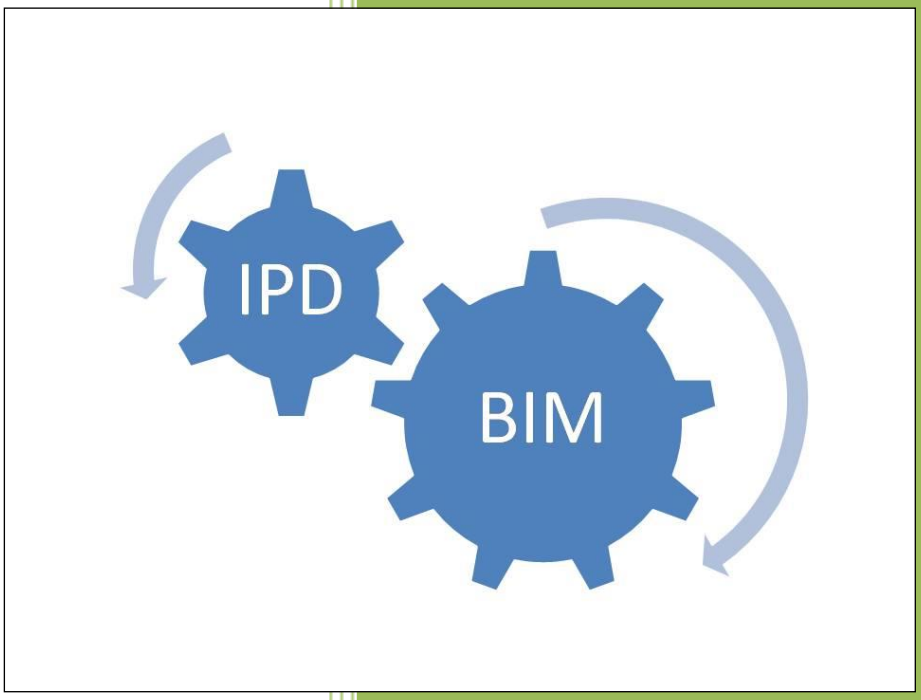
October 14, 2008

Steps Which Support Integrated Project Delivery (IPD) on Building Information Modeling (BIM) Projects



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CE499

Building Information Modeling

USC Fall 2008

Abstract:

The construction industry is changing and new project models such as Integrated Project Delivery Models (IPD) are becoming the new way of doing business within construction. Building Information Modeling (BIM) projects have introduced the use of new technology on complex projects. This research paper illustrates current business approaches and the steps required to manage and complete a BIM project using IPD models. Key Tem Members (KTM) must work in a collaborative environment maximize efficiency and to reduce waste and provide a cost effective and high quality project within time and budget. These new concepts and trends must be embraced by academia to prepare students to succeed in the collaborative environment that exists on BIM projects. Incentive based, private finance initiatives, and project alliances are new delivery models introduced in the construction industry which complement integrated project delivery on building information modeled projects. In order to continue with these new construction trends, similar business approaches must be fully embraces.

In today's construction industry, design collaboration and new project delivery models are gaining popularity. The construction industry has changed dramatically over the past several decades, for example, I have been in construction for almost 10 years and I see that technology aids construction and project manager to take control of schedules and cost. In addition, projects are increasingly larger and more complex (e.g., The Disney Concert Hall). As a result, Building Information Modeling (BIM) is becoming the future of design and construction when delivering a project which meets the client's design intent at the highest quality, within schedule, and cost effective through team work and collaboration.

Steps which support Integrated Project Delivery (IPD) on BIM projects requires an approach that integrates people, systems, business structures and practices into a process that capitalizes the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction (AIA, Integrated Project Delivery - A Working Definition, 2007). According to the American Institute of Architects, it is possible to achieve IPD without BIM, the process available through BIM is essential to achieve the collaboration required for IPD.

Under IPD, Key Team Members (KTM) would include the Architect, MEP consultants, General Contractors, as well as Subcontractors. The interests of KTMs are aligned in such a way that the members can be *integrated* with each other for optimal project performance.

IPD maximizes value and minimizes waste at the project level in an environment which historically has been known to inhibit coordination, collaboration, and innovation due to contractual/legal structures according to James A. Arnold (2008). He argues that in the historically fragmented nature of this industry, many firms understand that achieving the potential that IPD and BIM has to offer requires business process rethinking. Firms are experimenting with shifting project roles, responsibilities, and risk allocation. Furthermore, he recommends that new business relationships must be formed to exploit technical collaboration opportunities to improve the quality of service offered to customers. Lastly, he notes that several of the IPD delivery models that are gaining popularity are: incentive based project delivery models, private finance initiatives, and project alliances – all share a common dynamic that allows for IPD to exist in the demanding world of BIM.

