Pal, A. and Nassarudin, A. 2020. "Integrated Project Delivery Adoption Framework for Construction Projects in India." In: Tommelein, I.D. and Daniel, E. (eds.). *Proc. 28th Annual Conference of the International Group for Lean Construction (IGLC28),* Berkeley, California, USA, doi.org/10.24928/2020/0018, online at iglc.net.

INTEGRATED PROJECT DELIVERY ADOPTION FRAMEWORK FOR CONSTRUCTION PROJECTS IN INDIA

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ABSTRACT

The project delivery system and the contracting strategy adopted are the main governing factor that decides the success of a construction project in terms of time, cost, and quality. With the rising complexity of projects and stringent legal regulations, traditional practices turn out to be inefficient leading to disputes, cost, and time overruns. Integrated Project Delivery (IPD) system which is built on trust, collaboration, and pooled risk-reward sharing have been devised as an effective solution almost a decade ago. Despite its advancement, the adoption rate of IPD in India remains very low because of several reasons such as lack of awareness among the owners, the requirement of a new legal framework, unestablished BIM standards, and so on. This paper aims at proposing an IPD adoption framework for Indian construction projects by mapping the barriers of IPD implementation in India and the successful IPD implementation strategies adopted in developed countries. Selected literature consisting of published case studies of successful IPD projects, papers related to IPD implementation in India and, the IPD implementation guides, policy, and framework are utilized for this purpose. The framework proposes a step by step approach to effectively implement the IPD system in India.

KEYWORDS

Integrated Project Delivery (IPD), Collaboration, Lean Construction, Project Delivery System.

INTRODUCTION

Construction projects involve a great deal of capital investment, time, and resources, all of which are scarce and need to be utilized efficiently. Project success greatly depends on the chosen delivery system. The project delivery is a process, which involves the combination of the design and construction components such as, the activity sequence, roles and responsibilities, material costs, and workforce for the successful delivery of a project (Loulakis and Huffman 2000). The traditional delivery methods are found less effective in managing complex project issues like cost overrun, time overrun, disputes, etc. These methods also face many challenges in maintaining coordination and cooperation throughout the process (Shendkar and Patil 2017). It is high time to address those shortcomings.

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The introduction of Lean philosophy in construction production through Koskela and Ballard's lean construction movement (Ballard 2008) along with the contribution of the Lean Construction Institute (LCI) led to the development of lean project delivery systems (Raisbeck et al. 2010). Integrated project delivery (IPD) is a system that originated from a tradition in Japan known as "gentlemanly principles", which then emerged to take forms like "project partnering", "project alliancing" to finally emerge as IPD in North America (Lahdenperä 2012). It was introduced by the American Institute of Architects (AIA) in the year 2007 to address the issues of lack of collaboration and coordination among project team members.

The Indian construction industry is struggling to achieve the desired success by using traditional practices. According to PropEquity reports more than 4.65 lakh units of housing projects in India have failed in meeting the delivery deadlines because of construction delays. The total value of these projects is amounting to ₹ 3.3 trillion (46 billion US dollars) (Sharma 2018). At this same time, the adoption of a new delivery system like IPD has become essential. However, the AEC sector in India is facing various challenges for IPD adoption (Roy et al. 2018). One of the challenges is the non-availability of the IPD adoption framework specific to the Indian scenario.

Therefore, this study is aimed at developing a step by step IPD adoption framework for construction projects in India considering the challenges of IPD implementation in the country. As India is in the very early stage of IPD adoption, preparation for involvement and learning by involvement was encouraged through this framework. Existing IPD guides, policies, and lessons learned from successful IPD case studies from developed countries were considered as the source of information and knowledge.

