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LA IMPLANTACIÓN DEL SISTEMA DEL DISEÑO DE VALOR OBJETIVO Y LOS MÉTODOS DE CONTRATACIÓN COLABORATIVA (TVD E IPD) EN EL PROCESO EDIFICATORIO EN ESPAÑA TOMO II

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Hay que buscar caminos que no hayan sido transitados antes

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8.- APÉNDICES:



AIA National | **AIA** California Council
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2007
version 1

Integrated

Project Delivery:

A Guide

Integrated Project Delivery

Integrated Project Delivery (IPD) is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.

IPD principles can be applied to a variety of contractual arrangements and IPD teams can include members well beyond the basic triad of owner, architect, and contractor. In all cases, integrated projects are uniquely distinguished by highly effective collaboration among the owner, the prime designer, and the prime constructor, commencing at early design and continuing through to project handover.

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This Guide provides information and guidance on principles and techniques of integrated project delivery (IPD) and explains how to utilize IPD methodologies in designing and constructing projects. A collaborative effort between The American Institute of Architects (AIA) National and AIA California Council, this Guide responds to forces and trends at work in the design and construction industry today. It may set all who believe there is a better way to deliver projects on a path to transform the status quo of fragmented processes yielding outcomes below expectations to a collaborative, value-based process delivering high-outcome results to the entire building team.

Traditional Project Delivery

Fragmented, assembled on “just-as-needed” or “minimum-necessary” basis, strongly hierarchical, controlled

Linear, distinct, segregated; knowledge gathered “just-as-needed”; information hoarded; silos of knowledge and expertise

Individually managed, transferred to the greatest extent possible

Individually pursued; minimum effort for maximum return; (usually) first-cost based

Paper-based, 2 dimensional; analog

Encourage unilateral effort; allocate and transfer risk; no sharing

teams

process

risk

**compensation/
reward**

**communicatitons/
technology**

agreements

Integrated Project Delivery

An integrated team entity composed key project stakeholders, assembled early in the process, open, collaborative

Concurrent and multi-level; early contributions of knowledge and expertise; information openly shared; stakeholder trust and respect

Collectively managed, appropriately shared

Team success tied to project success; value-based

Digitally based, virtual; Building Information Modeling (3, 4 and 5 dimensional)

Encourage, foster, promote and support multi-lateral open sharing and collaboration; risk sharing

Change is Now

Technological evolution coupled with owners' on-going demand for more effective processes that result in better, faster, less costly and less adversarial construction projects are driving significant and rapid change in the construction industry. Envision a new world where ...

... facilities managers, end users, contractors and suppliers are all involved at the start of the design process

... processes are outcome-driven and decisions are not made solely on a first cost basis

... all communications throughout the process are clear, concise, open, transparent, and trusting

... designers fully understand the ramifications of their decisions at the time the decisions are made

... risk and reward are value-based and appropriately balanced among all team members over the life of a project

... the industry delivers a higher quality and sustainable built environment

This is the world of Integrated Project Delivery (IPD).

IPD leverages early contributions of knowledge and expertise through utilization of new technologies, allowing all team members to better realize their highest potentials while expanding the value they provide throughout the project lifecycle.

At the core of an integrated project are collaborative, integrated and productive teams composed of key project participants. Building upon early contributions of individual expertise, these teams are guided by principles of trust, transparent processes, effective collaboration, open information sharing, team success tied to project success, shared risk and reward, value-based decision making, and utilization of full technological capabilities and support. The outcome is the opportunity to design, build, and operate as efficiently as possible.

Benefits of IPD

Recent studies document inefficiencies and waste in the construction industry. For example, an *Economist* article from 2000 identifies 30% waste in the US construction industry; a NIST study from 2004 targets lack of AEC software interoperability as costing the industry \$15.8B annually; and a US Bureau of Labor Statistics study shows construction alone, out of all non-farm industries, as decreasing in productivity since 1964, while all other non-farm industries have increased productivity by over 200% during the same period. New technologies have emerged, that when utilized in conjunction with collaborative processes, are demonstrating substantial increases in productivity and decreases in requests for information, field conflicts, waste, and project schedules. Owners are increasingly demanding methodologies that deliver these outcomes.

There are reasons to acknowledge that highest and best sustainable results in meeting increasingly aggressive goals for energy and carbon reduction are best achieved through collaborative processes. The AIA's experience with the American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE's) Advanced Energy Design Guides suggest that although some reductions are prescriptively achievable (i.e., through the use of a checklist), as one exceeds a 30% reduction and moves toward even greater reductions, complex interactions of systems and context must be taken into account. Integrated processes are being acknowledged and encouraged in sustainable ratings systems such as LEED®. New energy codes, such as ASHRAE's Standard 189, include recommendations regarding integrated processes.

IPD results in greater efficiencies. The United Kingdom's Office of Government Commerce (UKOGC) estimates that savings of up to 30% in the cost of construction can be achieved where integrated teams promote continuous improvement over a series of construction projects. UKOGC further estimates that single projects employing integrated supply teams can achieve savings of 2-10% in the cost of construction. (Office of Government Commerce, *Achieving Excellence in Construction Procurement Guide*, Vol. 5, at p. 6 (2007) www.ogc.gov.uk)

Beyond these benefits, IPD provides positive value propositions for the three major stakeholder groups:

Owners—

Early and open sharing of project knowledge streamlines project communications and allows owners to effectively balance project options to meet their business enterprise goals. Integrated delivery strengthens the project team's understanding of the owner's desired outcomes, thus improving the team's ability to control costs and manage the budget, all of which increase the likelihood that project goals, including schedule, life cycle costs, quality and sustainability, will be achieved.

Constructors—

The integrated delivery process allows constructors to contribute their expertise in construction techniques early in the design process resulting in improved project quality and financial performance during the construction phase. The constructor's participation during the design phase provides the opportunity for strong pre-construction planning, more timely and informed understanding of the design, anticipating and resolving design-related issues, visualizing construction sequencing prior to construction start, and improving cost control and budget management, all of which increase the likelihood that project goals, including schedule, life cycle costs, quality and sustainability, will be achieved.

AIA and IPD

Through early collaboration and the use of Building Information Modeling (BIM) technology, a more integrated, interactive, virtual approach to building design, construction and operation is emerging. To embrace, master and influence this emerging method of project delivery and to seize the new business and cultural opportunities it offers to the industry, the AIA is working with other construction industry stakeholders and through its own national, state or regional and local components, Board committees, Knowledge Communities, Task Forces, Working Groups and related activities to:

- 1. Collaborate with industry leaders to facilitate the dialogue, share knowledge, and accelerate the rate of change for all those seeking to improve the industry's current practices by utilizing integrated approaches to the design, construction, and operation processes;*
- 2. Communicate the benefits of collaborative approaches to public and private sector clients, and promote changes to the design and construction procurement process to allow early information sharing;*
- 3. Promote the benefits of developing a virtual model of a project using available technologies, built with interaction and input from an integrated and collaborative team of project stakeholders – owners, designers, consultants, constructors, subcontractors and suppliers;*
- 4. Develop and promote the integration of collaboration techniques and technology into education curricula for architects and architectural students to enhance their design and team collaborative skills;*
- 5. Engage the legal profession and the insurance industry in preparing contracts that support the integration of collaborative models and technology into the design and build industry and offering insurance coverages responsive to IPD; and,*
- 6. Promote documentation of the measurable contributions resulting from implemented integrated project delivery approaches to stakeholders and promote the value and achievements of increased use of integrated project delivery methods.*

Designers—

The integrated delivery process allows the designer to benefit from the early contribution of constructors' expertise during the design phase, such as accurate budget estimates to inform design decisions and the pre-construction resolution of design-related issues resulting in improved project quality and financial performance. The IPD process increases the level of effort during early design phases, resulting in reduced documentation time, and improved cost control and budget management, all of which increase the likelihood that project goals, including schedule, life cycle costs, quality and sustainability, will be achieved.

The Guide

The Guide begins with introductory material about the principles of IPD and points to consider when setting up an integrated project, moves through a study of how to implement IPD, and culminates with a discussion of how to apply general IPD principles within the specific framework of new and traditional delivery models used in the marketplace today. When thoughtfully considered, absorbed, and then applied, the principles and techniques outlined in this Guide should allow readers to be able to:

- ☐ Understand principles of IPD
- ☐ Understand the value propositions of IPD from the perspective of various stakeholders
- ☐ Organize non-traditional delivery methods and alternative team relationships for improved project performance, understanding the necessary qualifications / attributes of team members
- ☐ Assess interest and adequate knowledge resources within one's team
- ☐ Discern subtle differences between possible models for IPD
- ☐ Advocate the benefit of an integrated delivery model
- ☐ Understand the issues that must be addressed in an integrated project delivery document
- ☐ With the appropriate resources, write an agreement based on integrated project delivery principles
- ☐ Implement IPD principles to proceed with confidence during this time of change.

Integrated Project Delivery is built on collaboration, which in turn is built on trust. Effectively structured, trust-based collaboration encourages parties to focus on project outcomes rather than their individual goals. Without trust-based collaboration, IPD will falter and participants will remain in the adverse and antagonistic relationships that plague the construction industry today. IPD promises better outcomes, but outcomes will not change unless the people responsible for delivering those outcomes change. Thus, achieving the benefits of IPD requires that all project participants embrace the following Principles of Integrated Project Delivery.

3.1 Mutual Respect and Trust

In an integrated project, owner, designer, consultants, constructor, subcontractors and suppliers understand the value of collaboration and are committed to working as a team in the best interests of the project.

3.2 Mutual Benefit and Reward

All participants or team members benefit from IPD. Because the integrated process requires early involvement by more parties, IPD compensation structures recognize and reward early involvement. Compensation is based on the value added by an organization and it rewards “what’s best for project” behavior, such as by providing incentives tied to achieving project goals. Integrated projects use innovative business models to support collaboration and efficiency.

3.3 Collaborative Innovation and Decision Making

Innovation is stimulated when ideas are freely exchanged among all participants. In an integrated project, ideas are judged on their merits, not on the author’s role or status. Key decisions are evaluated by the project team and, to the greatest practical extent, made unanimously.

3.4 Early Involvement of Key Participants

In an integrated project, the key participants are involved from the earliest practical moment. Decision making is improved by the influx of knowledge and expertise of all key participants. Their combined knowledge and expertise is most powerful during the project’s early stages where informed decisions have the greatest effect.

3.5 Early Goal Definition

Project goals are developed early, agreed upon and respected by all participants. Insight from each participant is valued in a culture that promotes and drives innovation and outstanding performance, holding project outcomes at the center within a framework of individual participant objectives and values.

3.6 Intensified Planning

The IPD approach recognizes that increased effort in planning results in increased efficiency and savings during execution. Thus the thrust of the integrated approach is not to reduce design effort, but rather to greatly improve the design results, streamlining and shortening the much more expensive construction effort.

3.7 Open Communication

IPD's focus on team performance is based on open, direct, and honest communication among all participants. Responsibilities are clearly defined in a no-blame culture leading to identification and resolution of problems, not determination of liability. Disputes are recognized as they occur and promptly resolved.

3.8 Appropriate Technology

Integrated projects often rely on cutting edge technologies. Technologies are specified at project initiation to maximize functionality, generality and interoperability. Open and interoperable data exchanges based on disciplined and transparent data structures are essential to support IPD. Because open standards best enable communications among all participants, technology that is compliant with open standards is used whenever available.

3.9 Organization and Leadership

The project team is an organization in its own right and all team members are committed to the project team's goals and values. Leadership is taken by the team member most capable with regard to specific work and services. Often, design professionals and contractors lead in areas of their traditional competence with support from the entire team, however specific roles are necessarily determined on a project-by-project basis. Roles are clearly defined, without creating artificial barriers that chill open communication and risk taking.

Traditional delivery and contracting approaches contemplate separate silos of responsibility that, in practice, yield inefficiencies whenever there is a hand-off from one silo to another. Additionally, projects delivered traditionally suffer because participant success and project success are not necessarily related. Indeed, it is quite possible for one or more project participants to “succeed” notwithstanding overall project failure. IPD, however, represents a behavioral sea change in the industry by breaking down the silos of responsibility, requiring close cooperation among all major participants, and aligning participant success to project success.

IPD strategically realigns participant roles, underlying motivations, and sequences of activities on a project to utilize each participant’s best talents and abilities at the most beneficial moment. Success is project-centric under an integrated delivery approach and relies on collaboration. The focus is on collectively achieving shared goals rather than meeting individual expectations. Success is measured by the degree to which common goals are achieved.

This realignment of traditional roles and project goals, however, inevitably leads to questions about what should be considered along the way toward integration. Accordingly, IPD presents a number of issues that must be considered when exploring this approach for a project. In addition to questions about how the participants’ behavior must be modified, another inevitable question concerns the risks associated with greater collaboration. While it may seem counter-intuitive to speak of the risks of collaboration, as far more mischief arises when people fail to work together than when they do, no project delivery approach is risk-free.

Identified below are issues that arise when setting up a project for integrated delivery. These issues are common to all IPD projects, and are universally applicable regardless of the level of integration actually employed on a project.

4.1 IPD Team Building and Functioning

The project team is the lifeblood of IPD. In IPD, project participants come together as an integrated team, with the common overriding goal of designing and constructing a successful project. If trouble arises on a traditional project, the tendency is often to “batten down the hatches” and protect one’s financial interests. Cooperation suffers and the project flounders. In contrast, IPD demands that participants work together when trouble arises. This “huddling” versus “hunkering” distinction is crucial. Because the hunkering down instinct in the face of trouble is so strong in the design and construction industry today, moving to an integrated, or huddling, approach is tantamount to cultural change. Therefore, the composition of the integrated team, the ability of team members to adapt to a new way of performing their services, and individual team members’ behavior within the team are critical.

4.1.1 Project Team Formation and Team Building

In an integrated project, the project team is formed as close as possible in time to the project’s inception. In some instances, the project team will establish itself based on pre-existing levels of trust, comfort and familiarity developed through past working relationships. In other instances, the owner may assemble the project team without regard to any pre-existing relationships among the team members. In any event, and to the greatest extent possible, project team members are identified and assembled at the earliest possible point in time.

Generally speaking, the project team includes two categories of team member: the primary participants, and key supporting participants. The primary participants are those participants that have substantial involvement and responsibilities throughout project, from beginning to end. For example, in a traditional project the primary participants are the owner, architect and contractor. Unlike the relationship in a traditional project, the primary participants in IPD may be defined more broadly and they are bound together by either a contractual relationship, or by virtue of their individual interests in a single purpose entity (SPE) established for the project. Refer to Section VI below for details regarding potential contractual arrangements and SPE possibilities.

The key supporting participants on an integrated project serve a vital role on the project, but perform more discrete functions than the primary participants. In a traditional project, the key supporting participants include the primary design consultants and subcontractors. In IPD, the key supporting participants enter into contracts directly with either one of the primary participants, or with any SPE the primary participants have formed. In either event, key supporting participants agree to be bound by the collaborative methods and processes governing the relationship among the primary participants.

In IPD, the difference between the primary participants and the key supporting participants is a fluid distinction that will necessarily vary from project to project. For example, on a majority of projects, a structural engineer is not normally considered a primary participant as it performs a discrete function for the project and is rarely substantially involved for the duration of the project. If, however, structural design is the overriding project concern as, for example, in bridge construction, the structural engineer would have substantial responsibilities and project involvement throughout the course of the project. Accordingly, the structural engineer would serve as a primary participant.

Great care is taken to establish an IPD team where participants can work together as a collaborative unit. Team formation considers capability, team dynamics, compatibility, communication, trust building and commitment to an integrated process. Although by no means necessary, the process of team formation and subsequent team building may include personality assessment, communication training, and other techniques to forge a strong team from disparate parts. Once the team is formed, it's important to create a team atmosphere where collaboration and open communication can flourish. Locating the team in a joint facility may facilitate open communication and cooperation, and regular meetings and video conferences may be useful when co-location is impractical. Regardless of the methods employed, it is necessary to establish a team where participants are willing and able to work together effectively and to provide the team with tools and circumstances that facilitate collaborative performance. Collectively-defined project goals and metrics to measure performance, along with compensation models that align individual success with project success, also provide incentives to work as a team.

4.1.2 Project Team Decision Making

The successful integrated project has decision making methods and processes that each team member accepts and agrees to abide by. In a fully integrated project, ultimate decision making abilities are not vested in a single team member. Rather, all decisions are made unanimously by a defined decision making body. Regardless of how the parties decide to structure the decision making body, in an integrated project one overriding principle directs the decision making body: all decisions are made in the best interest of the project.

The composition of the decision making body varies from project to project, but always consists of some combination of the primary participants and key supporting participants working collaboratively to render decisions in the best interest of the project. The actual composition of the decision making body is determined at the outset of the project and reflected in the various agreements between the parties.

In practice, team decision making is the area in which the distinction between primary participants and key supporting participants is most apparent. The primary participants, by virtue of their constant involvement on the project, are always part of the project's decision making body. Although possible, key supporting project participants are typically not part of the decision making body, but they serve as advisers to the decision making body on topics corresponding to their areas of expertise. Through the participation of all of project participants in the decision making process, whether as a member of the decision making body or in an advisory role, the project benefits because the process allows all project participants to bring their expertise to bear on the issue at hand.

In order to provide regular, timely and consistent decisions, the decision making body meets regularly according to a collaboratively set schedule. The more frequent the meetings, the greater the decision making body's ability to adapt to project circumstances. In addition to regular meetings, IPD also requires a process by which team members can call for emergency meetings to address issues that arise without notice and require immediate resolution. Without this flexibility, the project team cannot promptly respond to, and resolve, critical issues arising during the project.

4.1.3 Team Communications

Successful team operations rely on collaboration, which, in turn, necessarily relies on fluid and open communication. Accordingly, creating an atmosphere and mechanisms that facilitate the adequate sharing of information between and among team members is essential to successfully implementing IPD.

The development and use of an overarching communication protocol streamlines communications and facilitates the transfer of project data between participants and between technologies. The communication protocol and other communication tools are developed through joint workshops in which the project team discusses and decides how information will be used, managed and exchanged to ensure consistent and appropriate use of shared information. The decisions and communication protocol established at the workshops are documented and become the project's information specification.

4.1.4 Building Information Modeling

Building Information Modeling (BIM), a digital, three-dimensional model linked to a database of project information, is one of the most powerful tools supporting IPD. Because BIM can combine, among other things, the design, fabrication information, erection instructions, and project management logistics in one database, it provides a platform for collaboration throughout the project's design and construction. Additionally, because the model and database can exist for the life of a building, the owner may use BIM to manage the facility well beyond completion of construction for such purposes as space planning, furnishing, monitoring long term energy performance, maintenance, and remodeling.

BIM is an evolving technology and is not used consistently in the industry at the present time. For example, a small project or a portion of a large project may utilize a single model, but a large, complex project may depend upon many interconnected models developed by specialty participants. Major fabricator models may interact with a design model to produce fabrication information directly and to coordinate conflicts as the design and purchasing proceed simultaneously. Compared with analog practices, the constructor's work model can reduce time and material waste by interacting with the design model to provide construction staging and scheduling to pre-build the project in model form far in advance of actual construction. Models also allow for more accurate costing and estimating earlier in the project. The use of BIM allows the efficient development of extremely complex projects in ways that might otherwise not be possible given constraints of site, time or finances.

BIM is a tool, not a project delivery method, but IPD process methods work hand in hand with BIM and leverage the tool's capabilities. The IPD project team reaches an understanding regarding how the model will be developed, accessed, and used, and how information can be exchanged between models and participants. Without such a clear understanding, the model may be used incorrectly or for an unintended purpose. Software choices are made on the basis of functionality and interoperability. Open technology platforms are essential to the integration of BIM and other models into the process and they foster communication to the benefit of the project on all levels. To aid in this area, interoperable data exchange protocols are in development and are gaining acceptance in the marketplace.

Decisions are also made and documented regarding the level of detail to be modeled, the tolerances required for specific uses, and the purposes the model will serve, such as whether the model will be used to develop cost data, and will function as a contract document. If it serves as a contract document, then the relationship between the model(s) and other contract documents is determined. Protocols are also established for conflict resolution and submittal review as well. If the model is used to develop cost data, protocols are developed for how cost information will be created and exchanged. In addition, the methods for hosting, managing and archiving the model are determined.

These decisions and protocols are vital to the effective use of BIM in IPD. Similar to the communications decisions and protocols discussed above, BIM decisions and protocols are best developed through joint workshops. Any and all decisions are documented and readily available to any participant that will utilize the model—thus ensuring consistent use of the model over the course of the project.

4.1.5 Sharing Sensitive, Proprietary or Confidential Information

Collaborative contracting arrangements contemplate the sharing of much more information under different times and circumstances than is customary under traditional models. Confidentiality agreements serve to make all IPD participants aware of the importance of the proper uses of shared confidential information. Through careful participant selection and contract drafting, IPD participants achieve a level of comfort that project information exchanged will be utilized only for project purposes.

4.1.6 Compensation

From the perspective of collaboration and integration, traditional delivery methods suffer because the individual participant's financial success is not necessarily tied to the project's success. Given human nature, project participants will work hardest to preserve their own financial success. In traditional delivery methods, that behavior sometimes results in consequences that are detrimental to the project, other participants, or both. Methods of compensation that tie the participant's success to the overall success of the project are powerful tools for unifying individual and project success. In IPD, individual financial success relies on project success. For that reason, the IPD participant's natural instinct to protect and improve its own financial interest results in behavior that benefits the project.

There are many options available to parties interested in crafting methods of compensation that align individual success with project success. The appropriateness of any method will necessarily depend on the unique characteristics of any given project and its participants. Due to their inclusion of incentive provisions, IPD contracts can be more complex than traditional construction contracts. Also, to the extent that financial consequences flow from the attainment of specific goals (e.g., completion milestones, health and safety requirements, life-cycle costs, etc.), disputes may arise afterward over whether and to what extent certain goals were achieved. Careful contract drafting, clear and unambiguous definitions of incentive milestones, and due diligence in team selection, will minimize the likelihood that such disputes will arise.

4.1.7 Withdrawal/Assignment

As discussed above, creation of a collaborative team is critical to the success of IPD. While the initial selection of team members is critical to an IPD project, continuity of values and on-going commitment among the team members is perhaps just as important to the project's eventual success. As with any project, the loss of a participant is disruptive, but in IPD the loss is exacerbated given the importance of the project team to the project's success.

The loss and replacement of a team member is disruptive to the necessary collaborative nature of the team. When a team member is lost, any potential new participant is selected to meet the same criteria as the original. Extensive transitioning takes place so that the process may continue effectively, and many of the same team building efforts occur with the new team member. However, depending on when the participant is lost, the replacement participant may face an uphill battle overcoming the feelings of being an outsider to the remaining members of the team.

Accordingly, in order to glean the greatest benefit from IPD, every effort is made to maintain the continuity of the team. Withdrawal of team members, whether through assignment or voluntary termination, is highly discouraged. At the outset of the project, the team decides the few instances, if any, where withdrawal is acceptable. Any such decisions are made part of the agreement(s) in place and the agreements may include damage provisions for withdrawal in certain circumstances.

4.1.8 Team Member Dispute Resolution

As opposed to traditional delivery approaches where adversarial relationships abound, IPD is based upon collaboration in which team continuity is of the utmost importance. As a result of this working relationship and implementation of the team's decision making process, most internal disputes among team members are avoided. It would be naïve, however, to ignore the possibility that disputes may still arise among and between the team members, even within the most cooperative and well meaning teams.

As disputes arise throughout a traditional project, often the parties' only recourse is to submit claims, which immediately thrusts the parties into adversarial positions forcing them to act in their own best interest – adopting the “hunkering down” instinct. If the parties reach that stage, the team is crippled. At that point, the benefits of IPD are lost, and it is very difficult to regain later the collaborative culture within the team. To preserve both the team and the project in IPD, these disputes are resolved internally without the necessity of filing claims and adopting adversarial positions.

Internal disputes are resolved by the project's decision-making body, which, as stated above, makes decisions unanimously in the best interest of the project. Utilizing the project's decision making body to resolve disputes provides team members a sense of ownership in the decisions that are made. To this end, the agreements controlling the project teams' relationship emphasize internal dispute resolution and provide for specific procedures to effectuate such resolution. In some cases, the participants agree to a “no suit” provision, which waives their rights to litigate or arbitrate.

In large part, the success of internal dispute resolution will depend less on the particular procedures employed and more on the degree to which the team members have adopted the team approach of IPD. When a team member

hangs on to the notion of separate silos of responsibility, the project suffers. The better the team works together, the more likely it is able to survive internal disputes. Should internal dispute resolution fail, the participants' agreements address methods for external dispute resolution, absent a "no suit" provision. In this regard, the parties may follow more traditional lines of dispute resolution, such as mediation followed by arbitration or litigation.

The internal resolution of disputes under IPD emphasizes the difference between it and traditional project delivery and the need for cultural change among the team members to effectuate IPD. Traditional contracting is about creating boundaries. A well-drafted traditional construction contract clearly defines the parties' responsibilities and the consequences of failure. Responsibilities rarely overlap as that creates ambiguity as to the correct role. The contract's focus is on the transaction – the activity that must be performed. Integrated contract approaches, on the other hand, focus on the relationships necessary for the successful completion of the project. Such relational contracts, unlike transactional contracts, are quite rare in the domestic design and construction industry. As a consequence, a scarcity of legal precedent exists. Therefore, if disputes arise, it may be more difficult to evaluate one's rights and responsibilities or predict potential outcomes

4.2 Defining Roles, Responsibilities and Scopes of Services

Traditional contracting contemplates project participants operating within their own separate silos of responsibility. IPD seeks to break down these barriers by having all major participants focus on achieving shared goals. This is not to say, however, that IPD participants do not have separate work scopes for which they are primarily responsible. On the contrary, each participant has a clearly defined work scope. For the most part, the designers remain primarily responsible for design services and the constructors remain primarily responsible for construction services.

4.2.1 Service Scope

While still determined partly by registration laws, licensing laws and agency requirements, IPD team member roles and services are viewed functionally with tasks assigned on a best person basis, even when that differs from traditional role allocations. The project team ensures that the individual participant's tasks and responsibilities, or scope of services, are clearly set out and understood at the earliest possible stage. A carefully crafted matrix of parties, roles and responsibilities provides clarity for services, tasks, leadership and supporting roles and is often used for this purpose, though other means may be implemented.

The specific manner in which the traditional scopes of services for the individual team members are realigned will differ on a project-by-project basis. However, the expected effect on traditional scopes of services can be generally characterized in accordance with elements common to all integrated projects. Accordingly, the generally expected effects of IPD on designers, constructors, and owner are set forth below.

Designers—

IPD relies heavily on an extensive and thorough design process that incorporates input and involvement of other team members, including constructors, during the design phase. Thus, the design process takes on added importance as other team members come to understand how the integrated project will work and how it will be completed. As a team member, the designer is necessarily involved in defining the design processes that will apply to the project.

Integrated projects allow for more extensive pre-construction efforts related to identifying and resolving potential design conflicts that traditionally may not be discovered until construction. As a result, designers are required to perform in an earlier stage certain services that are traditionally performed later in the project. The resulting advancement of services potentially increases the volume of services provided in the design phase.

Frequent interactions with other team members during the design phase necessitates that designers provide numerous iterations of their design documents to other team members for their evaluation and input. This interaction results in an additional responsibility to track throughout the design phase both the status of iterations provided to other team members and the nature and substance of the input received from them.

Also, the designer may not necessarily serve as the “gate-keeper” for the flow of communications between the owner and constructors, as it does in traditional project delivery. Ideally, communications are facilitated by the collective team structure and do not rely on a single gate-keeper.

Constructors—

The nature of the constructors’ scope of services is primarily affected in IPD by their early involvement on the project and their participation within the integrated team. Specifically, the constructor’s role increases in a significant way during early stages of design, in which constructors now provide strategic services such as schedule production, cost estimating, phasing, systems evaluation, constructability reviews, and early purchasing programs. While constructors may provide these services in traditional projects, the timing of these services is advanced.

Constructors are brought in during early project phases to provide expertise and fully participate in the design of the project. The result is a greater role in commenting on and influencing design innovation. This increased role during design requires the constructor to provide, on a continuing basis, estimating services and/or target value design services during the design phase.

Owner—

In IPD, the Owner takes on a substantially greater and more active role in evaluating and influencing design options. Additionally, the Owner is required to participate in establishing project metrics at an earlier stage than is typical in a traditional project. In light of the fluid operation IPD requires, the Owner will also be called on more often to assist in resolving issues that arise on the project. As member of the decision making body, the owner will be involved on more project-related specifics and be required to act quickly in this regard to allow the project to continue efficiently.

4.2.2 Multi-Directional Duties

Most traditional construction contracts seek to limit the parties to whom duties are owed. In direct contrast, IPD proceeds under the theory that projects run more smoothly where all parties formally recognize what exists in practice – that every construction project is a network of inter-linked, roles, commitments and mutual promises.

One result of this approach is a blending of traditional roles. For example, IPD requires that the constructor have greater involvement in the design process. While it is not the case that “constructors design and designers construct” under IPD models, the discrete responsibilities of the two are more intertwined than in traditional models. The blending of roles, while strengthening the creative process, can lead to the question of who is responsible for particular scopes of work. For that reason, a well-drafted IPD agreement clearly spells out individual work scopes. Collaboration is not a substitute for accountability, at least as it pertains to the primary responsibility for performing one’s scope of work.

Current standards of care for designers and constructors remain intact for those activities that are traditionally performed. Nevertheless, IPD requires that, to some extent, the risk of non-performance be shared, thus promoting collaboration across traditional roles and responsibilities. IPD agreements often spread the risk of non-performance across all direct participants. In this way, the designer may directly bear some risk of constructor non-performance, and vice versa. In negotiating agreements and building project team relations, this issue is recognized and addressed up front. The participants necessarily negotiate the level of risk sharing they are jointly comfortable with, on a project-by-project basis.

4.3 Defining and Measuring Project Outcomes

In IPD, as in traditional projects, the risk of failing to meet expectations remains. Because success in IPD is measured by expressly stated shared goals, and in many cases financial consequences flow from attaining, or failing to attain, such goals, IPD agreements clearly spell out project goals and the consequences of success or failure.

The IPD project plan includes project metric values and reporting intervals to monitor progress of the project. Metrics include overall performance of the project as well as the traditional cost, schedule, and scope measurements. Meeting these metrics may also be tied to financial incentives for the parties.

4.3.1 Goals & Standards

Although the team may present alternatives and counsel the owner, goals remain the owner’s province. The owner determines its program and what it wants to achieve. However, standards based upon goals and used to judge project success and compensation are jointly agreed upon. It’s necessary for all parties to be comfortable with the agreed-upon anticipated outcomes, as they may affect potential bonus and compensation structures.

If the goals are simply economic, standards of project duration and cost may adequately measure attainment of these goals. Objective performance criteria, such as energy efficiency, are also easily determined. Quality of

construction and design creativity are less easily measured. These factors may require a weighted index, comparison structures, and independent evaluators. The team also agrees on when the standards will be measured. For example, the team determines if energy efficiency is measured during commissioning, or is averaged over a season or seasons. If lowered maintenance cost is a goal, the team determines when success is measured.

4.3.2 Project Cost

The overall project cost is a prime metric that is established at the project inception and tracked throughout the life of the project with agreed upon emphasis on life cycle and sustainability components. Included are the cost of the actual work, non-incentive based compensation (fees for services) and appropriate contingencies. The potential for a direct connection between the design and quantity survey during all phases creates a powerful tool to determine and manage the project cost. This is one of the prime opportunities to see the efficiency possible with IPD.

A significant benefit of IPD is the opportunity to replace value engineering with target pricing or target value design processes (a form of estimated budgeting). Under many IPD arrangements, significant consequences flow from exceeding (or beating) the target price. Early in conceptualization, the team confirms whether a project can be built for the funds available that will satisfy the owner's goals. Assuming the team validates the budget assumptions, it then pursues target value design. Unlike traditional design processes where design, budgeting, and then redesign is an iterative process, a target value design process uses immediate feedback on budget, schedule and quality to inform the development of the design. It promotes designing to a detailed estimate, rather than estimating a detailed design. For this to be accomplished, information needs to be communicated effectively to all interested parties, feedback received, and decisions made on an open and rational basis. If this is properly done, conventional "value engineering" vanishes. Moreover, by tying the decision process to the schedule, alternatives that require information can proceed on parallel paths until the appropriate "last responsible moment."

To the extent that setting the target price is a collaborative exercise, there are a number of issues to consider. In the first instance, each project participant has a direct pecuniary interest in where the target price is set. The owner's interests often favor a lower price, whereas the designers or contractors may have a financial incentive to seek a higher target price. This conflict is managed through careful participant selection, open book estimating, and proper use of independent consultants.

4.3.3 Project Schedule

One of the main potential benefits of IPD is the reduction of construction time due to the extensive planning and changes to project processes. This benefit is a common determinant in selecting IPD as a preferred process by owners. The ability to link schedule, phasing and detailed construction sequencing during design will provide efficiencies in material procurement. Early ordering of materials by key supporting participant trade contractors to coordinate with the development of the design reduces the time from the completion of design to the beginning of active work on the site of a project.

4.3.4 Project Quality

New technological tools available to IPD team members, including BIM, provide the opportunity to reduce errors within design documents as well as conflicts between trades--all well before purchasing of systems and products. Collaboration among the participants leverages these tools to create an atmosphere where quality of service, design and execution are integral to the project.

The measurement of quality is based upon metrics appropriate to the project type and is compared to previously completed projects of similar nature. As more IPD projects are undertaken by an owner or an industry, quality standards may increase.

4.3.5 Operational Performance

The establishment of performance criteria for major building systems within a project is made during early design and refined as the design proceeds. These are aligned with the project goals and set with the advice of the major trades participating in the project along with the associated design professionals.

The opportunity exists for financial performance metrics of the completed project to be established and tracked after completion. The contribution that the project team makes to the ongoing success of the performance of the finished project due to quality of design and implementation could lead to royalty or other long term financial profit sharing arrangements for those key participants.

4.3.6 Sustainability

One key area of opportunity for improvement from traditional delivery approaches is to set more aggressive goals for sustainability. Metrics can be established for lifecycle goals for all aspects of a project. Ratings criteria such as Green Globes, LEED® or SB Tool may be melded into the overall goals and incremental steps monitored throughout the design and delivery process. The opportunity also exists to set goals for carbon footprint and incorporation of alternative energies.

4.4 Legal Considerations

4.4.1 Non-Standard Contracts

Integrated approaches involve contractual relationships that are quite different from traditional contract models. Modifying a standard non-integrated contract form to call for integration can be a challenge because the approaches are very different. Negotiating and drafting agreements without the aid of prior similar contracts or standard forms can increase the cost of reaching an agreement. The AIA is currently developing standard forms to assist parties wishing to negotiate and execute an IPD agreement.

4.4.2 Professional Responsibility and Licensing

Because project participants remain responsible for individual scopes of work, an IPD approach should not alter traditional requirements with respect to professional or business licenses. Collaboration between designers and constructors does not inherently result in a blending of disciplines. Where assigned work scopes require a constructor to perform design services, it will need to handle that task consistent with registration requirements. This is no different than in the case under a non-integrated approach. If the IPD services are to be provided through a separate legal entity specifically created for the project (e.g. limited liability company), the entity may be required to obtain design and/or construction licenses, depending upon individual state laws.

4.4.3 Insurance

Using BIM and other tools to construct a building virtually in advance of actual construction substantially diminishes the risk of design errors and omissions. If the participants adopt “no suit” clauses, the risk of incurring internal first-party claims for economic loss can be eliminated through these waivers. However, where participants do not waive first party claims but assume non-traditional liability, traditional insurance products may not be available in today’s insurance market. Insurance for third-party claims for personal injury and property damage may also not be available. It is now incumbent upon the insurance industry to develop and offer alternative insurance products that align with the project goals and the specific risk allocation terms established among the IPD project participants.

Furthermore, the development and underwriting of bonding and insurance require a new approach that recognizes the risk sharing framework of IPD. This may require more than the customary interaction with surety and insurance markets. Traditional legal risk management operates on a philosophy that risk follows duty and the more duties one owes to more parties, the more legal risk one incurs.

4.4.4 Entity Formation

While it is entirely possible to structure an IPD project purely through contractual arrangements between the separate participants (and it is anticipated that most will be so formed), it is also possible to carry out such projects through the creation of a single purpose entity, such as a Limited Liability Company (LLC). There can be tax and management issues to address where a separate legal entity is created to carry out the project.

4.4.5 Joint Liability and Joint Venture

IPD arrangements contemplate a high degree of collaborative effort. In many cases, project participants share, to one degree or another, in the success or failure of the overall venture. In this regard, IPD arrangements are more likely to be classified as joint ventures than the independent contractor arrangements typically encountered under traditional models. A unique risk feature of joint ventures is the joint liability of all joint venturers. Therefore, if all major IPD participants are deemed joint venturers, they may be liable to third parties for the failings of their joint venture partners. In this way, the construction team

might well bear the risk of design error and the design team could be at risk for construction errors. This risk can be managed through careful planning (e.g., appropriate insurance products and structuring the legal relationships between the parties) and contract drafting.

In practice, integrated project delivery exhibits fundamental differences from traditional models in two primary areas: team assembly and project phasing / execution. Team assembly is covered generally below; project execution topics are introduced and then explored in detail.

5.1 Building an Integrated Team

The key to successful Integrated Project Delivery is assembling a team that is committed to collaborative processes and is capable of working together effectively. In order to accomplish this, participants must:

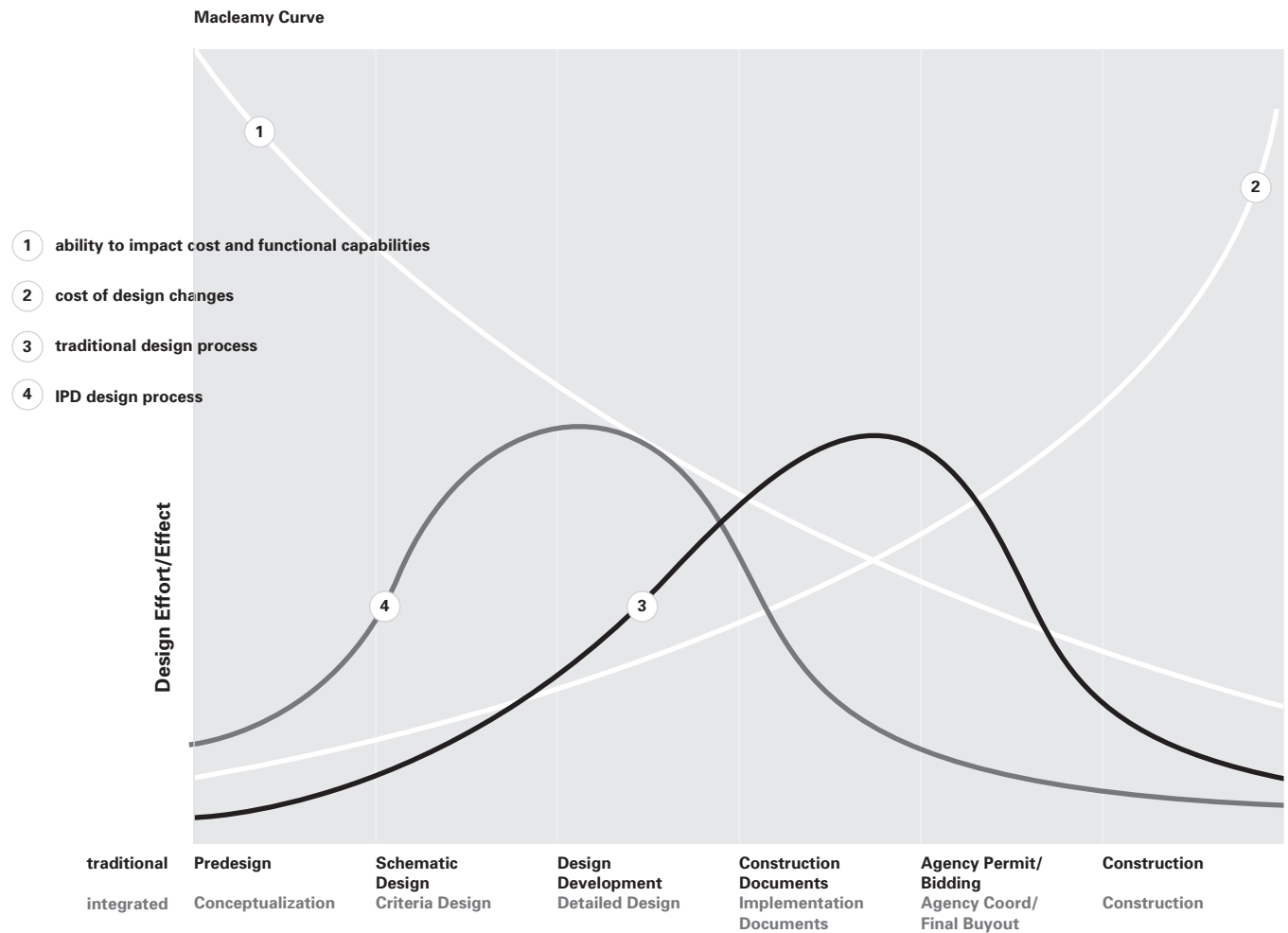
- 1 Identify, at the earliest possible time, the participant roles that are most important to the project.
- 2 Pre-qualify members (individuals and firms) of the team
- 3 Consider interests and seek involvement of select additional parties, such as building official(s), local utility companies, insurers, sureties, and other stakeholders.
- 4 Define in a mutually understandable fashion the values, goals, interests and objectives of the participating stakeholders.
- 5 Identify the organizational and business structure best suited to IPD that is consistent with the participants' needs and constraints. The choice should not be rigidly bound to traditional project delivery methods, but should be flexibly adapted to the project.
- 6 Develop project agreement(s) to define the roles and accountability of the participants. The project agreements should be synchronized to assure that parties' roles and responsibilities are defined identically in all agreements and are consistent with the agreed organizational and business models. Key provisions regarding compensation, obligation and risk allocation should be clearly defined and should encourage open communication and collaboration.

A Note on Building Information Modeling

It is understood that integrated project delivery and building information modeling (BIM) are different concepts – the first is a process and the second a tool. Certainly integrated projects are done without BIM and BIM is used in non-integrated processes. However, the full potential benefits of both IPD and BIM are achieved only when they are used together. Thus, the IPD phase descriptions included here assume the use of BIM.

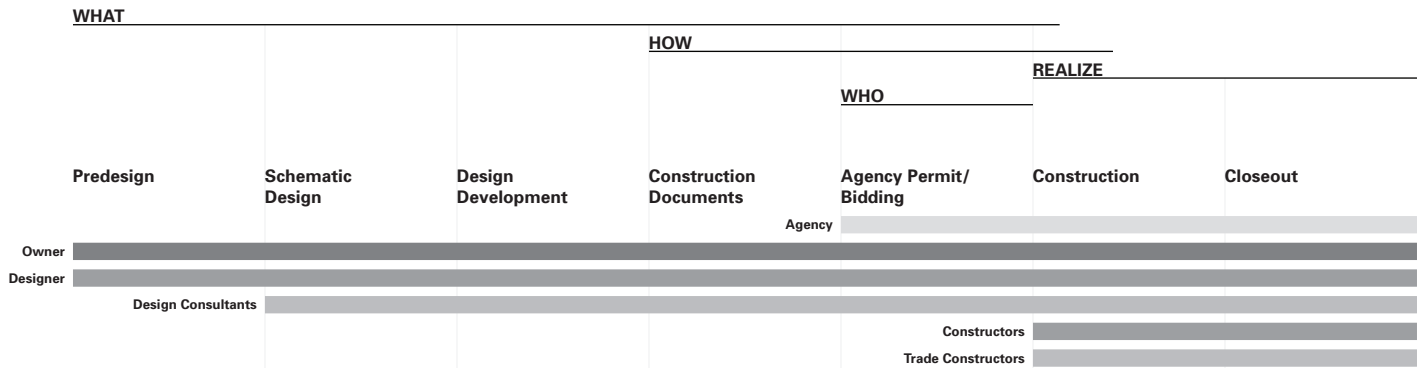
5.2 Project Execution / Redefining Project Phases

In an integrated project, the project flow from conceptualization through implementation and closeout differs significantly from a non-integrated project. Moving design decisions upstream as far as possible to where they are more effective and less costly suggests a re-thinking of typical project phases.

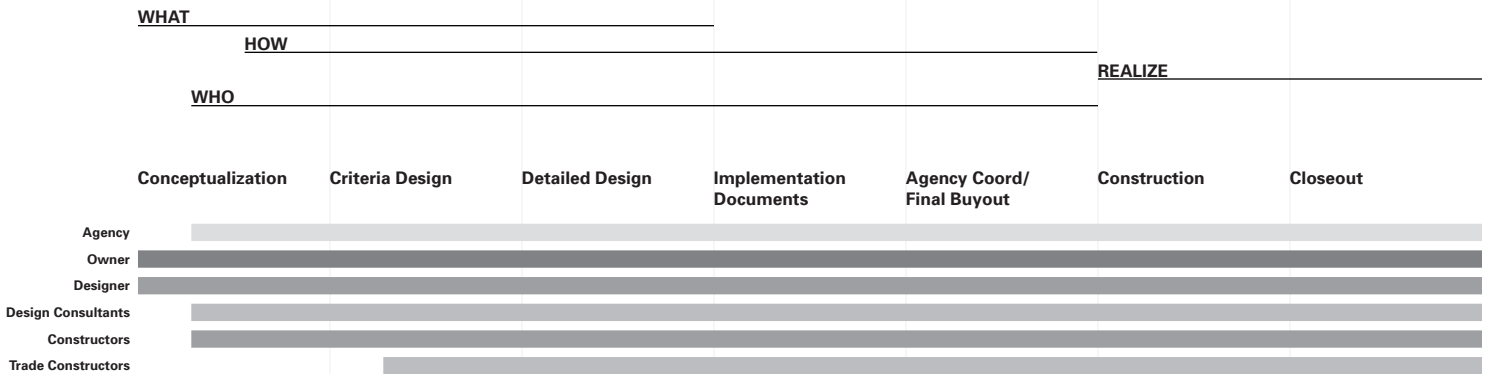


Introduced in the Construction Users Roundtable's "Collaboration, Integrated Information, and the Project Lifecycle in Building Design and Construction and Operation" (WP-1202, August, 2004)", the "MacLeamy Curve" illustrates the concept of making design decisions earlier in the project when opportunity to influence positive outcomes is maximized and the cost of changes minimized, especially as regards the designer and design consultant roles.

Traditional design process



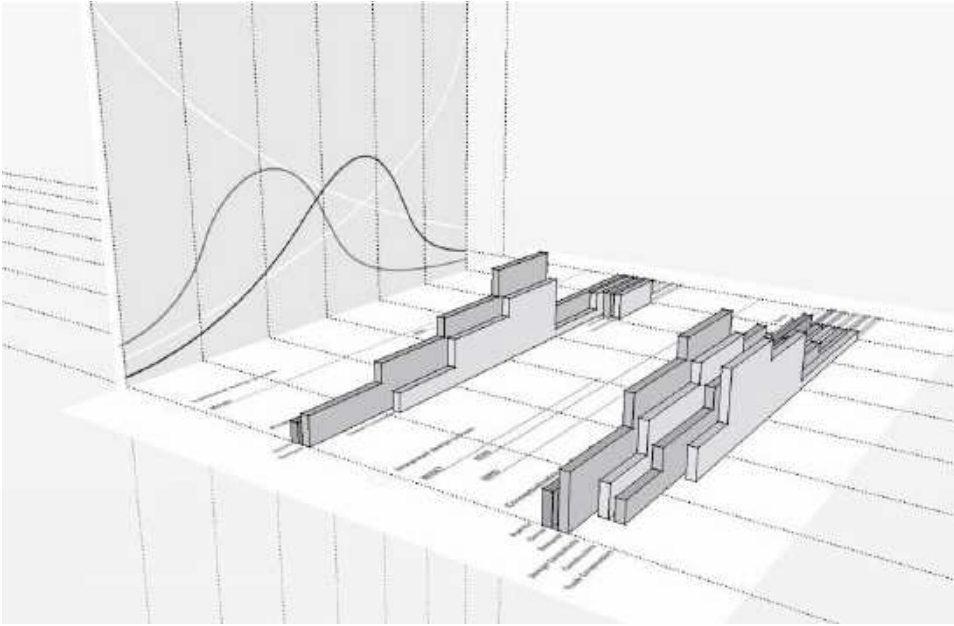
Integrated design process



From the AIA California Council's "Integrated Project Delivery: Working Definition", this diagram compares traditional delivery to integrated delivery, focusing on the shifts of when different aspects of the project are resolved ("Who, What, How, Realize") and when different project participants become involved. New phase names are also introduced.

In addition to shifting design decision making forward, redefinition of phases is driven by two key concepts: the integration of early input from constructors, installers, fabricators and suppliers as well as from designers; and the ability to model and simulate the project accurately using BIM tools. These two concepts enable the design to be brought to a much higher level of completion before the documentation phase is started. Thus the first three phases of the integrated project: Conceptualization, Criteria Design, and Detailed Design (described in detail on the following pages) involve more effort than their counterparts in the traditional flow.

This higher level of completion in earlier project stages means that the next phase, Implementation Documents, requires less effort than the traditional Construction Documents phase, and the early participation of regulatory agencies, trade contractors, and fabricators allows shortening of the fifth and sixth phases, Agency Review and Buyout, as well. The result is that the project is defined and coordinated to a much higher level prior to construction start than is typical with traditional delivery methods, enabling a more efficient Construction phase and a potentially shorter construction period. The IPD phases conclude at project Closeout.



The z-axis suggests levels of “design effort” of project participants during the different phases of the project. The “MacLeamy Curve” backdrop is offered for general comparison to the “shifting forward” concept in the area of design effort. Note in particular the increase in “design effort” of constructors and trade contractors over the traditional model.

The project phase descriptions that follow below in outline format are presented from two perspectives: Outcomes and Primary Responsibilities.

Outcomes—

The breadth of knowledge and depth of collaboration that is the essence of IPD require that phase outcomes – milestones and deliverables – be defined succinctly. These outcome definitions enable all team members to understand the level of detail at which they should be working, and what decisions have (and have not) been finalized so they can proceed with confidence.

Primary Responsibilities—

In an integrated project, all team members provide whatever input they can to all aspects of the project. Here “responsibility” means only that the indicated team member is charged with coordinating, integrating and ensuring the completeness of the task or information needed—it does not suggest that professionally licensed responsibilities are in any way modified or diminished. On many projects, where governing laws don’t dictate otherwise, certain building systems may be provided under design-build arrangements. In such instances, the specialty trade contractor may take on the design consultant’s responsibilities for those systems.

Team leadership under IPD will vary from project to project depending on a number of considerations, such as contractual relationships and the skills of individual team members. The Integrated Project Coordinator (IPC) is primarily a facilitator, and may be a retained third party or one of the team members. In many cases the responsibilities will migrate. For example, the prime designer may be the IPC during the design phases while the prime constructor takes on that role as the project moves into construction.

The following phase descriptions are offered as a point of departure – responsibilities and timing of deliverables will vary according to the needs and priorities of the specific project. References to traditional project phases are included in brackets [] for comparison purposes.

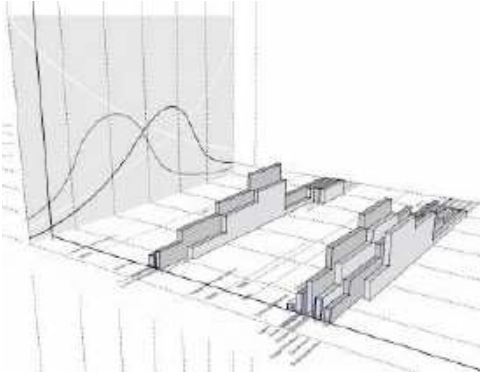


Diagram 1
Conceptualization

5.2.1 Conceptualization [Expanded Programming]

Conceptualization begins to determine WHAT is to be built, WHO will build it, and HOW it will be built.

Outcomes

- Performance goals are developed by the team:
 - Size
 - Sustainable or green criteria or goals
 - Economic performance based on the complete building life span including operation
 - Successful outcome metrics (e.g. cost, schedule, quality, etc.)
- Cost structure is developed earlier and in greater detail than a conventional project.
 - Costs may be linked to Building Information Model to enable rapid assessment of design decisions
 - Costs are detailed by system, providing an understanding of the cost range and importance of each system
 - Key parties assess areas where greatest improvements are possible
 - Initial benchmarking comparison is performed to assess project costs against market rates
- Preliminary schedule is developed and linked to developing model
- Communication methodologies and technologies are identified and key parameters agreed upon
 - Building Information Modeling platform(s)
 - Administration and maintenance of BIM(s)
 - Source of truth for all data
 - Interoperability criteria
 - Data transfer protocols
 - Level of detail development by phase
 - Development of tolerances

Primary Responsibilities

- Owner
 - Establish goals regarding the function and performance of the building, schedule, and budget based on organization's business case
 - Provide project funding establish critical financial milestones
 - Determine method of project procurement
 - Lead selection of integrated project team
 - Provide site data such as topography, utility locations, soils condition, environmental impact studies and reports, Phase I mitigation reports
 - Provide parameters of owner construction policies and programs regarding insurance, safety and risk mitigation
 - Establish internal processes and organization for user input, reviews, approvals and decision making
 - Provide team with information about legislative or jurisdictional requirements affecting project

- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
 - Team's compliance with owner's requirements
 - Overall project schedule
 - Completeness of necessary project information
- Prime Designer
 - Validation of opportunities and options of the business proposition to the physical outcome of the project
 - Confirm space program meets code requirements and applicable standards and is aligned with overall project goals
 - Visualize massing of building and adjacency concerns on its site
 - Identify sustainable design outcomes that have a cost impact to the project
 - Design schedule
- Design Consultants
 - Feedback on building systems relative to achieving project performance goals
 - Identify unique project and system requirements that will effect project outcomes
- Prime Constructor
 - Cost information: comprehensiveness and integration into model.
 - Constructability
 - Initial procurement and construction schedule, including integration into model
- