ASSESSING INTEGRATED PROJECT DELIVERY: A COMPARATIVE ANALYSIS OF IPD AND ALLIANCE CONTRACTING PROCUREMENT ROUTES

Peter Raisbeck[1], Ramsay Millie[1], Andrew Maher[2]

[1] *Faculty of Architecture Building and Planning, University of Melbourne, Australia*
[3] *Arup Australasia*

The proponents of Integrated Project Delivery (IPD) claim it can potentially achieve superior results over other procurement models. The American Institute of Architects defines IPD as: "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). This aspirational description suggests why IPD is said to be the next evolutionary step in collaborative contracting. In order to begin to assess these claims IPD is examined in relation to its theoretical sources and genealogy in lean construction, concurrent engineering and the collaborative structures of Alliancing. While fundamental similarities exist between Alliance and IPD procurement structures, improvements have been added to IPD contracts and processes which appear to respond to new technologies. These improvements include: Building Information Modelling (BIM) protocols, improved project management techniques to improve workflow and cost management as well as early stage collocation in a 'Big Room' environment. These innovations point to the need to understand the pre-conditions for IPD adoption: the take-up of BIM technology by contractors and sub-contractors and an understanding of IPD collaborative negotiations in practice. Whilst IPD is clearly a credible procurement model it requires further empirical and applied research in order to establish its widespread adoption.

Keywords: alliancing, integrated project delivery, procurement, project management, building information model.

INTRODUCTION

In theory IPD offers a number of potential improvements over existing models of procurement because it promotes a more collaborative and intense approach amongst stakeholders during the design phase. Variable outcomes, increased project size, complexity, time pressures and changes in technology have fostered a competitive landscape where new methods of procurement have been sought. The American Institute of Architects defines IPD in aspirational terms as: "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

[1] *raisbeck@unimelb.edu.au*

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efficiency through all phases of design, fabrication and construction" (AIA 2007). Key aspirations in developing IPD are to increase collaboration between project team members, align incentives to reward high-performing teams, integrate BIM technologies into contracts and ultimately increase Value for Money (VfM) for building owners. IPD is a significant new development in procurement innovation because it integrates design decision making, collaborative contracting and BIM technologies.

Many of the above theoretical concepts and aspirations are now embodied in IPD which emerged in practice following the 2007 publication of the IPD contracts developed by the California Council of the American Institute of Architects (AAIC) (AIA 2007). As a result IPD has been taken up and promoted in a number of projects ranging in cost from $12 million to $150 million. These include refurbishments, fit-outs and 4 new buildings. Notable amongst these are the Autodesk AEC Division HQ in Waltham MA, and the Walter Cronkite School of Journalism in Phoenix, AZ. A number of health buildings predominate including the UCSF Mission Bay project for the delivery of 6 medical buildings in San Francisco and the Sutter Fairfield Medical Office Building. This latter project is part of a much larger project that will deliver a number of facilities for Sutter Health in Castro Valley California.

On initial examination IPD appears closely related to the Alliancing model; a model championed earlier in the decade by a number of CM researchers in Australia and one which is now prevalent in the Australian context. Given this similarity, it is important to outline the common features and differences between these two procurement routes. For this reason, prompted by the above developments, what follows is a comparative analysis of IPD and Alliance structures. This outlines their commonalities and differences in order to conclude with a definition of IPD. Given that IPD is a model that has been designed to mandate the use of BIM technologies amongst both consultants, contractors and subcontractors this is discussed in detail.

The origins and emergence of IPD

IPD has parallels with Koskela's lean construction movement which has aimed to translate product manufacturing and production methods to construction. As Koskela outlines these methods originated in the Toyota production system developed in Japan in the 1950s. Specifically, the genealogy of these methods can be related to the production concepts of Just In Time (JIT) and Total Quality Control (TQC) (Koskela 1992). The Lean Construction Institute (LCI) which is a coalition of academics, consultants, large software vendors and contractors from different disciplines based in Southern California appears to be a key point for the transfer and dissemination of these ideas in construction. Moreover, many of the early documents about IPD appear to have emerged from the LCI via its journal (Matthews and Howell, 2005). Gregory Howell a co-founder of the LCI notes that the name IPD is trademarked in the USA and he notes that the term was first used by Owen Matthews of Westbrook Airconditioning in Orlando Florida well before 2005. (IPD is the trademark of Westbrook Airconditioning). Howell notes that IPD was not inspired by Alliancing but has much in common with it. Howell succinctly views Alliancing as "as a form of contract and organizational governance" and lean construction "as the operating system". In this view IPD can be seen as the combination of Alliance governance structures with lean construction operational systems. As Howell argues both Alliancing and IPD are in marked contrast to traditional procurement models. For example, Howell states that, "Traditional Project management, contracting and organizational practices attempt to optimize the whole by optimizing each piece –