RESEARCH METHOD

For this study, a thorough literature review approach was taken. The study was conducted in four steps. The first step was to understand the importance of IPD in the AEC industry. In the second step, the current IPD implementation situation in India was reviewed. The third step was focused on the lesson learned from successful case studies. And, the fourth and final step was to review the existing IPD implementation framework and propose a suitable IPD adoption framework for Indian based on the lesson learned from the case studies. The main source of information necessary for the study was identified to be the various research publications, journal articles, conference proceedings, and reports in the areas of IPD. Scopus database was primarily used for its wide variety of document availability. However, two major databases specific to lean construction namely, IGLC database and Lean construction institute database was used for more relevant documents. The lack of sufficient documents on IPD in India indicating its unfamiliarity in the industry. The case studies about IPD projects were the main tool for developing the framework. So, the selection of case studies was very crucial. Researchers found that the availability of success stories of IPD implementation was very limited (Roy et al. 2018). IPD research trend analysis by Kahvandi et al. (2017) concluded that the USA has taken the lead role in IPD implementation and possesses the maximum number of successful IPD projects. Another key consideration for choosing the case studies was the completion of the case projects. So, in this research, a total of 22 case studies across the USA and Canada was studied. 12 case studies were published by AIA in (2012) and another 10 case studies were published by the Lean construction institute (LCI) and Integrated project delivery alliance (IPDA) and compiled by Cheng and Johnson (2016). All the case projects were completed with successful outcomes before the reports were published. The

project type, the main problem addressed, challenges in implementation, and the solution formulated for solving the same is analyzed closely to find out the key success factors. The learnings are then used to relate to the challenges faced in IPD implementation in India to come out with a better solution by proposing a framework for the Indian construction industry.

ABOUT INTEGRATED PROJECT DELIVERY

IPD has been developed by AIA as an innovative and alternative project delivery system over the traditional ones to address the productivity issues in the construction industry. One of the earlier definition of IPD, as given by AIA, is "a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses 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" (AIA 2007). A more recent definition of IPD would be a method in which the key project participants are required to be involved in a relationship that is collaborative and mutually dependent, during the whole project lifecycle ranging from design till completion (Rahim et al. 2016).

The essential principle of a true IPD project is to optimize the project as a whole for which early and clear value definition and collaboration is needed, which arise out of trust, respect, joint ownership, integration, which in turn are fostered by transparency, safe environment, shared risk and reward combined with good technology (AIA 2007). Thomsen et al. (2009) defined the project delivery system as a combination of thee domains such as project organization, operating system, and the commercial terms. IPD tries to address the deficiencies in these three domains of a traditional delivery system and proposes a harmonic system. Some of the most common adjustments adopted in the IPD projects are multiparty agreements, early involvement of project stakeholders, risk-reward pool, Lean and BIM implementation, etc. (Kent and Becerik-Gerber 2010).

Unlike traditional systems, all the project participants get benefits in IPD, be it the owner, architect, and contractor. The project achieves desired success through cost and time optimizations and improved quality. According to Friedlander (2015), the owner gets benefits such as improved quality of construction through better collaboration and coordination, ease of budgeting through early cost determination involving a contractor who is better aware of the cost, improved flexibility in the procurement process, faster delivery with shorter time schedules, lesser disputes and claims due to elimination of "lowball bidding" and team building. The architects are benefitted with additional profits as a result of risk-reward pooling, better cost and time predictions for market advantages, increased control over construction, and reduced liabilities as a result of cooperative administration. While the contractor gets benefits through reduced overheads leading to profit gains, lesser chances of claims and litigations, better relation between subcontractors and suppliers, negotiated pricing compared to competitive bidding in traditional contracts. According to Cheng and Johnson (2016), the market advantage for architect and client, cost predictability through early cost determination, schedule predictability through detailed and collaborative planning, risk management through risk reward pooling, and the ability to simplify technical complexity are some of the advantages of IPD. Change orders in construction projects may affect the project negatively as it leads to cost overruns, delays, disputes/litigations, and decreased productivity. Collaborative construction systems such as IPD reduce the number of

change orders and hence minimize the negative impacts. Further, it gives better cost prediction and improved cost performance (Kulkarni et al. 2012).

