. Among different delivery methods that have been developed in construction, the IPD approach aims to lead the team through a collaborative pattern of thinking to reduce later conflicts such as extended schedules and cost overruns. The big idea for true integration "Every member of the team shared completely the responsibility for the entire project and set about correcting deficiencies or problems wherever they popped up without regard to who caused the problem or who is going to pay for it"[8]. The characteristics of a professional relationship are seen as the principles on which the entire method is founded.Integrative work cannot happen unless team members are agreeable to it and this willingness occurs when there is a safe environment to do so. 'Without trust-based collaboration, IPD will falter and participants will remain in the adverse and antagonistic relationships that plague the construction industry today' [1]. When all parties are equally vested in a project based on IPD philosophy, it's in everyone's best interest to quickly solve problems. This process eliminates the usual "blame game" and passing of responsibility, and replaces it with a working environment where everyone is looking for project harmony and ultimate prosperity. The point of IPD isn't to make less of a design effort, but rather to advance design results in order to streamline and shorten the much costly construction effort. Project integration mechanisms and the level of collaboration are divided into three

groups: contractual, organisational, and technological [9]. The consideration is depending upon if the integration principals are implemented with a new delivery system or under the existing project delivery approaches; however, both are believed to trigger better changes and content with higher investment return [10].

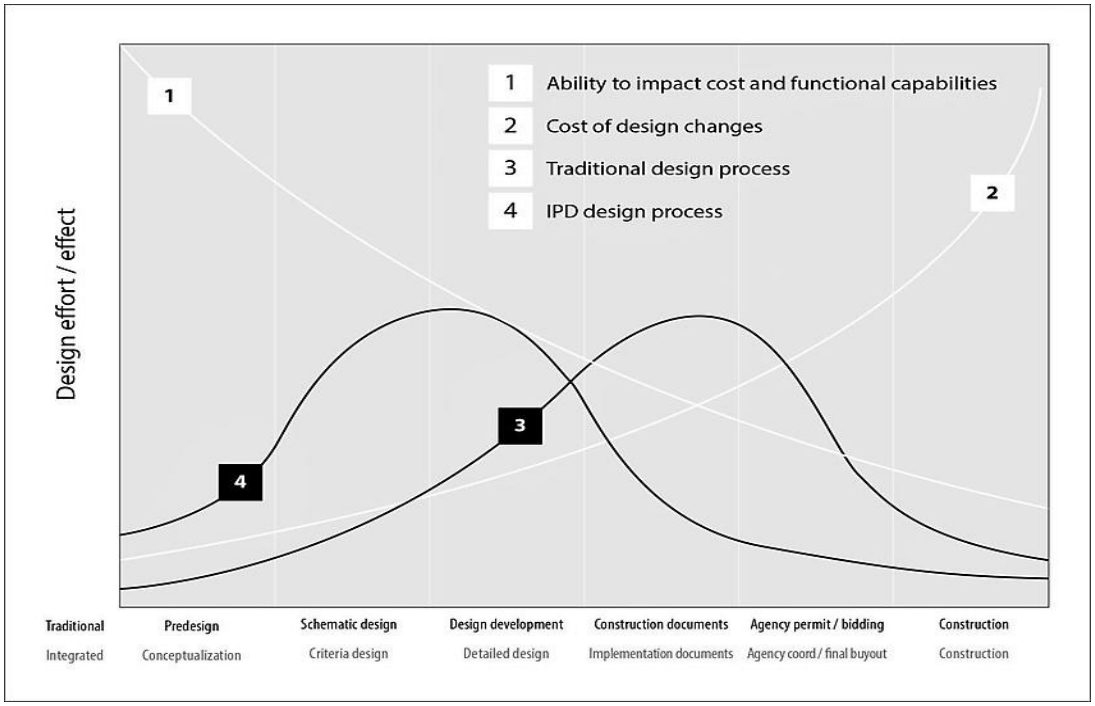

Figure 2: MacLeamy Curve (Source: AIA, 2007)

The MacLeamy Curve is a graph of the cost of decisions mapped along the timeline of a typical construction project. It shows that the decisions made early in a project (during design) can be made at lower cost and with greater effectiveness.