Provided that all team members share common goals and vision towards a successful project completion, the client will receive a cost effective building of the highest quality. In a perfect IPD environment, the following attributes are required to implement IPD model: mutual respect between team members; early involvement; early goal definition; enhanced communication; clearly defined standards; & the use of BIM technology.

Many project delivery models can be used towards achieving IPD. Some models are better suited to an integrated project than others. Early participation/collaboration by KTMs, subcontractors, suppliers, and fabricators generates the most benefit to an IPD model. For example, design-bid-build makes it impossible to identify subcontractors, fabricators or suppliers until bids are received. At this point, collaboration is not possible. Participation in the development early in the design is not attainable.

Consequently, design-bid-build *is not* suitable to achieve the efficiency and performance benefits of the integrated process.

According to many written journals and reports by Greg Howell and Glenn Ballard of the Lean Construction Institute, four major problems exist within traditional contractual approaches:

1. Good ideas are held back: The Mechanical, Electrical and Plumbing subcontractors are generally brought to the design process by the General Contractor once the drawings are in design development in hopes of establishing competitive pricing during the bidding process. MEP contractors are often consulted during the design process but there is no guarantee they will be awarded the contract; consequently the best ideas are withheld until they are certain that they will be awarded the scope of work pertaining to their discipline.

2. Transactional Contracting limits cooperation and innovation: Subcontracts link trades and the framework for relationships on the project. Prime contractors hold contracts for every subcontractor. Long subcontract agreements attempt to spell out in great detail exactly what each subcontractor is to provide, compensation guidelines, and information about when the scope of work is to be performed. The 20 to 30 page subcontracts deal with remedies and penalties for noncompliance. These contracts make it difficult to allow innovation across trade boundaries. Problems such as these create adversarial relationships with the general contractor.

3. Inability to fully coordinate the project: Some projects hold “partnering” sessions but no formal effort are taken to link the planning systems of various subcontractors, or to form any mutual commitments to each other.

4. Pressure for local optimization: Subcontractors fight to optimize their performance. The subcontract agreement and the inability to coordinate drives each trade to defend themselves at the expense of the client and/or vulnerable subcontractors. Right or wrong is clearly defined by the subcontract; subcontractors take on a very legalistic and litigious attitude to defend themselves.

Given the 4 aforementioned problems posed by Greg Howell and Glenn Bollard within traditional contractual approaches; the solution is to create an alliance in efforts to get all of the KTMs to function as one single company with common goals and objectives.

Howell and Bollard argue that delivery models that best serve an IPD model are those that: promote early involvement of key participants; includes risk and reward equity; provide compensation structure or tie incentives to the overall project success; clearly defines responsibility of all team members; and is one that provides management and control structures built around *team* decision making. However, the two main governing principles for such a relationship are: (1) KTMs are responsible for all prime contract provisions with the owner; (2) KTMs share the risk and profit for total project efficiency and performance.

According to Howell and Bollard, the first step towards implementing IPD on a BIM project is to create a prime contract that specifies the terms and conditions and defines scope, schedule and project cost. *One* of the KTM signs the prime contract with the client – Traditional contract approach tends to gravitate towards Guaranteed Maximum Price (GMP) during the DD phase – thereafter; a partnering agreement is executed and agreed upon between all KTMs – also known as a *multi-party* agreement (AIA, IPD Guide, 2007). This partnering agreement will bind all KTMs towards the fulfillment of the terms and conditions as outlined by the prime contract. This pact also spells out cost sharing and equal profit distribution in accordance with the level of each key team member's participation. Partnering contract provisions between each KTM includes the acceptance of full responsibility, and sharing of the cost and profits.

Second; each key team member is to provide a certificate of insurance noting the amounts as indicted in the prime contract according to Howell and Bollard.

Third, each team member agrees to keep their books open on the particular project under the agreed upon partnering agreement. Per Howell and Bollard, there is no accounting among KTMs on, who is over or under budget - Holding everyone solely accountable for their own scope and price would drive the project back down the road to local optimization and will inhibit innovation. IPD was formed to avoid this problem. If one KTM makes a mistake, everyone must pay for it.

Cost overruns will reduce gross profits for all. Each individual with leadership position works for the team, paid by the team, and is responsible for the team; their *allegiance* is for the team and the project and not that of their own sponsoring company. In alliance or incentive projects, successful outcome metrics (i.e., cost, schedule, quality) are developed and agreed upon (AIA, 2007).