LEARNING FROM CASE STUDIES

The analysis of the selected case studies adopted from (AIA 2012) and (Cheng and Johnson 2016) provided a deep insight into the successful IPD implementation in developed countries. The first thing that needs to be commented on is the willingness of all parties to collaborate. While few owners were experienced with lean or IPD others were taken initiatives to adopt and learn. Project participants were largely benefitted with continuous training and boot camps. BIM standards and BIM execution plans available in the country had made the project participants ready for implementing BIM and achieve seamless collaboration. The adoptive legal framework also eased the process of implementing new legal requirements for IPD projects. For effective implementation of IPD, policy formulation based on IPD principles were very useful. Early engagement of a team with mutual trust, respect, and a collaborative attitude was found to be at the core of the IPD success. The mechanism of pain and gain sharing, fiscal transparency, and open communication incentivized the collaborative culture. The common goal of all participants to project success had finally paid off through cost savings or time savings. Few tools and techniques were found very effective for knitting the team in one thread. The multiparty agreement was one of them. However, a few projects felt that a modification in the standard delivery method can also work for IPD. ConsensusDocs 300 and AIA versions of IPD contracts were found to be at the base of custom made multiparty agreements used in many projects. Few projects have very well documented the allocation of contingency and incentives into their contract document to avoid any future disputes. While BIM was mostly used for clash detection and collaboration purpose, information integration management platforms used in some projects were found very effective. Cheng and Johnson's (2016) team concluded that “IPD sets the terms and provides the motivation for collaboration; Lean provides the means for teams to optimize their performance and achieve project goals”. Lean tools were chosen inherently while the owners chose to implement IPD. Tools like the last planner system, target value design, A3s, big room for co-location, hurdle meetings, were found very effective. Table 1 represents a comparative analysis of case studies based on the effectiveness of the implementation of some key components of IPD. An exhaustive list of the lesson learned from the case studies is presented in table 2. The contribution of the lesson learned for the framework development is also mapped in the same table.

Table 1: Comparison of case studies: effective implementation of IPD components

Source	Case No.	Case Project Name	Country	IPD Awareness	Early Involvement	Project Aligned Goals	Team Building	Risk Reward Sharing	MultiParty Agreement	Lean Tools	BIM Implementation	Co-Location
(AIA 2012	1.1	Cathedral Hill Hospital	USA	✓	✓	✓	✓	✓	✓	✓	✓	✓
	1.2	MERCY Master Plan Facility Remodel	USA	⊘	✓	✓	✓	✓	✓	✓	✓	×

(Cheng and Johnson 2016)	1.3	Lawrence & Schiller Remodel	USA	✓	✓	⦸	⦸	✓	✓	×	×	×
	1.4	SpawGlass Austin Regional Office	USA	⦸	×	⦸	×	✓	✓	×	⦸	×
	1.5	Edith Green Wendell Wyatt Federal Building	USA	⦸	✓	✓	✓	✓	×	×	✓	✓
	1.6	Autodesk Inc.	USA	✓	✓	✓	×	✓	✓	×	✓	⦸
	1.7	Sutter Health Fairfield Medical Office Building	USA	✓	✓	✓	✓	✓	✓	✓	✓	×
	1.8	Cardinal Glennon Children's Hospital Expansion	USA	✓	✓	×	×	✓	✓	⦸	⦸	×
	1.9	St. Clare Health Center	USA	✓	✓	✓	✓		✓	✓	✓	⦸
	1.10	Encircle Health Ambulatory Care Center	USA	⦸	✓	✓	×	✓	✓	⦸	⦸	×
	1.11	Walter Cronkite School of Journalism	USA	⦸	✓	✓	×	×	×	⦸	✓	✓
	1.12	UCSF Mission Bay Medical Center	USA	✓	⦸	✓	✓	×	×	✓	✓	✓
	2.1	Akron Children's Hospital, Kay Jewelers Pavilion	USA	⦸	✓	✓	✓	✓	✓	✓	⦸	✓
	2.2	Autodesk Building Innovation Learning and Design Space	USA	✓	✓	⦸	⦸	✓	✓	⦸	✓	✓
	2.3	Mosaic Centre for Conscious Community and Commerce	Canada	⦸	✓	⦸	✓	✓	✓	⦸	⦸	✓
	2.4	Quail Run Behavioral Health Hospital	USA	✓	⦸	✓	✓	✓	⦸	✓	⦸	⦸
	2.5	Rocky Mountain Institute Innovation Center	USA	⦸	✓	⦸	⦸	✓	✓	✓	⦸	⦸
	2.6	St. Anthony Hospital	USA	⦸	✓	✓	✓	✓	✓	✓	⦸	⦸
	2.7	Sutter Medical Office Building: Los Gatos	USA	✓	✓	⦸	✓	✓	✓	⦸	✓	⦸
	2.8	Sutter Medical Office Building: Sunnyvale	USA	✓	✓	⦸	⦸	✓	✓	⦸	✓	⦸
	2.9	T. Rowe Price Owings Mills Campus Building 1	USA	✓	✓	⦸	✓	✓	✓	✓	⦸	⦸
	2.10	Wekiva Springs Center Expansion	USA	✓	⦸	✓	✓	✓	⦸	✓	⦸	✓

✓ = Effectively Implemented; ⦸ = Effectiveness to be improved; × = Insufficient information.

Table 2: Application of lesson learned in the proposed framework

Lessons Learned	Framework Component	Case Study Ref. No.
· Prior experience with IPD provides confidence in choosing it.	IPD Awareness	1.1, 2.2, 2.4, 2.7, 2.8, 2.10
· Owners should take initiative for adopting IPD, making organizational changes if required	IPD Awareness	1.2, 2.5, 2.9
· Continuous Training and experience sharing of IPD will change the mindset of people.	IPD Awareness	1.11, 2.1, 2.3, 2.5, 2.6, 2.10
· All project participants having similar BIM expertise would be beneficial.	BIM implementation	1.11, 2.1
· Tri-party arrangements are not necessary for IPD, especially for public projects, which would require a change in legislation to move away from existing contract structures.	Legal Framework	1.5

· IPD is most suited for large-scale, complex projects and has lesser value in terms of small-scale projects.	Project	1.6, 1.7, 1.9
· Healthcare projects have a lot of synergy with lean construction and IPD.	Project	1.8, 2.1, 2.4, 2.6, 2.7, 2.8
· IPD was a direct extension of the owner's lean culture	Preparedness	2.1, 2.3
· Lean and IPD mutually support each other	Preparedness	2.3
· The risk/reward pooling, fiscal transparency contributed to developing respect and trust among project partners	Mutual Risk & Reward	1.1, 2.2, 2.4, 2.6, 2.9, 2.10
· Value addition in IPD is realized through cost reduction	Mutual Risk & Reward	1.1, 2.1, 2.2, 2.7, 2.8, 2.10
· Despite the low-tech approach, the incentive system gave the contractors nothing to lose and everything to gain	Mutual Risk & Reward	1.8
· Transparency aligned goals and early involvement help in developing a collaborative culture.	Goal Formulation	1.2, 2.2, 2.4, 2.5, 2.7, 2.8, 2.10
· Effective project aligned goals were observed	Goal Formulation	1.2, 1.3, 2.1, 2.2, 2.3, 2.5, 2.7, 2.8, 2.9
· Open Communication and the notion of collaboration was encouraged	Open Communication	1.1, 2.1, 2.5, 2.7, 2.8
· Investment of time in the early phase of the project led to time savings in the latter part	Intensified Planning	2.1, 2.3, 2.6, 2.8
· In IPD, architect and builder must be selected carefully ensuring synergy between them.	Team Formation	1.6, 2.3, 2.4, 2.9
· Assigning responsibility for some activities to the single party will not affect collaboration negatively.	Team Formation	1.2
· Questionnaires could be used as a tool in selecting the team members	Team Formation	1.12, 2.9
· Choosing by Advantages (CBA) tool can be used or team selection	Team Formation	1.1, 2.1, 2.4, 2.10
· Formal team selection process like Request for Proposal (RFP) can also be used with criteria based on goals	Team Formation	1.5, 1.6, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8
· The contingency and incentive structure on IPD projects need to be better defined and adapted to achieve the desired behavioral goals from the team	Legal & Commercial Consideration	1.6, 2.2, 2.6, 2.7, 2.8
· The financial incentives recommended for IPD can be done with existing contract forms by using award term and milestone payments.	Legal & Commercial Consideration	1.5
· Appointing BIM superintendents on the field can help in the efficient use of BIM.	BIM	1.7
· BIM was effectively used for Coordination & Clash detection	BIM	2.1, 2.2, 2.4, 2.7, 2.8, 2.9, 2.10
· Daily huddle meetings help in coordinating activities effectively.	Lean Tools	1.2, 2.1, 2.6
· Co-location plays an important role in building trust and respect. Big Room found useful for Co-Location	Lean Tools	1.12, 2.1, 2.2, 2.4, 2.7, 2.9, 2.10
· Target Value Design/ Set-Based Design added value to the process	Lean Tools	1.1, 1.4, 2.1, 2.4
· Visual Management was found effective for communication & Control	Lean Tools	1.12, 2.1, 2.3, 2.4