RELATIVE COMAPRISION OF TRADITIONAL PROJECT DELIVERY AND IPD:

A project delivery system is defined as the comprehensive process by which a facility is designed and constructed. Project delivery methods are generally distinguished by two key characteristics; the relationships between project stakeholders and their timing of engagement [3]. Integration can be considered as the merging of different disciplines or organizations with different goals, needs, and cultures into a cohesive and mutually supporting unit. The traditional delivery system is sequential and is known as design-bid-build (DBB). There are several alternative project delivery methods used in the industry today including: design-build (DB); construction management at risk (CMAR); engineer procure construct (EPC); and IPD. In the traditional DBB the contractor is engaged when the design is 100% complete, whereas the other extreme is IPD that engages all key stakeholders at 0% complete before the design even starts. One of the key components of selecting an appropriate delivery method is to properly allocate risk to the different parties involved. Fig 3describes the difference between the traditional and the integrated design process with respect to involvement of various project stakeholders through the projects conception to the realization.

Table 1: Comparison between traditional project delivery and IPD

(Source: American Institute of Architects, 2007)

Traditional Project Delivery		Integrated Project Delivery
Fragmented, assembled on "just as needed" or "minimum-necessary" basis, strongly hierarchical, controlled	teams	An integrated team entity composed key project stakeholders, assembled early in the process, open, collaborative
Linear, distinct, segregated, knowledge gathered "just as needed", information hoarded, silos of knowledge and expertise	process	Concurrent and multi-level, early contributions of knowledge and expertise, information openly shared, stakeholder trust and respect
Individually managed, transferred to the greatest extent possible	risk	Collectively managed, appropriately shared
Individually pursued, minimum effort for maximum return, (usually) first-cost based	compensation/ reward	Team success tied to project success, value based
Paper-based, 2 dimensional, analog	Communication/ technology	Digitally based, virtual, Building Information Modeling (3,4 and 5 dimensional)
Encourage unilateral effort, allocate and transfer risk, no sharing	agreement	Encourage, foster, promote and support multi-lateral open sharing and collaboration, risk sharing

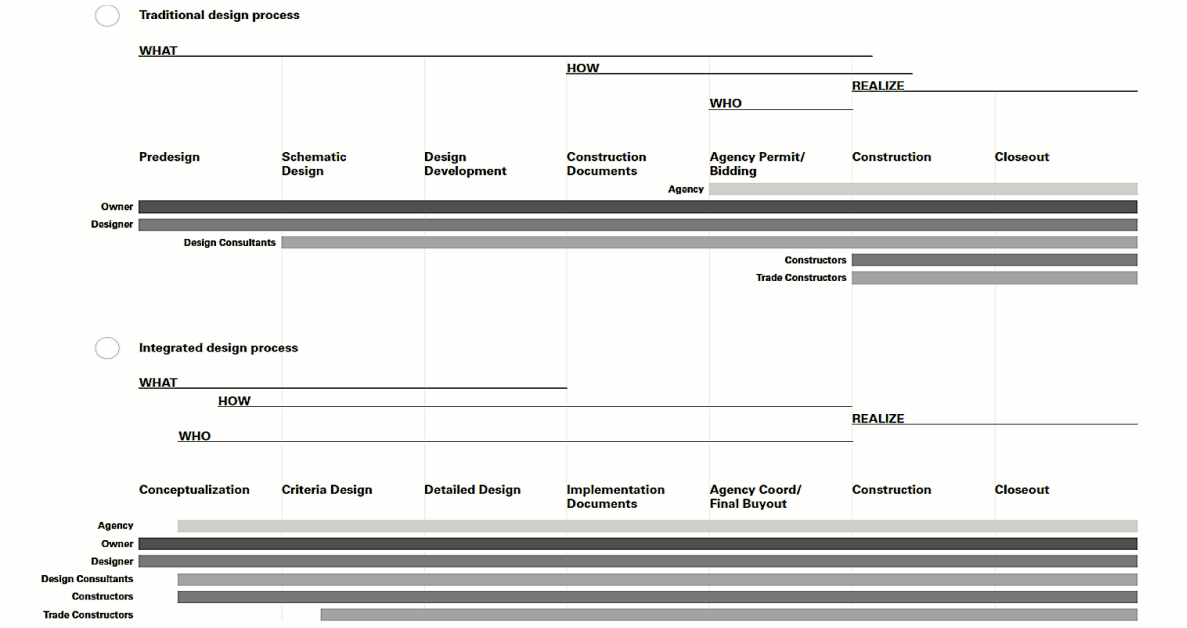

Figure 3: Traditional and Integrated design processes (Source: AIA, 2007)

IPD BY TARGET VALUE DESIGN:

Target Value Design (TVD), refers to the application of Target Costing (TC) to the delivery of projects in the Architecture-Engineering-Construction (AEC) industry. This design method radically differs from what has become the traditional way of designing and making products. Rather than treating cost as an outcome of wasteful design-estimate-rework cycles, TVD is a method that makes customer constraints (on cost, time, location, and others) drivers for design in pursuit of value delivery. Glenn Ballard, one of the developers of Target Value Design (TVD), claims that projects implementing TVD are completed about 19% below the market price and strive to reduce waste. "TVD is a management practice that drives design to deliver customer values, and develops design with in project constrains" [11]. Target value design plays an integral role in IPD. First, the integrated team verifies that a facility can be built with available funds and will work within market constraints. The IPD team of architects, engineers, and contractors then establishes a target cost, based on innovative thinking and best practices. They then design to that target. TVD is not just about target costing, it goes beyond that to establish a link between the three milestones, namely expected cost, allowable cost, and target cost. In order to carry out target value design, the IPD system usually uses a new form of contact, the "Integrated Form of Agreement" (IFOA) [12]. TVD for IPD can induce more cooperative design work than DB or CMR because IPD teams include not only the contractor and the A/E but also the owner, subcontractor, and supplier [13]. In addition, before the IFOA contract is signed, TVD enables the IPD team to cooperate to accomplish the target cost through the optimized design because attainment of the target cost is necessary for the IFOA contract to be signed and IPD team's efforts are reimbursed evenly.

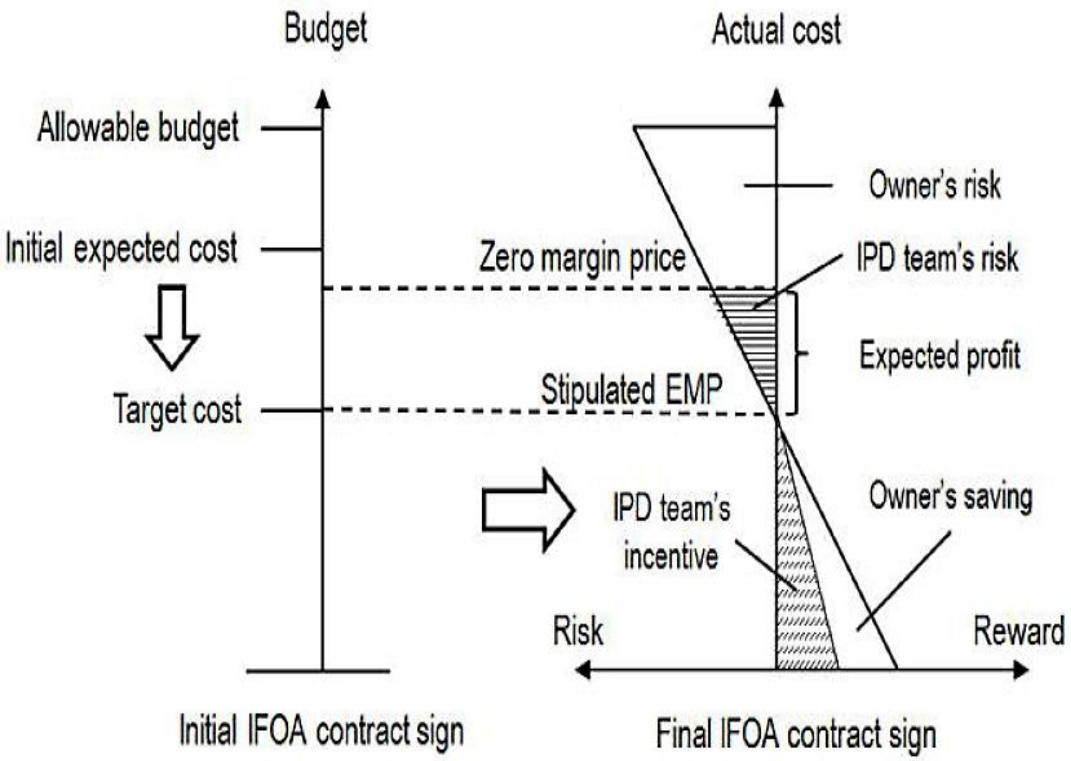

Figure 4: IFOA contract with risk and reward (Source: Jung et. al ,2012)

THE ROLE OF BIM TECHNOLOGY IN THE IPD:

Building Information Modeling (BIM) technology creates a virtual model of a building with quantitative and qualitative characteristics. IPD used with BIM is changing the way that Owners, Architects/Engineers, and Contractors interact throughout the life of a project. A Building Information Model (BIM) will exist for the life of the structure and the Owner will benefit from building efficiencies, initial cost savings, and operations and maintenance of the facility. Combining BIM with the collaborative nature of IPD makes sense because all parties are involved from the inception of the project and have provided input in the development of the model. BIM technology provides certain prerequisites for the realization of IPD, while the use of BIM allows IPD having function perfect technology tools, IPD as a deliver way of construction overall the is only way to achieve sustainable development of construction industry, with the continuous development of the construction industry and information technology, to promote vigorously integrated delivery IPD of the project as the core support of BIM, optimizing the use of BIM, which will greatly enhance the efficiency of the construction industry towards sustainable development goals [14]. Ma summarizes (1) BIM provides data storage exchange service for IPD. (2) BIM provides services for handling associated legal matters of IPD. (3) BIM provides services for design and construction tasks to complete IPD. (4) BIM brings about impact of organizational culture on the formation of IPD. It is very important to understand that IPD and BIM are two separate subjects: IPD is a new method of project delivery and BIM is the latest advancement in model-based technology. IPD can be performed without using BIM,and BIM can be used in projects that do not use the IPD method. However, the greatest benefits are realized when the IPD method is used for project delivery with BIM being used as a design and construction tool. IPD need related technical support carrying on effective exchange information between the parties beginning to work together in the early stages of the project. Due to historical reasons of the development of industry expertise technology, different party often uses different data storage format, which makes it very difficult to communicate on design results. says BIM technology has been able to provide open data storage exchange standards fortunately for users with various fields related to construction projects and data storage exchange service for IPD [15].

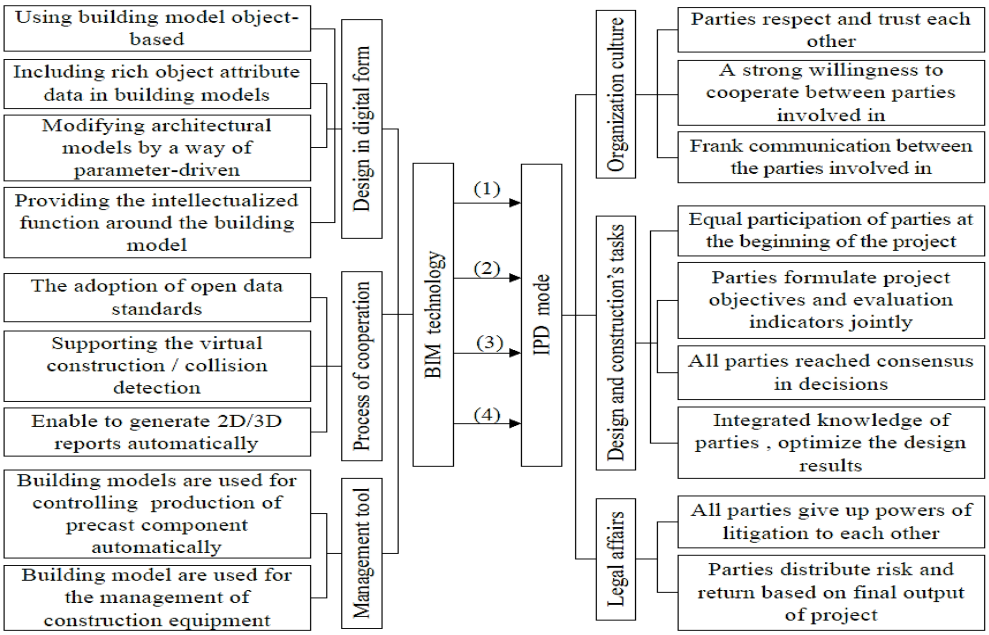

Figure 5: Application framework of BIM technology in the IPD;

(Source: Ma et al., 2014).