lump sum contracting connected with centrally developed and managed Critical Path Method (CPM) schedules for best example. By contrast, Alliancing and design build contracting like partnering and lean construction optimize the project not the piece" (Howell 2010).

IPD has clear links to Concurrent Engineering (CE) theories. This also reinforces the between IPD and product manufacturing. As has been noted CE describes the "method of concurrently designing both the product and its downstream production and support processes" (Kamara *et al.* 2007: 1). This approach has parallels in the IPD early stage workshops and the use of collocation in a "Big Room" environment. As with IPD, central to the idea of CE is two guiding principles: "integration and concurrency". Integration, as an ideal, aims to share and transfer information and knowledge "between and within project stages and all of the technologies and tools used in product development process". Concurrency as an ideal also determines "the way tasks are scheduled and the interactions between different actors (people and tools) in the product development process" (Kamara *et al.* 2007: 1). As with IPD CE design processes require early stage briefing, analysis and consideration of lifecycle issues by multi-disciplinary teams (Kamara *et al.* 2007: 1). Koskela defines CE as "a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support (Koskela 2007).

The emergence and origins of alliancing

Alliance contracting was developed in the early 1990s for high-risk Oil and Gas projects in the North Sea, in particular the Andrew Drilling Platform project, to create a more collaborative work environment, and share project risks more evenly among project teams (Walker and Hampson 2003: 64). In 1994 the Wandoo Project 75 km northwest of Dampier, Western Australia was Australasia's first Alliance project. The project was to develop a drilling platform in 55 metres of water, and its owners Ampolex chose to develop this field under an Alliance contract. Several key management decisions enabled the success of the Wandoo Alliance. For example, Ampolex dedicated $1 Million to behavioural workshops, training and collaborative sessions. All parties agreed to shift from a confrontational approach for pricing, to a collaborative 'open book' policy. This was tested during construction, when there was a breech in the sea wall, and construction was brought to a halt. A solution was developed in under a week and construction resumed (Care 2009, Walker and Hampson 2003: 64).

In Australia, since Wandoo Alliancing has grown in increasing popularity as a viable procurement method. The National Museum of Australia which opened in 2001 is often cited as being the first Alliance project for a building (Manley 2002). This project has been the subject of much research as it was the focus of a funded research study between Queensland University of Technology, CSIRO and RMIT University. Earlier in the decade there was a vigorous research industry focused on Alliancing which included qualitative case studies surrounding the NMA project (Walker 2002, Walker and Keninger 2002) and following this a number of critical success factor studies (Jeffries 2006, Rowlinson *et al.* 2006). By 2010 a number of Australian government's had actively adopted Alliance contracting as a procurement method. Writing in a report for the Victorian Department of Treasury, Duffield reports that between 2004 and 2009 Alliances projects in Australia amounted to at least $AUD 32Billion (DTF 2009: 7).

ALLIANCING COMPARED TO IPD

Alliance contracting theory

At the heart of Alliance contracting theory is the notion of collaboration. This notion engenders some of the broad definitions of Alliancing. As Yeung *et al.* point out definitions of Alliancing are "hopelessley vague" as definitions of Alliancing abound from broad apsirational definitions to more specific definitions (Yeung *et al.* 2007). For example, Mistry and Davis, following Yeung *et al.*, define it as a "cooperative arrangement between two or more organizations working towards achieving common goals and objectives for a specific project (Mistry and Davis 2009). These definitions and features suggest that in the Alliance model there is a joint rather than a shared commitment between partners (Hampson and Walker 2003). Another important feature is the selection of an Alliance consortium which is achieved on the basis of performance criteria rather than through price competition alone (Hampson and Walker 2003: 63). For this reason the formation of the Alliance team is a critical decision point in the Alliance model. Selection is based on qualification and the builder is brought on board from day one. In theory this gives the owners or clients more control over critical areas such as budget, schedule, building functionality and sustainability features.

Alliance contracts fall under the general umbrella of collaborative contracting and can be described as Multi-Party contracts which are developed and executed by key project participants. In order to govern risk and reward allocation amongst participants the Alliance model is governed by a three '3 limb' compensation model (see Figure 1) which includes a 100% open book policy between the Alliance parties. In this model there is a fee to cover corporate overheads and normal profit. In theory, a gain-share pain-share regime rewards outstanding performance and the pain of poor performance is shared equitably among all Alliance participants.

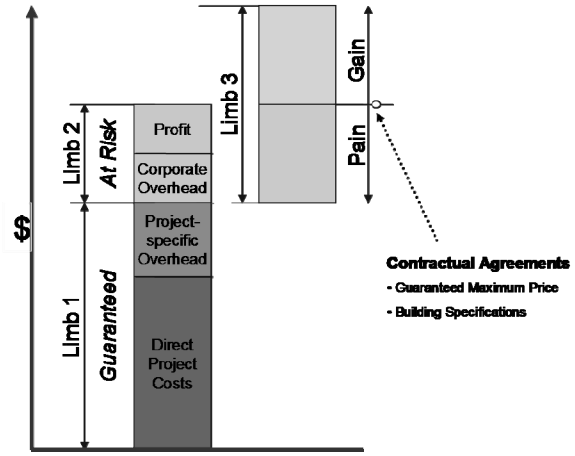

Figure 1 Alliancing (IPD similar) Pain/Gain-Share Concept

As with IPD, Alliancing has been subject to a number of aspirational claims about its potential benefits and as a panacea for the perceived ills that plague construction projects. Much of this rhetoric emanates from the ideal of collaborative contracting which is seen as being superior to adversarial procurement and price competition. Sometimes these aspirations take on a metaphysical tone. For example, Hampson and Walker claim the importance of "qualitative aspects of relationships" arguing that Alliancing is built on "team spirit" and is a procurement method where costs can be managed in an "atmosphere of trust and commitment" (Hampson and Walker 2003: 69). However, despite these sentiments recent quantitative research into Australian

Alliances by Duffield raises the question that other forms of procurement may provide a greater degree of cost certainty over Alliances (DTF 2009: 47).

IPD Contracting Theory

In many respects IPD is similar to Alliancing. Clearly, if the project is sent out for bid or tender, the project cannot be considered an IPD project. In IPD contractors, other sub-contractors, consultants and all parties agree to a Guaranteed Maximum Price (GMP) at the beginning of the process. The IPD project team is thus a multi-party network responsible for determining specific project cost targets in alignment with the owners project goals. This takes place in early stage workshops before the Multi-Party agreement is signed. Workshops typically take place off-site and representatives from all teams are required to attend. The workshop facilitator prompts the building owner to disclose the budget for the building project, in addition to other goals such as quality, functionality or sustainability. A GMP document (part of the AAIC IPD suite of documents) is carefully populated with the data resulting from these workshops and this a the GMP profit-risk sharing scheme is negotiated by the IPD team. Again this is similar, if not the same as, the Alliance model (Figure 1).

Under IPD the GMP limb risk sharing structure and incentive pool is set up at the beginning of the project. This pool serves as a benchmark for project team members. This pool is made up of the profits of the IPD contingency or a percentage of the profits for the IPD team, the designers, the contractors, and the major sub-contractors. If money is saved during the project the stakeholders can increase profits and the amount in the pool would get bigger. If risks are realized and money is lost on a job or if a sub-contractor depletes the pool then all stakeholders lose on the project. Under IPD if the pool is depleted to the maximum amount the owner pays beyond that.

IPD Early Stage Collocation and BIM

The above comparison points to the obvious similarities between IPD and Alliancing. However, there are a number of key points of difference between the IPD model and Alliancing. The most notable of these are collocation in a "Big Room" environment and the mandated use of BIM. An increasingly popular tool for scheduling collaboration in IPD projects are physical maps which allow project teams to discuss schedule sequencing as an integrated team in the "Big Room" environment. These maps appears to be closely related to Koskela's lean construction philosophy where construction processes are conceptualized as "flows". In the IPD model "value stream mapping" appears to have been borrowed and adapted to construction from Toyota's lean manufacturing process (Lichtig 2005, Khemlani 2009). As one IPD contractor noted: "You are pointing people to the number you need to achieve. You're setting up this dynamic process where you can all share in the cost of work savings and contingency preservation, but you're targeting a number and designing to that number. That's how the rest of the world develops products and now our industry is moving in that direction" (Carbasho 2008).

Table 1 Alliance and IPD comparison

Phase	Alliance	IPD	Traditional
Pre Design and Schematic Design	Team formation of client, contractor and main consultants based on performance and capabilities Cost estimation and and performance targets determined No Collocation	Team formation of client, contractor, consultants and sub-contractors based on performance and capabilities Cost estimation and and performance targets determined Collocation in a "Big Room" environment	Client and consultants (e.g. architect) No collocation Early cost estimation
Design Development	Use of BIM at discretion of stakeholders	Mandated use of BIM BIM integration with sub-contractors	Cost estimation
Construction Documentation	Use of BIM at discretion of stakeholder.	Mandated use of BIM BIM integration with sub-contractors	Cost estimation No integration with subcontractors
Bidding/Tendering	No bidding or tendering process GMP developed in SD stage	No bidding or tendering process GMP developed in SD stage	Tendering or Bidding Bidding costs incurred by contractors
Construction	Alliance Team Governance Conflict resolved within leadership team.	Alliance team Governance Conflict resolved within leadership team	Contract Governance Conflict resolved through adversarial negotiation
Post Construction	Profit distribution based on agreed formula No recourse to litigation	Profit distribution based on agreed formula No recourse to litigation	Adversarial negotiations Litigation a possibilty

The collocation and "Big Room" approach taken under IPD is similar in conception to NASA's Team X located at the Jet Propulsion Lab (JPL). Team X was the first concurrent engineering team in the aerospace industry: Since 1995 Team X has carried out over 800 studies, dramatically reducing the time and cost involved, and has been the model for other concurrent engineering teams both within NASA and throughout the larger aerospace community. Since its inception Team X spreadsheet-based tools have evolved from simple standalone engineering models into a networked spreadsheet intensive system with real time parameter updating (Warfield and Hinh 2009).

IPD and BIM

Another feature of IPD project is the mandated use of BIM under the IPD contracts that have been developed by the AIACC. In theory, this helps to further phase integration in the design and construction process. A project's BIM platform compliments the project management tools set forth in the IPD documents by enabling collaborative meetings where the model is shared and virtual co-ordination. Detection of uncoordinated elements, trades and services can take place earlier to resolve issues before building components are assembled on site. It is claimed that this process alone is said to have incredible cost savings for building owners because issues are resolved virtually rather than in physical form on site. By contrast, in earlier Alliancing case studies Information Systems tended to be seen simply as means for communication amongst project stakeholders. For example, Hampson and Walker *et al.*, emphasize

the use of intranet and project collaboration and proprietory web solutions such as ProjectWeb in their study of the New Museum of Australia. (Hampson and Walker *et al.* 2003:132).

In IPD BIM is the fundamental platform which enables 3D model integration and data sharing between team members. In the IPD model BIM technologies sit above an intranet which serves as the project's base IT infrastructure. It is then digital modelling which drives innovation in the project. To this end the IPD documents crafted by the AIACC mandate and promote the full scale implementation of digital technologies. For example, contract E 202 2008, the BIM Protocol Exhibit, explicitly encompasses a range of acceptable uses for BIM including: model ownership, responsibilities and authorized uses covering cost estimating, construction scheduling, documents, shop drawings and project adaptations (Table 2). Model ownership is established in early stage workshops and is critical to the success of the project. Participants' capability to take a model to a given level of detail – from '100 level' to '500 level' is also considered at this stage. The team member with the strongest BIM capability will often be assigned 'Model Owner', regardless of their role on the team or parent organization. Under IPD if the model is inaccurate all parties share the risk. Other features such as schedule sequencing and cost estimating is tied to the 3D model and continuously updated to reflect the estimated cost of the proposed design. This information allows IPD designers to consider multiple streams of information while crafting a preferred design. In IPD projects "Clash Meetings" are held weekly to determine if there are any issues in the placement of building systems. Therefore under IPD a BIM model is used to update data continuously so that all project teams are working from the latest version.

Discussion

The above would suggest that IPD might easily be seen as a procurement model which updates the Alliance model in light of advances in information technology. But this also needs to be considered alongside concepts of risk. It is a common mantra in procurement studies that risks should be allocated to those parties best able to manage them. However, under IPD there is no individual allocation and subsequent quarantining of risks between parties. From this perspective IPD can be defined as a procurement model in which risks are allocated jointly to all project parties and this joint allocation of risk is governed collectively. Risks are then managed through contracts which mandate the joint use of BIM amongst project parties. In other words, allocation of these risks, as they unfold as either profits or losses, is determined by the projects governance group and this also has a technological underpinning. This definition suggests that the definition and analysis of procurement routes should take into account technology as well as issues of risk allocation. Indeed, it is the mandated use of BIM technologies which positions IPD as a more advanced procurement model than Alliancing. From this point of view it is easy to see why a number of large software vendors have promoted the IPD model. It also suggests why IPD can be seen as, simply for some sceptics, Alliancing with a BIM operating system grafted onto it (Table 2).

Table 2 (Example of AAIC contract E 202 2008, the BIM Protocol Exhibit)

Level of detail and model content and authorized uses.	**100**	**200**	**300**	**400**	**500**
Design and Coordination (function / form / behaviour)	Non-geometric data or line work, areas, volumes zones, etc.	Generic elements shown in three dimensions - maximum size and purpose	Specific elements Confirmed 3D Object Geometry - dimensions - capacities - connections	Shop drawing/ fabrication - purchase - manufacture - install - specified	As-built - actual
4D Scheduling	total project construction duration phasing of major elements	Time-scaled, ordered appearance of major activities	Time-scaled, ordered appearance of detailed assemblies	Fabrication and assembly detail including construction means and methods	
Cost Estimating	Conceptual cost allowance Example $/sf of floor area, $/hospital bed, $/parking stall, etc.	Estimated cost based on measurement of generic element. E.g., generic interior wall.	Estimated cost based on measurement of specific assembly. E.g., specific wall type.	Committed purchase price of specific assembly at Buyout.	Record costs

Nevertheless a number of questions and challenges still remain. Firstly, IPD presumes that clients can make a sophisticated decision to opt for a multi-party contract. This is difficult if either clients, architects and or project mangers feel that price competition is still a superior process to deliver VfM. IPD proponents presumes that the processes of collocation and the early stage workshops in the "Big Room" environment will change negotiation behaviours for the better. But as IPD sceptics argue IPD may no longer seem promising as soon as a large problem takes place on an IPD project and this is tested in court via litigation. In the California context, where a handful of IPD projects have shown promising results, for some participants in the construction industry close collaboration between contractors, architects and owners will be too much of a cultural change (Post 2010).

IPD also presumes that all the parties to this contract will have the same IT capabilities and in practice clients, sub-contractors and indeed contractors have varying BIM and IT capabilities within their organizations. Further research could analyse the different factors between project partners which might inhibit the take up of IPD. The project management techniques associated with IPD such as, collocation, the mapping of construction flows and the "Big Room" environment seemingly adopted from the aerospace industry deserve further empirical observation and investigation. More comprehensive research could ascertain how these operational strategies developed in Aerospace could or could not be used in construction. Once more IPD projects are completed the dynamics of IPD negotiations and governance also require further research. For example, how is the GMP negotiated and how does this differ form traditional price competition? In light of how much has been written about collaborative contracting, at the very least, further investigation might gather

quantitative data gained from IPD practice in order to evaluate the actual VfM outcomes of IPD projects.

CONCLUSION

While collaboration and behavioural change are central to the IPD set of values, the use of digital technology via BIM and its incorporation into IPD contracts is a key factor which differentiates IPD from Alliancing. Alongside this IPD proponents argue that an IPD project team aspires to two important goals: Firstly, although it perhaps goes without saying, to deliver high quality projects on time and within budget and to reduce errors and omissions. Secondly, IPD as with the Alliance model, seeks to redefine and change traditional or adversarial behaviour. Despite these goals it remains to be seen if this model will become a widespread procurement model in the future. If IPD is to be taken up by owners, clients, architects, engineers and contractors as a distinct procurement model then empirical research into its dynamics and outcomes must go beyond limited qualitative research and aspirational statements.

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