• Last Planner System was effective for managing project schedule	Lean Tools	1.1, 1.2, 1.4, 1.7, 1.9, 1.10, 1.12, 2.1, 2.3, 2.4, 2.5, 2.7, 2.8, 2.9, 2.10
• A3s/ Plus Delta was used effectively for analysing issues	Lean Tools	1.1, 1.12, 2.1, 2.4, 2.5
• Multiparty or Poly party agreements were effective to bring all the stakeholders in the same page	Multiparty agreement	1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 1.9, 1.10, 2.1, 2.2, 2.3, 2.5, 2.6, 2.7, 2.8, 2.9

IPD IMPLEMENTATION SCENARIO IN INDIA

IPD implementation in India was found to be very limited because of various reasons. Two recent papers (Roy et al. 2018) and (Charlesraj and Gupta 2019) coded as 1 and 2 respectively, classified the challenges for IPD implementation in India into four major categories namely technological, legal, financial, and cultural. In these papers, they have identified critical IPD implementation challenges from previous literature published around the world, and then challenges most specific to the Indian construction industry were extracted through expert judgment and questionnaire surveys. Some of the most critical challenges in each category are as follows. Technical issues related to lack of clarity in the usage of BIM and early definition of goals in the absence of fully mature design were two of them. When it comes to legal, the need for a new legal framework for the value-based selection of contractors against traditional criteria of the lowest bid was observed. Devising a formula and accounting system for risk-reward sharing was found to be a major financial challenge. Culturally, the development of mutual trust and respect was the main challenge due to a lack of knowledge in IPD and lack of experience of working with each other. Reluctance to cultural change needed to be overcome to contractually and behaviourally implement IPD. Other challenges were lack of knowledge among owners, early involvement of stakeholders, and subjectivity in measuring quality for reward sharing. However one of the key limitations of both the papers was the non-availability of required solutions for overcoming those IPD adoption challenges. In the current paper, authors have taken a step ahead to propose possible solutions to the IPD adoption challenges in India by linking the lesson learned from the case studies of successful IPD projects in developed countries. The complete list of IPD implementation challenges in India extracted from the study of Roy et al. (2018) and Charlesraj and Gupta (2019), and the proposed solutions to those challenges can be found in table 3. Sarkar (2015) also tried to find out the factors affecting IPD implementation for a road construction project in India through a case study. However, most of the factors are found similar to recent studies.

Although IPD adoption in India was found to be challenging, one of the recently completed projects named Ramanujan IT city has made the Indian AEC practitioners hopeful for overcoming those challenges. In this project, the alliance method was adopted over traditional delivery methods. Project aligned goal of all parties, risk and reward sharing, no blame policy were some of the key features of the project. The project's success was evident from timely completion within the allotted budget (Chidambaranathan and Kumar 2017).

Table 3: Possible challenges & solutions for the implementation of IPD in India

Challenges	Source Code	Proposed Solutions	Case Study Ref. No.
Developing mutual trust & respect	1,2	The multiparty agreement, risk-reward pooling, and fiscal transparency have proven to develop trust & respect.	1.1,1.2, 2.2, 2.4, 2.6, 2.9, 2.10
Lack of experience working together and on IPD	1,2	Owners initiative in trying IPD on one of his projects to begin with	1.2, 1.8, 2.5, 2.9
IPD awareness & willingness among owners	1,2	The need for more IPD workshops and training	1.11, 2.1, 2.3, 2.5, 2.6, 2.10
Nature and Language of contract Document	1,2	A modified version of standard contract documents	1.5, 1.12
Multiparty agreement for project life cycle	2	Use of ConsensusDocs 300 and AIA versions of IPD contracts	2.1, 2.4, 2.5, 2.10
Lack of BIM standards and practices	1,2	Implementation of BIM standards and regulations regarding its use	1.7
Information integration and management systems	1,2	Adopt huddle meetings, big room & collaborative software platforms	1.2,1.5, 1.12, 2.1, 2.3, 2.4
The need to fully developed design for early target setting	1,2	Using BIM efficiently in the design phase	1.11
The requirement of a new legal framework	1,2	Develop a new legal framework for IPD	1.5, 2.2, 2.7, 2.8
Equitable distribution of gain and loss among team members	1,2	To be decided based on mutually determined performance goals, with a more precise definition of contingency	1.5, 2.2, 2.7, 2.8
No uniformity in the accounting system followed by owner, and other firms (designer, contractor, etc.)	1,2	Adopt a common accounting system for the project to be developed in earlier phases.	1.6, 2.2
Cost-based vs. Value-based selection	1	Change of owners & contractors' approach to projects.	1.8,1.9, 2.1, 2.4, 2.10
Involving subcontractors early in the team	1,2	Contractor to promote collaboration from sub-contractors' side	1.3,1.8,1.9
Client needs to be risk-tolerant and competent	1	Owners to take initiative	1.2, 1.8,1.7, 2.5, 2.9
Subjectivity in the measurement of quality	1	Use of Key Performance Indicators (KPIs)	1.5,1.6, 2.2
Lack of motivation for a common goal	2	The incentive system gave the contractors nothing to lose and everything to gain by finding and fixing clashes as early as possible	1.1, 1.8, 2.2, 2.4, 2.6, 2.9, 2.10
Resistant to change	2	Significant cost reduction and time savings can motivate for the change	1.1, 2.1, 2.3, 2.2, 2.6, 2.8, 2.10

PROPOSED FRAMEWORK

Considering the challenges faced by the Indian AEC industry for IPD adoption, based on the lessons learned from the case studies, and by reviewing the existing frameworks (Fischer et al. 2014; Yee et al. 2017) and guides (AIA 2007; AIA 2014; NASFA et al. 2010) an IPD adoption framework for Indian construction projects has been proposed as shown in Figure 1.

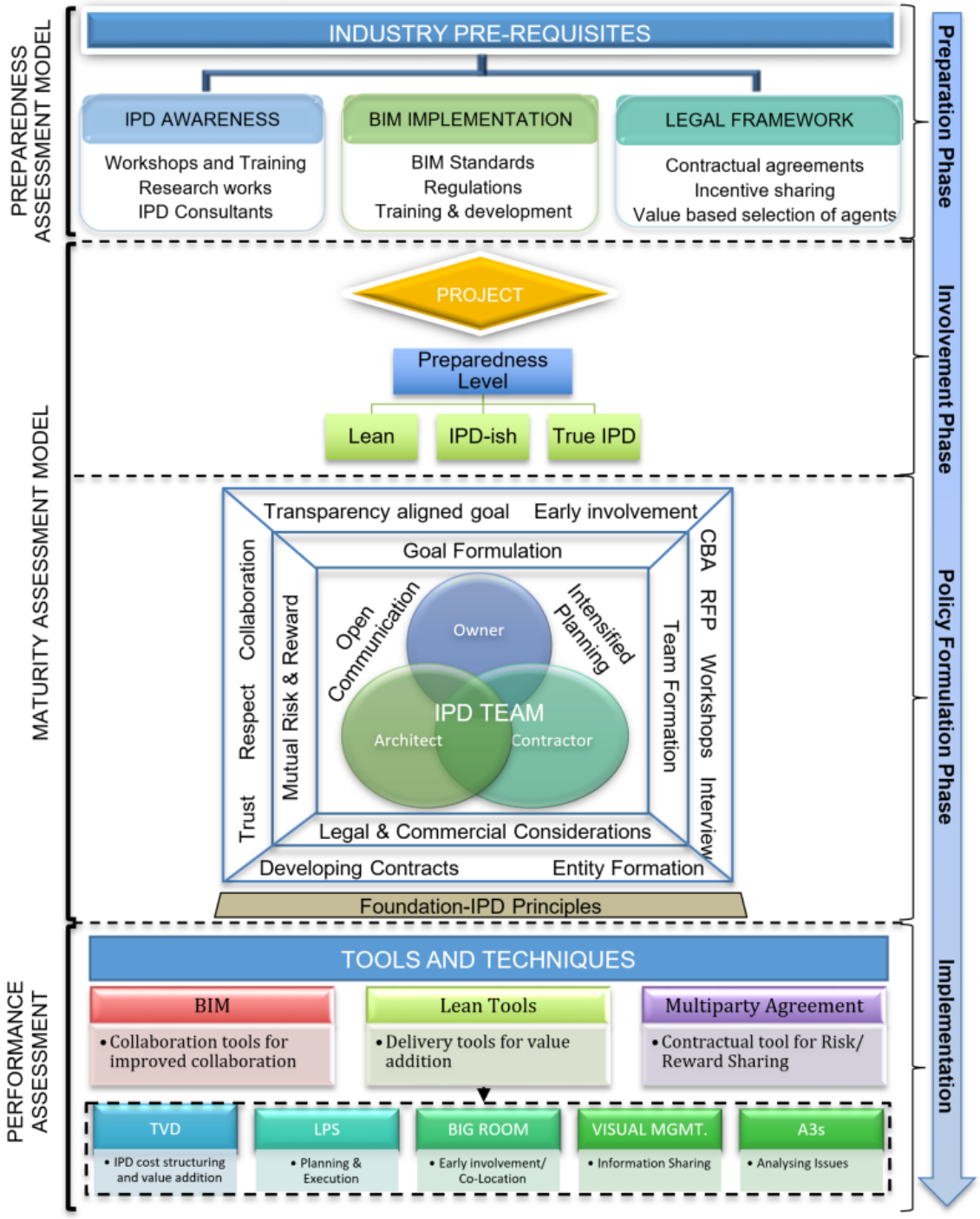

Figure 1: Proposed Framework for IPD adoption in India

PREPARATION PHASE

The framework suggests some pre-requisites to effectively implement IPD in India, which are IPD awareness among owners and industry experts, BIM implementation and a new legal framework to support IPD. As the construction industry in India is in the early phase of the change, the preparedness for IPD implementation needs to be monitored continuously through some preparedness assessment model. The requirement of IPD awareness is very essential as it can only motivate owners and other agencies to try IPD in their projects and thereby realize its benefits. IPD is all about collaboration and BIM is

an effective tool, which can help in achieving the same. Currently, the industry lacks standards and regulations regarding its use. BIM needs to be embraced to enjoy IPD benefits. The existing procurement systems make it difficult to implement some of the aspects of IPD like the value-based selection of contractors, risk-reward sharing, etc. This highlights the requirement of a new legal framework. Some case projects (1.5) highlighted that in case of public projects or government projects where there are restrictions regarding the agreements, IPD doesn't necessarily require tri-party agreements as it will require a legislation change to move from prevailing contract structures. The alternative to this is by use of milestone payments and award terms for the provision of financial incentives as recommended in IPD. This phase needs more attention form Indian AEC practitioners as India lacks preparation for IPD adoption

INVOLVEMENT PHASE

When it comes to consideration of a project for IPD implementation, the first thing to be decided upon is the level of integration aimed at. Based on the level of preparedness, the extend of IPD have to be determined. From the literature reviews, it was found that there are three levels of IPD implementation, first being adopting IPD as a philosophy in "lean construction" practices, the second one is "IPD-ish" where only some IPD principles are used in the project and the third one is the "true IPD" where all of the IPD principles and features of IPD is adopted (NASFA et al. 2010). The awareness about IPD benefits and change in the mindset of owners doesn't happen overnight, it takes time thus it is suggested that projects start adopting level 2 integration and start observing associated benefits and gradually move towards level 3 (NASFA et al. 2010).

POLICY FORMULATION PHASE

IPD principles (AIA 2007) should be considered as the foundation for policy formulation. The IPD team is captained by the owner who needs to take the initiative of adopting IPD and promoting collaboration, mutual respect, and trust among the team members. The team selection is very important for achieving the goals, the process should be based on the best value offered (CBA) than a cost basis. The process can involve Request for Qualification (RFQ) followed by Request for Proposal (RFP), IPD workshop, and finally an interview. The architect/designer should promote the use of BIM and other collaborative tools, further willingness to integrate is necessary. The contractor must embrace the IPD principles and should ensure collaborative efforts from the subcontractor's side by engaging them early in the project. The goal formulation must be transparent, and each member should be aware of the same. The team members should engage themselves in open communication and intensive planning for overall project success. The risk-reward sharing criteria and the contingencies should be clearly defined to avoid any issues later on (Edmonson and Rashid 2011). Legal and commercial considerations like contract selection, entity formation policy needs to be established in this phase. The level of maturity for IPD adoption needs to be assessed before moving to the implementation phase.

IMPLEMENTATION PHASE

IPD implementation is to be facilitated through various tools and techniques. These tools are divided into three types such as Collaboration Tools, Lean Tools, and contractual tools. BIM can be used extensively for seamless collaboration among the team members. Lean tools such as Target Value Design (TVD) helps in incorporating value, Last Planner System (LPS) is used to execute the project effectively, visual management tools can

improve the project information sharing system, A3s can help in analyzing the issues, Big Room is useful for co-locating the team members for improving collaboration and coordination. The team is bound through multi-party contracts instead of the owner having transactional contracts with each party. The standard contract forms could be used for this purpose or it could be modified and used to meet project objectives (Lahdenperä 2012). Owners can take advantage of ConsensusDocs 300 and AIA versions of IPD contracts for customizing the multiparty agreement terms. For deriving substantial IPD benefits, the framework suggests continuous assessment through performance assessment models. The details of the assessment models are out of the scope of the present study.

CONCLUSIONS

The understanding developed about IPD from the study indicates that IPD is only 20% technical and the rest 80% is about the culture. IPD advocates a change in the mindset of the stakeholders to collaboratively work for the good of the project. Implementing an integrated project requires commitment from all key stakeholders, for continuous collaboration from everyone and extensive owner involvement. Compared to traditional systems it requires a significant amount of upfront efforts from all participants, but it is worthy enough by helping deliver a high-performance building that is of value to all the stakeholders. A cultural and behavioral change is thus essential for implementing IPD.

A framework has been developed for the Indian construction industry as a result of the study conducted, which suggests IPD awareness, BIM implementation standards, and new legal framework as the pre-requisites for industry readiness. At the project level, the owner has the major role to play by taking the initiative and risk of trying it in the new projects. IPD is also about forming a highly synergic team, with the designer and contractor supporting the owner and showing the willingness to collaborate with mutual trust and respect. IPD implementation through this framework is expected to give market advantage to designer and contractor, cost, and time savings for the owner and a product of value to the end-users.

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