ADOPTING IPD FOR ENERGY-RELATED RISK MANAGEMENT:

One of the factors that contribute to the success of the project outcomes is related to good risk management and risks detected that could impact project's scope. Risk management is crucial part of the project management, and in the construction industry it is not an exception. Nowadays the world is demanding sustainable practices in every sector, the construction sector being one the most resource consuming one, needs to thrive towards sustainable practices. IPD promotes enhanced collaboration and integration that can make it a preferred delivery system for the energy-related risk management (ERM). In IPD, the alignment of shared risk and reward, early involvement of specialists, and improved team collaboration contribute to improving project outcomes [16], including sustainable values of building projects [1]. However, empirical evidence on the effectiveness of IPD in developing energy-efficient buildings has been limited, and only a few relevant studies have been identified [17]. The building industry would benefit from more evidence that features of IPD actually contribute to successful implementation of the ERM. In other words, the decision to apply IPD when developing energy-efficient commercial buildings must be supported by studies that present relationships between the features of IPD and their effectiveness in increasing energy efficiency (EE) financial values [18]. The study found that the collaborative IPD environment greatly helped the team to achieve the exceptional depth and breadth in applying the ERM to their decision making. Which identified the importance of considering the unique energy-related risk generated by dynamic uncertainty around EEMs, an under investigated topic in project management. It describes the use of ERM as a way to contribute to the current body of knowledge in project management and design management practices.

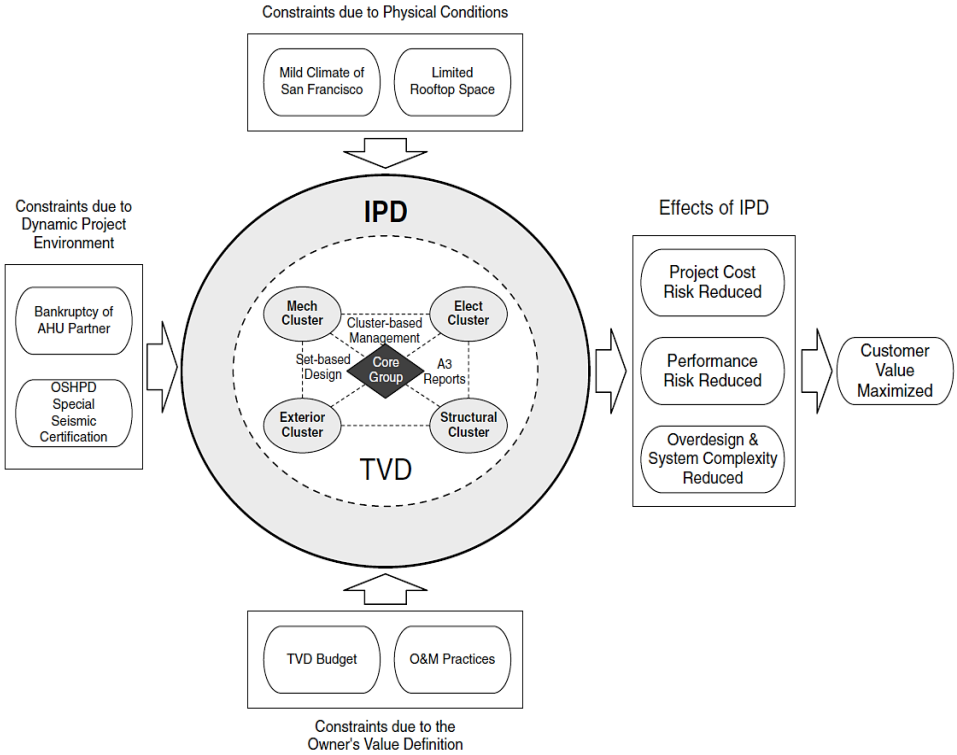

Figure 6: Effects of IPD in energy-related risk management practice

(Source: Lee et al. ,2013)

CONCLUSION:

IPD demonstrate superior performance in terms of quality, schedule, project updates, communication among stakeholders, environmental aspects, and financing in comparison with non-IPD projects. How to determine the risk/reward compensation system in the early project stages is a realistic problem in the engineering field that requires an urgent solution. The purpose of this study is to solve this issue. With the entire team aligned toward a common goal and working together, waste is reduced and efficiency is optimized. When using this kind of project delivery model, it's important to ensure that everyone is on board with the principles of IPD. While as a key technology of affecting the development of the construction industry, the appearance of BIM technology provides conditions for promoting the development and improvement of IPD and TVD is one of an important design process based on lean thinking. Working together, the design and construction tries to find innovation that can lower costs without compromising on scope or quality. Application of this technique promise to help the construction industry raise the number of successful outcomes by allowing the project team to effectively control project costs. IPD and Lean work hand-in-hand, IPD applies to the contractual multiparty agreements and Lean is the pathway to achieving it.

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