Understanding Construction Industry Experience and Attitudes toward Integrated Project Delivery

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Abstract: Integrated project delivery (IPD) seeks to improve project outcomes through a collaborative approach of aligning the incentives and goals of the project team through shared risk and reward, early involvement of all parties, and a multiparty agreement. Although there has been a huge interest in IPD in principle, the current adoption status by the construction industry is unknown. Several professional organizations are supporting the advancement of IPD, and several projects have demonstrated its benefits; however, the amount of projects using IPD remains relatively small. This research is based on the results of a web-based survey that was designed to target a wide range of construction professionals in an effort to shed light on current status of IPD use and its future widespread adoption by the construction industry. The paper attempts to provide hard data concerning the knowledge and experience levels of construction professionals regarding IPD as well as their opinions concerning its benefits and problems as a project delivery method.

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Introduction

Public procurement policies since the 1940s have greatly embraced design-bid-build, making it the most widely used project delivery method in the United States for the majority of the 20th century (Miller et al. 2000). As buildings have become more complex, the construction industry has become more specialized, segregating a process that was formerly directed from inception to completion by one master builder. This approach resulted in the formation of multiple cultures within the industry, causing inefficiency, high levels of fragmentation (Department of Commerce 2004), and high costs of inadequate interoperability (Gallaher et al. 2004). Construction management (CM) was introduced in the 1960s as a solution to these problems and has been providing value to owners ever since (Tatum 1983) but has not changed the underlying problem of fragmented project teams and information. In the 1990s, design-build was established. Shortly after its inception, a study was conducted gathering empirical evidence that showed design-build could improve the cost, schedule, and quality of building projects over traditional delivery methods (Konchar and Sanvido 1998). During the same time that design-build was being developed in the United States; a delivery method known as project alliancing was being used successfully for a number of infrastructure projects in Australia (Noble 2007). This delivery method seeks to improve project outcomes through a collaborative approach of aligning the incentives and goals of the team [Australian Department of Treasury and Finance (ADTF) 2006]. Project alliancing is the model for a new project delivery method that has recently emerged in the United States, commonly referred to as integrated project delivery (IPD).

Among other applications, IPD has materialized as a delivery method that could most effectively facilitate the use of building information modeling (BIM) for construction projects. BIM is the development and use of a computer software model that is data-rich, object-oriented, intelligent, and parametric digital representation of a facility used to simulate the design, construction, and operation of that facility [The Associated General Contractors of America (AGC) 2006]. BIM is not only a tool but also a process (Eastman et al. 2008) that allows project team members an unprecedented ability to collaborate over the course of a project from early design to occupancy. Like project alliancing, IPD attempts to create the collaborative atmosphere required for the most comprehensive use of BIM by aligning the goals of all team members and incentivizing them to work closely together throughout all phases of a project. The coupling of BIM with IPD enables a level of collaboration that not only improves efficiency and reduces errors but also enables exploration of alternative approaches and expansions of market opportunities (Middlebrooks 2008).

Although several professional organizations are supporting the advancement of IPD [AIA California Council 2007; The Associated General Contractors of America (AGC) 2009] and several projects have demonstrated its benefits (Post 2007; Matthews and Howell 2005), the amount of projects using IPD remains relatively small (Post 2007; Sive 2009). There are several reasons for slow adoption. Among these are high degree of concern regarding risk in relation to IPD and the close partnerships it necessitates and need for new legal frameworks to match new IPD approaches. Moreover, many industry stakeholders feel that there is a need for those within the industry to assimilate new competen-

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cies and skills relating to collaboration and information management to support IPD (Autodesk White Paper 2008). Yet, there has not been any significant research investigating the current adoption status and causes of slow adoption of IPD in the industry (Sive 2009).

This paper attempts to provide hard data concerning the knowledge and experience levels of professionals in the construction industry regarding IPD, as well as their opinions concerning its benefits and problems as a project delivery method in an effort to shed light on the future of IPD use and what it would take to achieve widespread adoption by the industry. First, IPD is defined for the purposes of this study. Second, research methodology is explained. Analysis of the survey responses and discussion of the results follow. Finally, recommendations are made for education and future research projects regarding this topic, and findings are summarized in the concluding remarks.

IPD and BIM

The American Institute of Architects (AIA) 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 project participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction" (AIA California Council 2007). Professional organizations such as AIA and Associated General Contractors of America (AGC) are establishing standards, disseminating guidelines and facilitating discussions within their memberships that highlight successful projects and consider the obstacles to adoption. Most notably, the AIA has published a handful of documents with the purpose of defining IPD and providing information about how its principles and techniques can be applied to construction projects (AIA 2008). ConsensusDOCS, an organization that is established by 22 leading construction associations, published a consensus set of IPD contract documents (ConsensusDOCS 2009). The ConsesusDOCS 300 was the first standard construction contract to address IPD and continues to be a multiparty IPD agreement (Perlberg 2009a). Integrated form of agreement (IFOA) is a relational IPD contract (Lichtig 2005, 2006) that creates the contractual and financial framework to facilitate the effective collaboration between construction project participants (Parrish et al. 2008).

Despite these efforts, there does not exist a standard definition of IPD that has been accepted by the industry as a whole. Different definitions and widely varying approaches and sophistication levels mean that the term "IPD" is used to describe significantly different contact arrangements and team processes (Sive 2009). There are, however, consistent similarities that have been found within most IPD projects and definitions. In the context of this paper, the writers use the following common principles to define IPD: (1) multiparty agreement; (2) early involvement of all parties; and (3) shared risk and reward. It is generally accepted that not all of these principles are necessary in order to constitute IPD. Similarly, there are other principles that may be regarded as important for project success, but the three named principles have been selected due to their integral nature and inclusion in the majority of IPD projects and literature supporting IPD.

Multiparty agreement: In traditional project delivery, the owner typically has a separate contract with the architect and the general contractor. When IPD is used, there is typically one contract for the entire project that is entered by the owner, architect, general contractor, and any other party who may have a primary role in the project. The primary goal of IPD is to maximize collaboration and coordination for the entirety of the project, and these contracts are the vehicle that allows these goals to be reached successfully without being complicated by separate contracts that create opposing motives.

Shared risk and reward: Most existing IPD contracts include elements that are designed to encourage teamwork and promote the success of the project rather than any specific team member. Unlike traditional projects where each party typically takes careful steps to minimize their own risk, IPD contracts combine the risks and rewards of all team members and incentivize collaboration in order to reach common project goals. These goals may vary but are usually associated with cost, schedule, and quality metrics commonly used to measure project success. An example of an associated risk includes covering budget overages with each entity's overhead and profit, but if the project is under budget the team may receive a compensation bonus. The following risk/reward sharing methods are found in literature:

- Based on value—incentivizes the project team by offering a bonus linked to adding value to the project;
- Incentive pool—reserves a portion of the project team's fees into a pool that can increase or decrease based on various agreed upon criteria before being divided up and distributed to the team;
- Innovation and outstanding performance—in which the team is awarded for hard work and creativity;
- Performance bonuses—provides an award based on quality; and
- Profit sharing—in which each party's profit is determined collectively rather than individually.

Early involvement of all parties: One of the most fundamental advantages that IPD affords is the ability for all parties to be present and involved with a project from the earliest design phase. Early collaboration, under the right conditions, can directly address the problem of fragmentation between design and construction professionals that results in inefficient work practices and costly changes late in the construction phase. While it is important to recognize that this early collaboration does not require the use of technological tools such as BIM, these tools can greatly increase the efficiency of collaboration throughout all phases of a project.

BIM is poised to revolutionize the construction industry because of its promise to radically improve collaboration among the wide ranging and expertise needed to design and construct a building and to increase efficiency (Bedrick and Rinella 2006). However, the perceived legal risks of moving from a two- to a three-dimensional (3D) industry are a major stumbling block for many companies to move aggressively into BIM (Perlberg 2009b). The absence of standard BIM contract documents and issues arising from how BIM is used as a collaborative framework are two major obstacles to fully adoption. Business models and contract relationships to reward "best for project" decision making should be established for widespread BIM adoption (Ashcraft 2008). There are also some constrains and difficulties of applying IPD. While new contracts supporting IPD exist, they have not been tested over time and are not fully proven or even understood. Also, the insurance industry does not yet have coverages for IPD. More important, construction industry firms are accustomed to traditional way of leadership, responsibility, and opportunity, and change is slow. Public institutions and agencies lack the authority to restructure their procurement processes to enable the IPD model. However, if implemented successfully,

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IPD can facilitate sharing of rewards and risks among stakeholders, create incentives for exceptional results, reduce operational and maintenance costs of the finished project, improve project delivery timelines, and reduce waste through better planning and shared costs (DeBernard 2008).

Research Methodology

Interviews

A significant amount of the information for this research was gained from interviews, which were conducted with 15 construction industry professionals that are all knowledgeable and/or experienced with IPD. The interviewees were initially selected from AIA's IPD Steering Committee, who referred the writers to other professionals that are experienced on the topic or involved with past or current IPD projects. All formal interviews were conducted over the phone, with three resulting in face-to-face interviews. The process of developing and conducting interviews took about nine weeks between January 28 and April 1, 2009. Interviews were conducted for two main purposes: to attain general information about IPD and its current use within the construction industry and to develop the appropriate constructs for the survey instrument. As a result of these interviews, it became obvious that there are little empirical data regarding IPD application and use in practice. In addition to the typical literature review, the qualitative survey in this research to garner initial data about practitioners' perceptions was needed. Results of the interviews were used to develop questions for the survey contained in this paper.

Survey

Purpose

The online survey was designed to target a wide range of professionals in the construction industry and to determine the level of awareness, experience, and interest of the respondents regarding IPD. The goal of the survey was to answer the following questions:

1. What is the current status of IPD adoption throughout the construction industry?
2. What are the knowledge and experience levels of each of the different stakeholders in the construction industry regarding IPD?
3. Are the various industry players satisfied with traditional delivery methods and do they see a need for integrated delivery methods?
4. What factors attribute to the success or failure of IPD projects?
5. Does experience with IPD affect the attitudes of industry professionals toward this delivery method?
6. To what degree is BIM an integral component of projects that have used IPD?

Development

Survey questions were developed with information attained from interviews, general research, and literature reviews. The writers underwent five weeks of iterations regarding the type, amount, and configuration of questions between February 6 and March 13, 2009. A sample group from initial interviewees was chosen to test the appropriateness of the developed survey and to validate survey questions and choices. The results were primarily analyzed for clarity check and data clustering. The intent of the survey was to attain information from individuals that are from the different disciplines of the construction industry. The survey breaks into three tracks of questions directed toward three different groups of respondents: those who are experienced with IPD (Group 1); those who are inexperienced though informed about IPD (Group 2); and those that are inexperienced and unfamiliar with IPD (Group 3). Many of the same questions were possessed to each group in order to determine if there is a difference in attitudes between those who are experienced (Group 1) and inexperienced (Group 2) with IPD. The greatest amount of questions is directed toward Group 1, which considers specific aspects of IPD as they are applied to actual projects. The survey was designed with a set of "logic" rules built into it. Two key questions facilitated the separation of three groups. These are as follow: "Are you currently (or have you in the past) been involved with a project that utilized IPD or some form of collaborative agreement?" and "Are you familiar with the basic principles of IPD?" Based on respondent's answer to these questions, the survey administration tool automatically took them to the next set of questions.

Administration

The survey was hosted on https://new.qualtrics.com/ through an account funded by USC Viterbi School of Engineering. This web-based survey tool keeps a record of the computer's IP address from which the survey was completed and assigns an ID to each respondent. IP addresses and respondent IDs were downloaded and were checked for repeated entries and multiplicity. Qualtrics' analytical tools were used to analyze survey results.

Distribution

Distribution was primarily directed toward owners, architects, engineers, general contractors, and construction managers. In order to garner the maximum participation from the industry, the survey was advertised in two different ways: via direct e-mail through distribution lists of several professional associations [The Southern California Chapter of Construction Management Association of America (CMAA), BuildingSmart Alliance, and AGC Project Delivery Committee] and via variety of media outlets including various industry groups and organizations associated with BIM and IPD (BIM Forum and Linkedin.com groups: BIM Experts and Collaborative BIM Advocates). No personalized and direct e-mails were sent. Since the survey was available to the entire industry, it is hard to determine the sample size. There are 415 respondents to the survey, which are adequately spread between disciplines to show trends within the industry. The findings of the survey represent useful information about the respondents and the topic as well as show trends within the industry. Although the survey was open for six weeks between March 18 and May 1, 2009, 53% of the total responses were recorded on the same days that the distribution e-mails were sent.