Once the allegiance pact has been signed; team member automatically begin to bring their best ideas early in the design phase of the project. In addition, value engineering takes place at the beginning of the project. This type of collaboration greatly reduces project cost overruns.

Other benefits to IPD models regarding dispute resolution are that all discussions are agreed upon between the KTMs as opposed to resorting to the contract guidelines.

According to the National BIM Standard (NBIMS) and the National Institute of Building Sciences (NIBS); BIM is a digital representation of the physical and functional characteristics of a facility or building. It serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward (JBIM, Fall 2007).

The fourth of Howell and Bollard's steps is to agree on the IPD method which best supports IPD. In order to achieve the creation of BIMs digital representations and models, willing participation and collaboration is required. Several IPD models have been identified to best serve BIM; they are *Private Finance Initiatives (PFIs), Project Alliances, Single Purpose Entities, Relational Contracts* and *Incentive Based Delivery Models*.

According to James R. Bedrick, AIA (2007) notes that *PFI*s are widely used in the UK by the Ministry of Health on several large hospital projects. He claims that a PFI model is a consortium that is formed to design, build, and operate a facility which leases it to the owner. At project inception, programmatic requirements, quality measures, and other performance specifications are developed. Lease rates and duration of occupancy is agreed upon. The consortium bears the costs of designing, constructing, and operating the facility, and collects the predetermined lease fees from the tenant. Thus, design and construction efforts of the consortium reduce(s) capital and/or operating costs, and increases profits.

Furthermore, Bedrick shared that *Project Alliances* on the other hand, are popular in Australia and New Zealand. This delivery model is especially common on public-works projects. He argues that this arrangement requires the KTMs (owner, architect, consultants, builder and subcontractors) to form a contractual alliance with two key points: (1) create an enforceable no-blame clause; and (2) agree upon explicit formulas for equal share of risk and reward. To reinforce *Alliance* teamwork, significant decisions are made by facilitated consensus and all parties waive any claims between them, except for willful default.

According to AIA (2007)*, Single Purpose Entity* (SPE) is a temporary, but formal, legal structure created to realize a specific project. SPEs can be a corporation, LLC, limited liability partnership, or other legal form. Key participants have an equity interest in the SPE based on their individual skill, creativity, experience, services, access to capital or financial contribution. Typically, equity owners are paid for services they provide to the SPE. However, an additional element of compensation is tied to the overall project success.

In addition, AIA (2007) notes that *Relational contracts* are similar to project alliances; but differ in its approach for compensation, risk sharing and decision making. The parties agree to limit their liability to each other, but it is not completely waived. If errors are made, conventional insurance is expected to respond. Thus, there is a measure of traditional accountability. Compensation structures have project-based incentives, but there may or may not be any collective responsibility for project overruns. Under relational contract agreements, the owner usually retains final decision rights in the absence of team consensus.

According to Howell and Bollard, the fifth step is to agree on a delivery model (contract agreement). All IPD methods identified above are common to any BIM project. However, certain characteristics of a particular project or delivery model may affect the level of integration that can be achieved. In some cases, participants may be required to use a delivery model that does not include the contractor's involvement early in the conceptual design phase – design-bid-build. Other models do rely on early contractor participation/involvement and is preferred to utilizing IPD methods – CM at Risk & Design Build (AIA, 2007).

AIA (2007) notes that in *Multi-Prime* project delivery model, the owner contract with multiple contractors or trades directly. This model allows the owner to act as a general contract/construction manager; however, owners typically hire construction management firms to oversee and manage the

construction efforts. This model will be successful only if the owner has extensive construction experience and the ability to write individual contracts, facilitate buy-out, verify and approve progress payments, respond to RFIs, and execute change orders among many other responsibilities.

Multi-Prime can be modified to achieve the benefits of IPD and can be adapted into Design-Build or other models depending on when it is advantageous to select contractors according to AIA. It is up to the owner to delegate and outline the level of participation within the integrated process.

The challenge of *Multi-Prime* is that IPD relies on collaboration from KTMs to have a level of equality in decision making early in the design process. In addition, AIA claims that multi contracts create disjoined teams. In this case, the main benefit of *Multi-Prime*, optimization of owner control, is its own challenge to IPD; only the owner is in a decision making position says AIA.

AIA (2007) recommends that possible solutions to the *Multi-Prime* challenges is for the owner to establish contract terms establishing common processes and performance requirements that aids in aligning behavior among each participating member; the owner must either negotiate coherency of all agreements or set a general condition that all participants agree to be governed by, apart from their individual contracts and also choose to negotiate a teaming agreement among the parties to control their interrelated activities.

In addition, AIA mention that *CM at Risk* is where construction manager services are required in addition to what general contractor services traditionally provide. CMs are hired early to deliver cost commitments and to manage schedule, cost, construction and building technology. In this delivery model, the CM assumes all liability and responsibility of a general contractor. This model works well with IPD since the CM is involved on preconstruction efforts and brings parties into the process early, thereby achieving a primary goal of IPD. CMs and Architects work with the owner to establish project goals, implementing BIM and adopting other principles of integration and implementation techniques.

Challenges to *CM at Risk* is similar to that of *Multi-Prime*, separate contracts pose challenges to implementation of a successful IPD process. Owners must negotiate separate contracts with architects and the CM firm. In addition, this also creates a disjointed team and does not allow for the *CM at Risk* to identify subcontractors, fabricators, and suppliers early in the design phase according to AIA.

Design-Build is characterized by a single point of responsibility for both design and construction activities. *Design Build* transfers risk and coordination efforts to one contractual entity to assure a high level of coordination; the owner simple defines the project criteria. Design Build increases collaboration among the design and construction team members.

According to AIA, under *Design Build*, the owner provides the design criteria and later minimizes input and involvement to protect the clear silos of responsibility and risk. Consequently, opportunities for project improvement and innovation are minimized as well. Integration can only exist if the owner adjust' his/her involvement to the Design Built delivery model and considers changes that increases the

level of integration; along with modifying compensation outlines to create incentives for Design Build teams to seek for improvements and to promote collaboration for better outcomes.

Design-Bid-Build is the most prevalent model of construction in the industry. This delivery model offers the owner the market advantage of open competition through a regimented design phase followed by separate bids prior to the construction phase. Many governments dictate that open bidding is to be used on state projects. This does not allow subcontractors, fabricators or suppliers to be identified early in the design phase; thus, early participation is not possible. *Design-Bid-Build* offers little benefits to the integrated process argue(s) AIA.

As noted above, the industry is changing; it is allowing new technologies to greatly advance in efficiency and accuracy, but said changes are more significant in new delivery methods. To succeed, IPD requires that all participants take on new roles and competencies. Clearly defined models provide collaboration for KTMs; provide clearly defined roles and responsibilities of each participant; minimizes risk; maximizes shared respect; rewards and recognizes; and provides incentives for taking on new process that allows for the success of IPD on BIM Projects.

Until recently, the popular delivery models have inherent obstacles towards integration and must be discussed to address and identify these challenges and issues. Given the new trends in construction industry and especially within IPD methods on BIM projects; academia can spearhead that effort. Academia must become sensitive to the changes the construction is experiencing and revise their curriculum to provide students the latest, trend setting approaches to project delivery models.

According to Rick Runnels, AIA, the general agreement within the building industry is that BIM – in both practice and education – is essential (2007). He argues that BIM helps students learn about coordination and collaboration, giving students valuable knowledge regarding how building elements and systems interact, which in turn helps them interact with KTMs once they are involved on an IPD and BIM project.

In addition, Runnels continues that currently, the curriculums of architecture and engineering schools are generally isolated from other disciplines. Architectural, engineering and construction programs rarely intersect, and curricular relationships between design and construction are non-existent. “As the building industry becomes more integrated, the education of future professionals will no doubt follow suite with altered curricula that reflects the increasingly large footprint of design and construction” (Autodesk).

At the University of Southern California (USC), many programs exist where students benefit from interdisciplinary curriculums. The Undergraduate and Master programs allow students to participate in architecture, construction management, engineering, public policy, and business classes. Other universities should follow suite with this type of curriculum model(s). At USC, students work together in a collaborative environment which fosters cooperation, collaboration and innovation.

IPD and BIM also foster a collaborative work environment and allows for the KTMs to solve design and constructability issues quicker, thus reducing waste and cost overruns. IPD was established to outline

the possible delivery models available while working on BIM projects. By educating students on these industry trend setting technologies, they will be quick to adapt to the collaborative environment required to complete a successful BIM project.

In addition, the industry will also benefit by having a larger pool of qualified candidates to perform the highly technological solutions available in the BIM market. BIM is not at a place where interoperability is at 100%, but the industry is definitely headed in that direction. Integrated project delivery is upon us. BIM solutions enable IPD and can deliver dramatic advances in building technology, but the full potential of BIM will not be achieved without adopting structural changes to existing project delivery methods (Autodesk).

Resources:

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