# Implementation of Integrated Project Delivery and Building Information Modeling on a Small Commercial Project

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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 multi-party agreement. The coupling of Building Information Modeling (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. Although several professional organizations are supporting the advancement of IPD, the amount of projects using IPD still remains relatively small. This paper summarizes a successful example of IPD implementation supported by BIM on a small commercial project.

**Keywords:** Integrated Project Delivery, Collaboration, Construction Industry, Delivery Methods, Case Study, BIM

## Introduction

As buildings have become more complex and the construction industry has become more specialized, a new project delivery method referred to as Integrated Project Delivery (IPD) is introduced in the U.S. construction industry to improve the cost, schedule and quality of projects over traditional delivery methods. This delivery method seeks to improve project outcomes through a collaborative approach of aligning the incentives and goals of the team (ADTF 2006). Although several professional organizations are supporting the advancement of IPD (AIA CA Council 2007; AGC 2009), and several projects have demonstrated its benefits (Post 2007, Matthews et al. 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 there is a need for those within the industry to assimilate new competencies 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). 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. This paper attempts to provide a project example that has implemented IPD as a project delivery method. With this paper, first IPD is defined for the purposes of this study, and Building Information Modeling is discussed in the context of IPD. Second, a short case study is presented as an example of how IPD can be applied to a commercial building project. Recommendations are made for education and future research projects regarding IPD in the conclusion section.

## Integrated Project Delivery

Professional organizations such as the American Institute of Architects (AIA) and the Associated General Contractors of America (AGC) are establishing standards for IPD, disseminating guidelines and facilitating discussions within their memberships that highlight successful IPD projects and consider the obstacles to IPD 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). The AIA defines IPD as *"a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harness 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 CA Council 2007). ConsensusDOCS, an organization that is established by twenty-two leading construction associations, published a consensus set of IPD contract documents (ConcensusDOCS 2009). The ConsesusDOCS 300 was the first standard construction contract to address IPD and

continues to be a multi-party IPD agreement (Perlberg 2009a). Integrated Form of Agreement (IFOA) is another type of an IPD contract (Lichtig 2005, Lichtig 2006) that creates the contractual and financial framework to facilitate the effective collaboration between construction project participants (Parrish 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 following common principles to define IPD is used: (1) multi-party 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.

*Multi-Party Agreement*: When IPD is used, there is typically one contract for the entire project that is entered into 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, 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;
- 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, it is also important to note that information technology, such as Building Information Modeling (BIM), can greatly increase the efficiency of collaboration throughout all phases of a project.

However, there are 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 any coverage for IPD. More importantly, 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, 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).

## Building Information Modeling

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 (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. 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).

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, et al. 2006). However, the perceived legal risks of moving from a 2D to a 3D industry are a major stumbling block for many companies to move aggressively into BIM (Perlberg 2009b) Absence of standard BIM contract documents and issues arising from how BIM is used as a collaborative framework are two major obstacles to full adoption. Business models and contract relationships to reward "best for project" decision making should be established for widespread BIM adoption (Ashcraft, et al. 2007).

## Methodology

A significant amount of the information for this paper was gained from interviews, which were conducted with fifteen construction industry professionals that are all knowledgeable and/or experienced with IPD. The interviewees were selected from (1) AIA's IPD Steering Committee to attain general information about IPD and its current use within the construction industry and (2) project participants to develop the case study presented below. All formal interviews were conducted over the phone, with three resulting in face-to-face interviews. Case study interviewees included project participants from the architect, general contractor and owner teams. The process of developing and conducting interviews took about nine weeks between January 28 and April 1, 2009. Some of the questions asked to the project participants are listed below.

- How was the team selected?
- At what point were the different players brought on?
- What role did each player have in plan development?
- How did the team communicate? What meetings were held / how often?
- How was decision-making handled?
- What contractual structure was used? Did any issues arise that were not addressed well by the contract?
- Were there any problems with the team?
- When was the budget established?
- Did variations from the budget occur? How were they handled?
- What kind of benefits did you observe that could be attributed to IPD?
- What kind of obstacles did you run into?
- What kind of metrics developed to determine project performance?
- How was compensation of the team members structured?
- Was BIM used and to what extent? What team members contributed?

## Case Study – Autodesk One Market

The following case study describes how the above principles have been applied on a specific project. The project, Autodesk One Market, located at One Market Street, San Francisco, California, was a commercial interior renovation consisting of a roughly $10 million budget and an aggressive twenty-two week construction schedule. The project's core group included the following four companies: Autodesk (owner), DPR (general contractor), Anderson Anderson and HOK (architects). Team selection began in October 2007, and the project was completed in August 2008. The owner's program called for two separate spaces – a 16,500 sq ft customer-briefing center and gallery designed by Anderson Anderson and 29,295 sq ft of office space designed by HOK. Unique aspects of the project include the pursuit of Leadership in Energy and Environmental Design (LEED) Platinum Certification from

the United States Green Building Council (USGBC) and a highly sophisticated use of audio-visual equipment, consisting of about 10% of the construction cost. This A/V system, coupled with a custom open ceiling system, comprises one of the major design elements of the gallery. Autodesk stated that they used IPD "because it is an emerging and innovative trend in the industry and also leverages technology that the company produces. It is a great way for Autodesk to demonstrate leadership in the industry and learn lessons that can be applied to improve the software". This was the first project that Autodesk completed using IPD and they have since used this delivery method for their AEC Headquarters project in Waltham, Massachusetts.

*Multi-Party Agreement*: A four-party agreement was entered by the owner, general contractor, and two architects that bound together each party and specified their roles, decision-making process and compensation structure. Any subcontractors or consultants whose contract consisted of more than 5% of the construction cost held a similar agreement with one of these parties. The A/V consultant (Charles Sulter Associates) and the electrical subcontractor (Decker Electric) each held such an agreement. Each party was primarily responsible for their traditional expertise on the project but also provided input during each phase and area of work and shared the risks associated with their completion. The contract organized the team into three levels to facilitate the decision-making process: the Project Implementation Team (PIT), Project Management Team (PMT) and Executive Committee. The PIT was the first level, managing daily technical activities and identifying issues in the field. When the PIT could not reach a unanimous decision, the issue was escalated to the PMT who managed broader concerns of program, budget and schedule. If the PMT could not reach a unanimous decision, the issue was ultimately deferred to the Executive Committee, who required a majority vote to reach a final decision. During the course of this project, only one issue was elevated to the executive committee, the majority of issues being resolved at the PIT level. All interviewed team members who subsequently voiced a desire to work under a similar contract in the future considered this multi-party agreement effective.

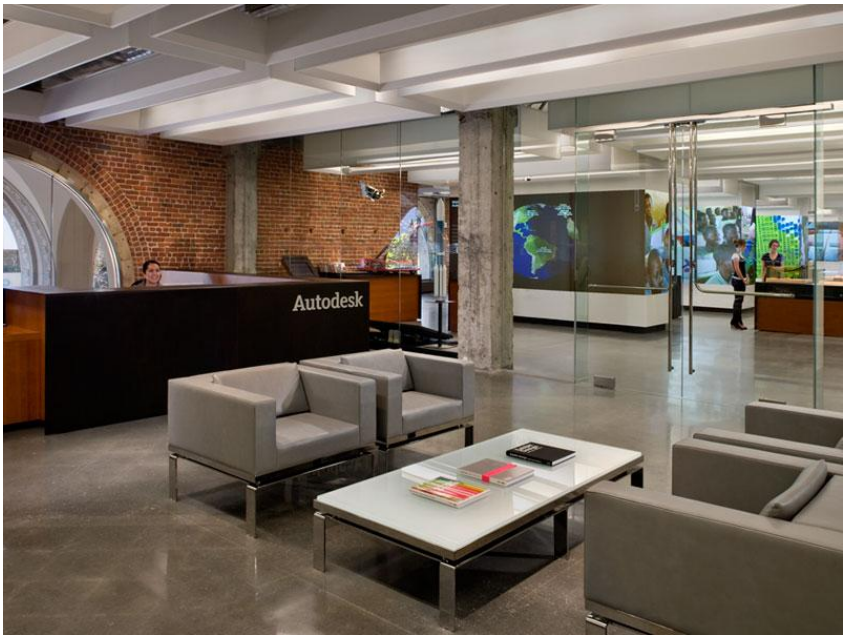


*Figure 1*: Autodesk One Market project interior

*Early Involvement of All Parties*: Autodesk brought on the general contractor, DPR, at the same time as design firms, Anderson Anderson and HOK. Subcontractors and design consultants were also present at early design meetings. Since all parties were present from the beginning of the project, each member of the team was able to contribute their expertise throughout the design process. Collaboration was enhanced by the use of BIM, which was a requirement built into the IPD contract and each subcontract. Autodesk's own software, Revit® and Navisworks®, were used along with approximately thirteen other types of BIM software to model and integrate the designed spaces. The general contractor, designers, A/V consultant, electrical subcontractor, mechanical subcontractor (ACCO) and fire suppression subcontractor (Cosco) each developed models, most of which were combined by DPR into a single, information-rich model in Navisworks®. Modeling was used for several functions including constructability review, energy modeling, day lighting analysis, MEP coordination, visualization, prefabrication, just-in-time delivery and model-based layout. Integral to the success of modeling was the decision to perform a laser scan due to the inaccuracy of the available as-built drawings. Laser scanners capture geospatial information of a scene and deliver thousands of points, referred to as point cloud, which is used for creating as-built BIMs of the scanned environment. Since the program called for the re-use of 60% of the HVAC infrastructure along with the existing concrete columns and floor slab, it was necessary to obtain the precise location of these elements before

designing the new spaces. The end result of developing such accurate models that were designed with the input of consultants and subcontractors was the limiting of change orders for BIM modeled elements to only $632 (0.1% of the construction cost). Other benefits of having the entire team involved from the start of design included limiting the project to seventy-two RFIs (Request For Information) with an average three-day turnaround, no RFIs related to BIM-modeled elements and increased quality as discussed in the *Shared Risk and Reward* section below. It was also an ideal platform for the successful pursuit of LEED Platinum Certification as confirmed by recent studies that show IPD methods to be more conducive to the delivery of LEED-certified projects than a design-bid-build approach (Schaufelberger and Cloud 2009).

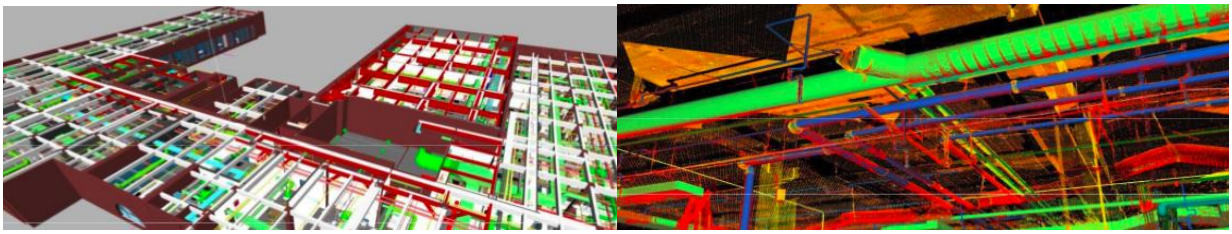

*Figure 2.* Coordination model and 3D point cloud data

*Shared Risk and Reward:* Project risk and reward was shared by all parties through the creation of a system referred to as *the incentive compensation layer*. Under this system, the direct costs of construction and project overhead are guaranteed to each party, but their profit and corporate overhead are placed in a common "pool", receipt of which is based on project success. The success of this project was determined by the following criteria: functionality, aesthetics, materials, workmanship and sustainability. At the end of the project, an independent reviewer was hired to review the space based on the requirements of the program and compare them against a benchmark of three other projects with similar scope and purpose. Out of a range from negative two to positive two, the reviewer awarded the project the highest available score. A score of "zero" would mean the design met expectations and the team would receive the full amount from the incentive compensation layer. A negative or positive score would mean the design was either below or above expectations, and the awarded amount could be increased or decreased by a maximum of twenty percent. The project received a score of two, increasing the incentive compensation layer by twenty percent. This award was then divided among the team members proportional to each party's contract amount. The four parties comprising the core group were all satisfied by this outcome.

## Conclusion

Although Autodesk One Market is an example of a rather small project, it still provides a successful case of an IPD project, in an industry where the use of IPD is still in its infancy. However, 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, what is the return on investment of IPD or how the risks, responsibilities, expectations, project goals and liabilities should be defined 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. In addition, if BIM's capabilities and collaboration through BIM are vital to project and IPD success should be investigated further.

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