Survey Findings

Considered in this analysis are the following disciplines each consisting of at least 10% of the total survey respondents: construction managers (38.1%); general contractors (18.3%); architects (17.3%); engineers (12.8%); and owners (10.6%). These next disciplines consisted of 5% or less of the total survey respondents: facility managers; technology representatives; developers; suppliers; and manufacturers. Based on the detailed personal information provided, respondents were categorized into the following

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profile groups: executives (25.7%); senior management (38.2%); and junior staff (36.1%). Almost two-thirds of the respondents were in top management. This could be due to the top management's interest in the topic as well as the nature of questions in the survey. Results were analyzed based on different seniority groups; however, no major differences were found. 98.8% of the respondents were based in the United States and participated from 30 different states. The most frequent response by state was from Calif. by 35.9%.

One of the first questions asked was if respondents think that projects in the construction industry are delivered in an efficient manner or not (Fig. 1). Overall, 65.9% think construction projects are not delivered efficiently. 84.1% of the architects, 72.2% of the general contractors, 61.6% of the construction managers, 59.6% of the engineers, and 51.2% of the owners think that construction projects are not delivered efficiently. It is important to note that owners are the most optimistic group among the five disciplines. Broken down, 68.2% of the respondents in Group 1, 76.7% of the respondents in Group 2, and 48.5% of respondents in Group 3 think that construction projects are not delivered in an efficient manner. It is interesting that respondents who are inexperienced with or uninformed about IPD are unsure (23.2% of Group 3) if construction projects are delivered in an efficient manner compared to the rest of the groups. Overall, this finding confirms that the perception of the industry players in 2009 regarding efficiency of construction project delivery is aligned with the findings of the study completed in 2004 (Gallaher et al. 2004).

In the following sections, IPD experience and awareness among respondents is analyzed, characteristics of IPD projects are identified, and issues around IPD are discussed. Since owners have the most say on whether IPD projects are adopted, the perception of this particular group is singled out and highlighted when appropriate.

IPD Experience and Awareness

Overall, 44.7% of total respondents have experience with IPD (Fig. 2). The rest of respondents (55.3%) are inexperienced, saying they have not been involved with an IPD project. 55.1% of those inexperienced respondents are, however, informed about IPD (30.6% of all respondents). The remaining 44.9% are both inexperienced and uninformed, which consists of 24.7% of the total amount of survey respondents. No further analysis of this group is conducted in this paper. The results show that the majority of the respondents either do not have direct IPD experience or is not familiar with IPD concepts. This is an important finding, which suggests despite the best efforts of professional organizations, there is still a need for professional development and education on the topic as one-forth of the respondents are uninformed about IPD. However, it is also promising that slightly less than half of the respondents have some sort of first hand IPD project experience. The following analysis demonstrates how responses from the experienced and informed groups vary based on respondents' occupation, the size and revenue of their firms, and their experience with other project delivery methods.

Occupation: Architects were the most experienced discipline with IPD at 58% and also the most informed discipline about IPD at 86.2% (Fig. 3). Slightly more than half of the general contractors (51.4%) polled claimed to have experience with IPD. The least experienced appears to be owners (30.2%), engineers (36.5%), and construction managers (42.0%). General contractors also seem to be highly informed (68.6%), and then engineers (54.5%), construction managers (42.9%), and finally owners are the least informed at 34.3%. Interestingly, owners seem to be the least experienced and informed about IPD. Since this group tends to have the most influence on the type of delivery method to be used on their projects, this could be one cause for slow industry adoption.

Firm size: The number of employees at a firm does not have a significant effect on IPD experience or on how informed respondents are about IPD. Survey respondents were given a choice of seven incremental groups ranging from "under 50" to "2,000 or more" employees. With the exception of two groups, all percentages are within 3% of the overall 45% of experienced respondents. The two exceptions are respondents who work for firms with 50–100 employees (38.8%) and firms with 500–1,000 employees (34.6%), which do not appear to be of great significance, since an overall low deviation spans from the smallest to the largest firm sizes. With the exception of a slightly low percentage for firms with 50–100 employees (40%) and a high percentage for firms with 100–300 employees (75.8%), all other groups are within 2% of the overall 55% of informed respondents.

Firm revenue: When considering the respondent firms' size by the previous year's revenue, there appears to be slightly less experience among the respondents that work for midsized firms (Fig. 4). 53.8% of respondents from firms with under $100,000 revenue have IPD experience and around 48.3% (average) from firms whose revenues were $10 million or greater. Of the groups whose revenues were between $100,000 and $10 million, only 36.5% (average) are experienced. Respondents from firms with revenue under $100,000 are substantially less informed about IPD than the rest. The remaining categories stay around the overall inexperienced informed respondents, with the exception of respondents who work for firms with $10 million to $100 million; 63.4% of this category is informed about IPD.

Experience with other project delivery methods: Fig. 5 shows the overall percentages of all respondents and the percentages from Groups 1 and 2, who have experience with different delivery methods. It is interesting to note that experience level with IPD increases with the level of experience with nontraditional delivery methods. Comparing informed respondents' experience (Group 2) on other project delivery methods shows similar results as the comparison with experienced respondents (Group 1). However, when all respondents are taken into account, the construction industry participants, in general, are less experienced with nontraditional project delivery methods when compared to the groups experienced with and informed about IPD.

Characteristics of IPD Projects

Survey participants with IPD experience were asked to consider a specific IPD project while answering a series of detailed questions regarding IPD principles. The purpose of these questions is to verify whether or not these projects are actually being delivered in the same manner as described in prevalent literature on the topic and also to ascertain the attitudes and opinions on IPD from the professionals delivering the projects. IPD project characteristics and the benefits observed on IPD projects as well as the same three topics discussed above were covered in these questions: (1) multiparty agreements; (2) early involvement of all parties; and (3) shared risk and reward.

Multiparty Agreements

Background research revealed the following three contract models to be the most widely available IPD agreements for construction projects: (1) IFOA; (2) ConsensusDOCS 300; and (3) AIA's

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Table 1. Involvement of Project Team Members during Stages of a Project

	Preliminary design (%)	Early design (%)	Design development (%)	Construction (%)	Closeout (%)	Facility management (%)
Owner	94.3	85.8	84.9	82.1	72.6	71.7
Architect	92.3	89.4	92.3	82.7	67.3	15.4
Engineers	71.0	86.9	91.6	85.0	60.7	19.6
General contractor	46.7	69.2	82.2	89.7	76.6	23.4
Subcontractors	17.1	41.9	72.4	89.5	67.6	22.6
Manufacturers/suppliers	11.8	41.2	74.5	87.3	48.0	23.5
Specialty consultants	43.1	69.6	83.3	79.4	46.1	28.4

transitional agreements or single purpose entity agreement. Based on the survey results (Fig. 6), AIA contracts are the most widely used at 28.7%, next is the IFOA at 15.7 and 5.6% have used the ConsensusDOCS 300 agreement, and 21.3% said they have used another IPD contract. These were modified traditional contractual agreements created internally or created by a client. The remaining 28.7% said they have not used a multiparty or IPD agreement, which suggests that their experience is on a project that employed some principles of IPD while using a traditional contract. The traditional "non-IPD" contracts listed by the respondents include the following: lease/lease back, design/build, guaranteed maximum price, and other standard contracts. Only slightly more than half of the respondents (51%) have actually used one of the three IPD contracts. Although the other half of the respondents (49%) claimed that they have experience with IPD, they implemented IPD concepts and tools with traditional or modified traditional contractual agreements.

When asked if any unforeseen contractual issues or problems arose during the course of the project, there were not major differences between the responses of three groups: respondents used an IPD contract; respondents used a modified traditional contract; and respondents used a traditional contract (Fig. 7). However, when responses from different disciplines analyzed, owners responded substantially different from the rest: 62.5% of the owners responded negatively and only 37.5% responded affirmatively (Fig. 8).

The following are some of the contractual issues raised by respondents: errors and omissions in contract documents; various interpretations due to unclear contract documents; lack of definition/structure for use of contingency; unclear BIM requirements; concerns regarding risk sharing and open-book accounting; owner's program not validated; and misunderstandings regarding the use of project contingency.

Early Involvement of All Parties

Experienced respondents were asked to indicate which team members were involved during each phase of their specific IPD project in order to determine how early each party is getting involved. Table 1 shows the percentage of projects in which each party is involved at the corresponding project phase. Of particular interest in this analysis is the involvement of the general contractor, subcontractors, and manufacturers or suppliers during the design phases because these parties are typically not involved until the construction phase on traditional projects. However, the degrees of involvement of the owner, architect, engineers, and specialty consultants are useful for comparison with these other parties. In order to provide a benchmark, the results of each phase are compared with guidelines set forth in AIA California Council's "Integrated Project Delivery: A Working Definition" (2007) regarding the involvement of these parties on IPD projects as well as traditional projects.

Preliminary design: Traditionally, this phase is limited to the owner and architect. They are also the only two parties present at the beginning of this phase on IPD projects, but the specialty design consultants and general contractor are also to become involved during this phase. 43.1% of survey respondents indicated that specialty consultants were involved during this phase and 46.7% indicated that general contractors were involved. Involvement of subcontractors and manufacturers/suppliers was limited.

Early design: In addition to the owner and architect, design consultants are typically introduced during this phase on traditional projects. According to the AIA guidelines, all parties may be present at this phase of an IPD project. Respondents indicated that 69.6% of specialty consultants and 69.2% of general contractors and only 41.9% of subcontractors and 41.2% of manufacturers/suppliers were present.

Design development: According to AIA, all parties should now be present on IPD projects and continue their involvement at some capacity through the remainder of the project. Traditionally, the owner works with the architect and specialty consultants to design the project and no other parties are introduced until agency review and construction. The survey results do indicate a high level of involvement from all parties during this phase—82.2% of general contractors, 72.4% of subcontractors, and 74.5% of manufacturers and suppliers—as well as those traditionally present during this phase: 83.3% of specialty consultants; 84.9% of owners; 91.6% of engineers; and 92.3% of architects.

While this analysis is mainly focused on the early phases of IPD projects, the construction, close-out, and facility management phases were included in the survey question in order to reveal continuous multiparty involvement in IPD projects. The construction phase demonstrates the most involvement overall, with each party reported to be involved in 80–90% of IPD projects. Closeout still shows fairly high involvement from the major parties, while the consultants and suppliers become less involved. Finally, the facility management phase shows the owner as the primary participant with some involvement from all other parties though only of less than 30% of reported IPD projects.

Shared Risk and Reward

Experienced respondents were asked to indicate what compensation method was used to incentivize collaboration on their specific IPD project. The following options were provided: 45.8% selected "based on value," which incentivizes the project team by offering a bonus linked to adding value to the project; 25.2% selected "incentive pool," which reserves a portion of the project

team's fees into a pool that can increase or decrease based on various agreed upon criteria before being divided up and distributed to the team; 17.8% selected "performance bonuses," which provides an award based on quality; 15.9% selected other; 13.1% selected "profit sharing," in which each party's profit is determined collectively rather than individually; and 7.5% selected "innovation and outstanding performance," in which the team is awarded for hard work and creativity. The "other" category included lump sum bid, fixed fee, negotiated guaranteed maximum price, and various methods of shared savings. Owners relied on the other type of compensation methods (57.1%) including liquated damages and fixed price, followed by based on value and incentive pool type of compensation methods. When the results were filtered by IPD contracts only (ConcensusDOCS, AIA, and IFOA), based on value (52%) was followed by incentive pool (30%), profit sharing (20%), performance bonuses (18%), and innovation and outstanding performance (12%). The category other was used only by 6%.

Experienced respondents were also asked what kind of metrics developed to determine project performance. The majority said cost metrics were developed (82.4%), then schedule (81.5%), quality (60.2%), other (13.9%), and 5.6% were unsure. The metrics provided in the other category included based on value added, safety, sustainability, and less field changes. Again, when only the respondents who used one of the three IPD contracts were analyzed, the results were similar to all experienced respondents: cost (84.3%); schedule (78.4%); quality (60.8%); other (9.8%); and not sure (2%).

Benefits

According to AIA's "IPD Working Definition" (AIA California Council), construction phase is where the benefits of integrated model are realized. The following analysis outlines the various benefits that were observed by experienced respondents on a specific IPD project. The most commonly observed benefits are fewer change orders (70.3%), cost savings (70.3%), and shorter schedule (69.4%). Fewer request for information is another significant benefit observed by 58.6% of respondents. Slightly less than half incorporated BIM-integrated operations (45.9%). Less construction administration (36%), more prefabricated materials (32.4%), and fewer injuries (21.6%) were also observed. Other benefits suggested by respondents include better quality, less stress and friction, more productivity, and more enjoyable projects.

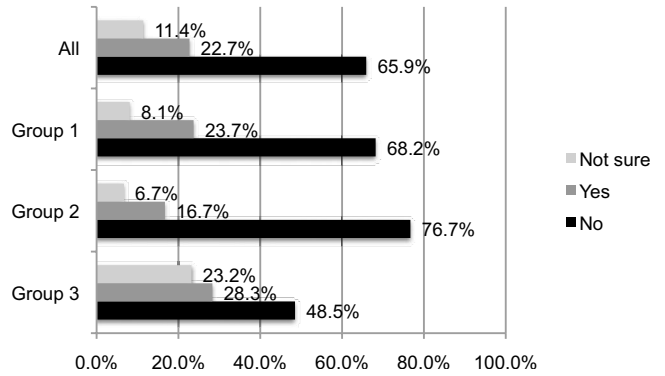

Fig. 1. Opinions of groups and all respondents regarding whether or not projects in the construction industry are delivered in an efficient manner

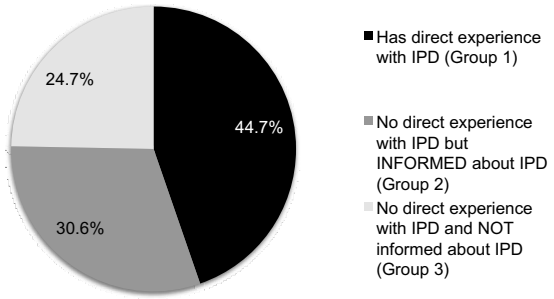

Fig. 2. IPD experience and awareness level of respondents

Projects

Experienced respondents were polled to get their opinions regarding project types and sizes that they believe would work well with IPD. The majority (59.6%) believed that IPD would work well with all types of projects. However, in terms of project size, most believe large projects (39.4%) and medium projects (30.3%) are better fits for IPD than smaller projects (9.2%).

Based on the answers, healthcare (32.1%), civic/government (31.2%), and industrial (30.3%) project types were found to be the top three appropriate projects for IPD implementation. Education (27.5%), commercial (27.5%), infrastructure (25.7%), and transportation (22.9%) projects followed closely. Residential (11.9%) and cultural (11.0%) projects were found the least appropriate project types for IPD. 4.6% selected the other category and suggested sports stadiums/entertainment venues and large remediation projects to work well with IPD. These results infer that IPD is believed to work best on projects that are large, unique, or that require substantial coordination. It has been pointed out by the respondents that many public agencies are not able to secure construction contracts without open lump sum bidding, and there needs to be an industry-wide effort to lobby lawmakers to make the necessary changes in the governing codes to allow IPD methodology.

Issues around IPD

A portion of the survey questions was designed to determine the attitudes and opinions of those polled regarding issues surrounding IPD that do not require direct experience with an IPD project to answer. While the more detailed questions in the previous section were only asked of experienced respondents, these questions were asked of both experienced (Group 1) and informed (Group 2) respondents. The results are intended to draw general conclu-

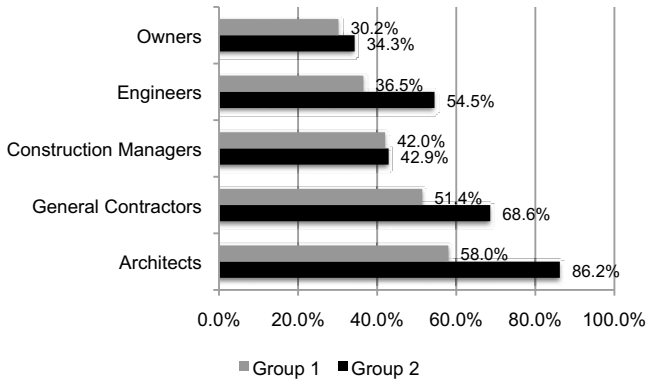

Fig. 3. IPD experience and awareness of respondents by discipline

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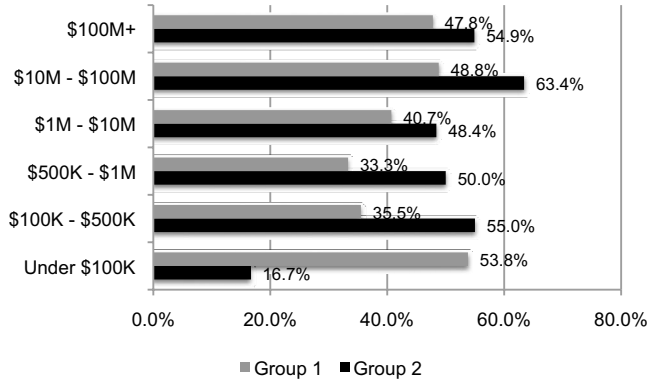

Fig. 4. Comparison of respondents that are experienced with IPD and that are informed about IPD to their firms' last year annual gross revenue

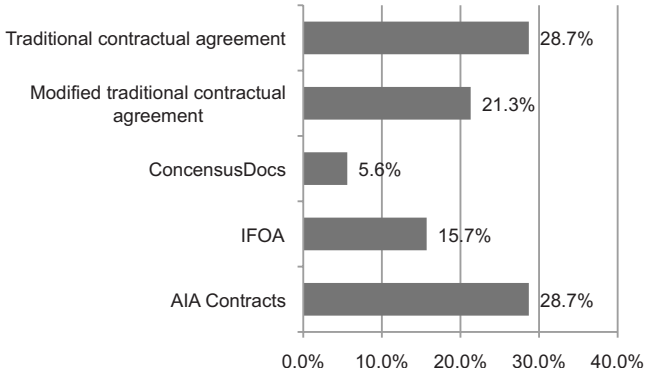

Fig. 6. Utilization of IPD contracts within the respondents who are experience with IPD

sions about these issues as well as determine if there are any noteworthy differences between the attitudes and opinions of these two groups.

Preferred Delivery Methods

Both groups were asked if they prefer IPD to traditional delivery methods and respondents were given the option to choose one or more answers from the six options provided; therefore, percentages do not add up to 100% (Fig. 9). No sizable difference was found between how the two groups responded to this question. Both groups overwhelmingly responded in the affirmative, but the experienced group had slightly more affirmative responses. Twice as many informed respondents were unsure if they would prefer IPD to other delivery methods. The respondents, who selected other, provided their own answer. The other responses include more yes or no answers with different reasoning as well as opinions that IPD has not been around long enough to determine if it is preferable to traditional delivery methods. The results were analyzed for projects that claimed to be IPD projects but adopted a traditional contract, but the results were similar to all respondents' preferences. For these projects, the answer "yes, because projects are delivered more efficiently" received 56.9%; "yes, because IPD avoids adversarial relationships" received 51%; "no, because it does not work with my business model" received 12.7%; and "no, because the risks of adopting a new system are too high" received 3.9%.

Respondents were asked to select contractual agreements from a list to which they believe IPD can be applied. This list was developed by using AIA's "IPD Working Definition" (AIA California Council 2007), which identifies the organizational and business structure best suited to IPD consistent with the participants' needs and constrains as the following: design/build, CM at risk, single purpose entities, multiple prime, design assist, bridging, and alliancing. Like the previous question considered, the experienced and informed groups responded very similarly to this question (Fig. 10). Both groups selected design/build more than any other contractual type—85.3% of experienced and 77.6% of informed. CM at risk came in second with both groups at 64.2%

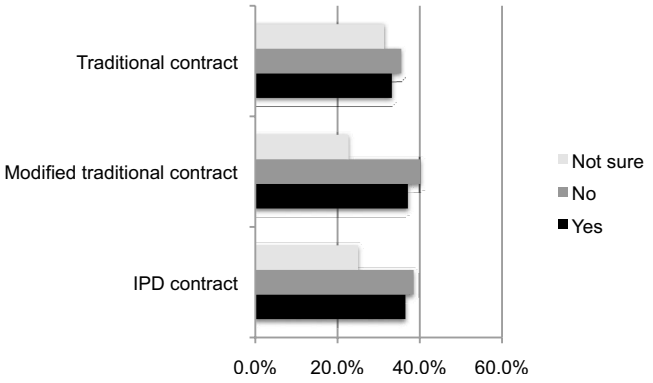

Fig. 7. If any unforeseen contractual issues or problems arose during the course of the project—by contract type

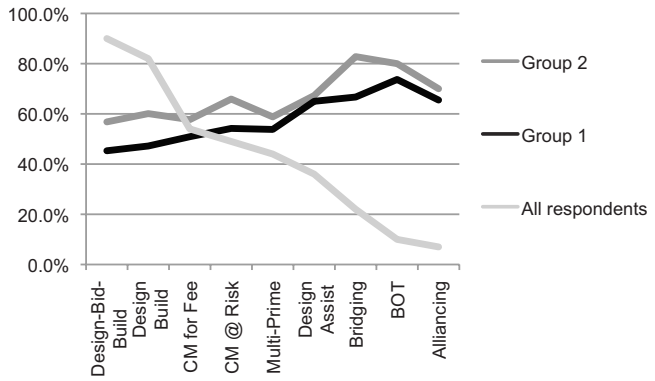

Fig. 5. Comparison of respondents that are experienced with IPD and that are informed about IPD and other project delivery methods

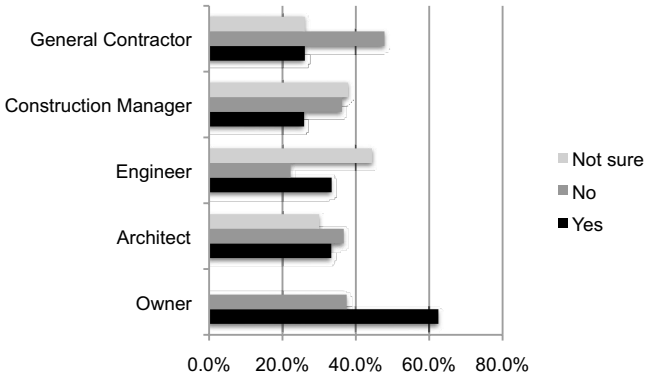

Fig. 8. If any unforeseen contractual issues or problems arose during the course of the project—by disciplines

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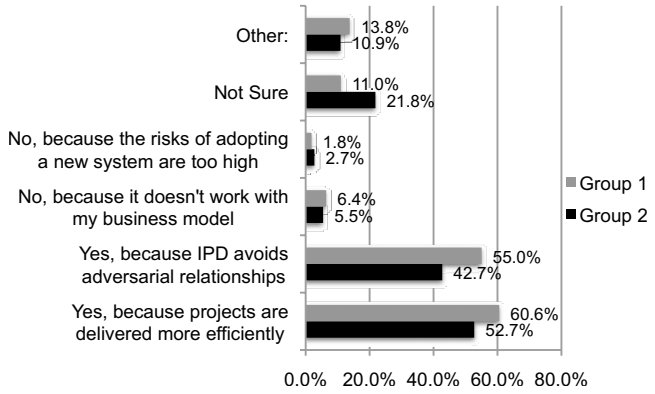

Fig. 9. Preference of IPD over traditional contractual agreements

of experienced and 53.3% of informed. CMs for fee, multiprime, design assist, and design-bid-build follow for both groups. Build-operate-transfer, bridging, and alliancing were selected the least for both groups. It is interesting to note that both groups believe that IPD could be applied to current delivery methods, especially to the design/build and CM delivery methods and also to more traditional delivery methods such as design-bid-build (around 40% of both groups).

Factors Important for IPD Success

Respondents were asked to drag and drop a list of factors in order of importance to the success of an IPD project. The list of factors was developed based on the AIA's "IPD Working Definition" (AIA California Council 2007), which outlines the essential principles the IPD embodies in its ideal state. Interestingly, there was no significant difference between the responses of each group.

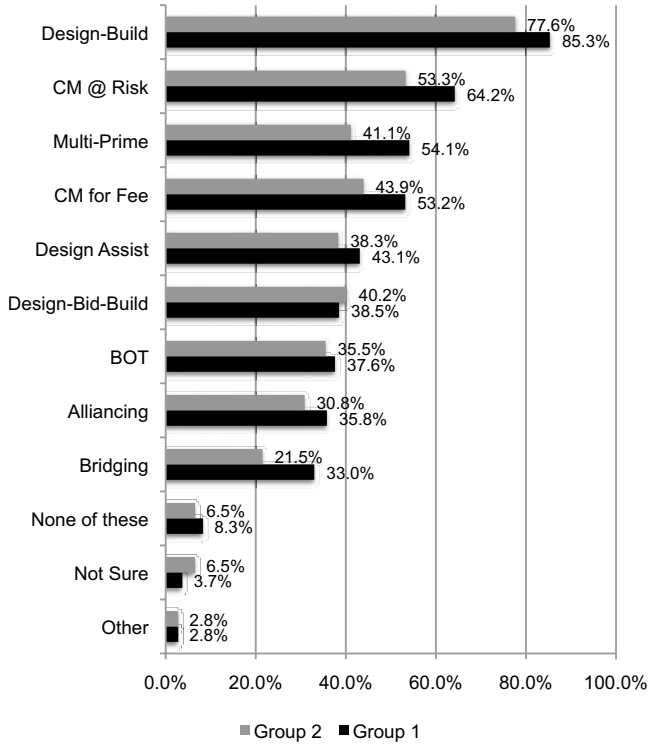

Fig. 10. Contractual agreements to which respondents believe IPD could be applied

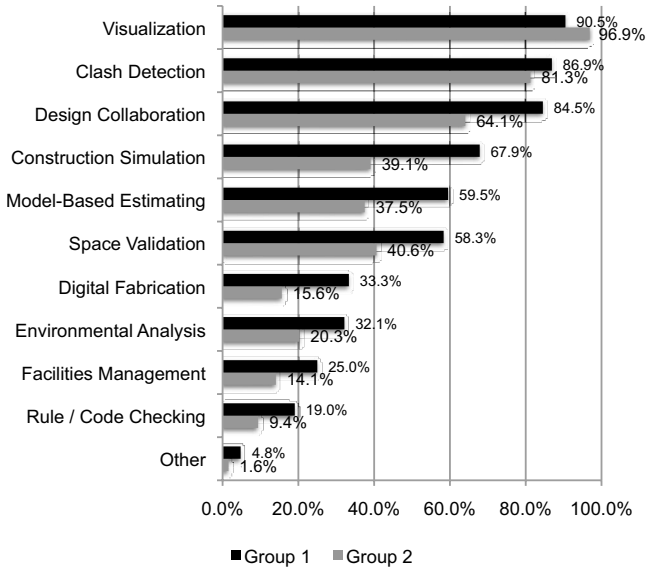

Fig. 11. BIM capabilities used on a project

Both groups indicated the following three factors as the most important for IPD success: well-defined contractual relationships; early definition of project goals; and early team formation. Likewise, both groups indicated the following three factors as the least important listed for IPD success: compensation linked to project outcome; experience implementing IPD; appropriate technology/BIM; and lean construction methods. Other factors that respondents felt are necessary for the success of an IPD project are clearly defined scope of work; specific project goals; clearly defined roles, relationships, and responsibilities between the project participants; creating a team spirit of win-win for every team member; preexisting environment of trust; and mutual support. Surprisingly, many commented that if there has to be a monetary initiative to force a team to work together, it is a poor motivator and also a major reason for blaming rather than resolving the issues. Some commented they do not believe the construction industry needs this IPD contract type and others said collaboration is not solved through contracts but relationships between all project stakeholders.

Respondents were asked to select from a list of options regarding what concerns they might have with being involved on an IPD project. The biggest concern for both groups is concerning insurance and risk allocation. 46.2% of informed and 43.1% of experienced respondents indicated that "there is not enough evidence

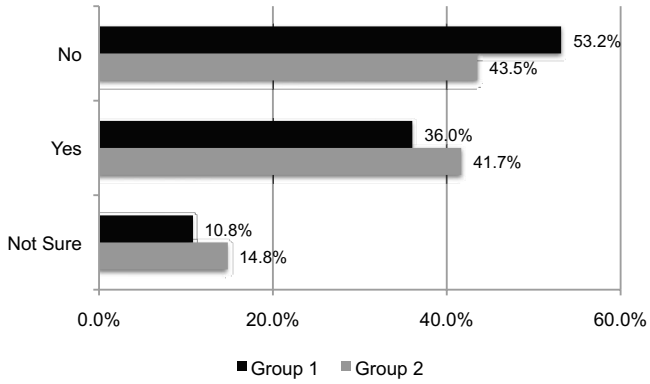

Fig. 12. If BIM is a prerequisite for IPD

that risk allocation and insurance concerns have been addressed." The second largest concern for both groups is "industry use of technology and BIM is not advanced enough yet to support IPD as intended," selected by 31.1% of informed and 37.6% of experienced respondents. A considerable amount of respondents from both groups (33.9% of experienced group and 24.5% of the informed group) indicated they "do not have any concerns with IPD." 24.5% of informed and 18.3% of experienced respondents indicated that "there is not enough evidence backing the supposed benefits." Mistrust issues do not seem to be of concern for respondents of either group as only 11.9% of experienced and 12.3% of informed respondents indicated that "they do not trust other industry professionals enough to work with them as a team on a project" and only 6.4% of experienced and 4.7% of informed respondents indicated that "they are not interested in sharing risk and reward with others." A number of respondents chose the other option and provided their concerns, most of which were concerning the client: lack of client understanding of IPD; clients' lack of willingness to share costs associated with the delivery method; lack of client education around the topic; and unfitting client procedures/policies.

IPD and BIM

It is noted in the Introduction to this paper that IPD has materialized as a delivery method that could most effectively facilitate the use of BIM for construction projects. Due to the suggested efficiency of using BIM and IPD together, the survey included questions regarding respondent's BIM experience and opinions about BIM's relationship to IPD. Both groups showed a high level of experience on projects where BIM was used, though more so with experienced respondents (76.2%) than informed respondents (62.2%). It is notable that experienced respondents overall have used a greater number of BIM's capabilities than informed respondents (Fig. 11). Both groups have an equally high level of experience using clash detection and visualization (rendering, 3D presentations, model walk thrus, etc.), but for all the other eight BIM capabilities listed, the experienced group responded 10–30% higher than informed respondents. Figure below shows the percentage of BIM capabilities used by both groups. Since it was a multiple-selection answer set, the percentages represent only a comparison to the total number of respondents that answered the question and not to the other tasks. When the results are analyzed, more conventional capabilities of BIM solutions, such as visualization, clash detection, and design collaboration, are used more widely than specialty-focused capabilities, such as digital fabrication, environmental analysis, and facility management.

Further, 73.8% of experienced respondents consider themselves or their companies to be "well trained and capable enough to use BIM effectively on an IPD project," while only 59% of informed respondents indicate such. This might have direct correlation with the amount of experience respondents have with BIM functions. Respondents were also asked if BIM is a prerequisite for IPD (Fig. 12). Overall, respondents think that BIM is not a prerequisite for IPD: 43.5% of informed and 53.2% of experienced. 41.7% of informed and 36% of experienced respondents agreed that BIM is a prerequisite and 14.8% of informed and 10.8% of experienced respondents were unsure. The same trend was realized when owners are analyzed. 63% of the experienced owners and 70% of the informed owners think that BIM is not a prerequisite for IPD. However, once more, the informed group of respondents thinks that BIM is a prerequisite for IPD more than the experienced group of respondents. General comments provided by the respondents at the end of the survey support the agreement that BIM is not a prerequisite for IPD.

Industry Adoption

Respondents were asked if they foresee IPD someday becoming a widely embraced project delivery method in the United States. Experienced respondents (66.7%) believe more strongly that IPD will be used widely in the future. However, informed respondents also agree (58.3%). Almost one-third of the respondents of both groups are still unsure (27% of experienced group and 31.5% of informed group). When owners are analyzed separately, two-thirds of the owners with IPD experience and half of the informed owners believe that IPD will become a widely embraced project delivery method in the future.

Respondents were also asked to organize a list of potential obstacles in order of their hindrance to the widespread adoption of IPD. Both groups indicated that business risk and fear of change were the biggest obstacles. Lack of IPD awareness and lack of appropriate legal structure were next on the list for both groups. The obstacles most frequently listed last for both groups were limitations of technology and lack of industry-wide standardization. Other obstacles offered by the respondents are lack of trust and greed by involved parties, cultural barriers within the industry, and lack of appropriate insurance products. Responses reflect a general attitude of falling back on tradition and an unwillingness to try something new because "we have done it this way for many years." However, when respondents in the informed group were asked if they would be interested in working on a project that used IPD as a delivery method, 97% said yes (99% when owners are filtered out). However, only 71% of the informed owners indicated that they would be willing to work on a project that used IPD as a delivery method. This demonstrates that respondents who are informed believe in the concept of IPD and are very much willing to work on an IPD project.

Recommendations for Education and Future Research

While this survey represents a first step toward understanding construction industry experience and attitudes regarding IPD, there are several other avenues that should be pursued. As the construction industry shifts toward adopting IPD, the education system should take a more collaborative approach in teaching and research. Degree programs in civil engineering and CM need to address new procedural and technological concepts in the undergraduate programs, in more sophisticated master level courses, and as prime research objectives for doctoral students.

Further investigation is needed for several research questions such as how to best improve liability insurance products and current contractual models and if and when the design/build delivery method is truly a better methodology than IPD. There is also a need for a study on IPD's return on investment. Introducing IPD will be difficult unless there is overwhelming evidence that it will improve profits, reduce operating cost, and save money in the long run. One of the greatest difficulties is defining the risks, responsibilities, expectations, project goals, and liabilities when negotiating IPD contracts. Some of these issues would be better examined in detailed case studies with extensive interviews and concurrent project documentation. Collecting best practice IPD case studies would help professionals who are unfamiliar with IPD to get assurance of how the profits have played out both on successful and unsuccessful project examples. Finally, the survey

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or versions of the survey could be distributed at future points in time to compare the progression of change as the industry becomes more proficient and experienced with IPD.

Conclusions

The use of IPD by the U.S. construction industry is still in its infancy. Although some professionals have worked on IPD or IPD-like projects, the majority either does not have direct IPD experience or is not familiar with its concepts, which suggests that a focus on education in IPD is necessary. Considering the high level of interest in IPD and the industry-wide opinion that construction projects are delivered inefficiently, there would seem to be openness toward that further education.

Respondents suggest trust, respect, and good working relationships are the key to successful IPD projects. Many believe IPD cannot work without these relational factors and indicate monetary incentives are not the most effective at fostering collaboration. Respondents also feel good leadership is required to encourage a collaborative team environment. On the other hand, the survey reflects a high degree of uncertainty from the respondents about the possibility of creating this type of environment. The majority would prefer IPD to traditional delivery methods. However, contracts specifically developed for IPD are not widely used by the industry, and there are concerns around risk and reward sharing, liability insurance, and open-book accounting. Although several believe that there are benefits, the majority is still looking for more evidence to fully adopt IPD as a project delivery method.

Finally, the survey responses show that experience with IPD does not significantly affect the attitudes of industry professionals toward this delivery method. Experienced respondents were slightly more optimistic about the amount of delivery methods to which IPD could be applied. There was virtually no difference between the responses concerning success factors and concerns about using IPD. The only significant difference between the two groups was regarding their use of BIM. Respondents with IPD experience had a higher level of experience using BIM and have also used more of the capabilities that BIM has to offer. While this seems to suggest that BIM is being used on IPD projects more than other types of projects and to a higher level of sophistication, many respondents emphasized that BIM or advanced information technology applications are not a prerequisite for IPD. Experienced respondents were also generally more optimistic that IPD will eventually become widely embraced in the United States. However, there are still cultural, procedural, and organizational barriers to widespread use of IPD within the industry.

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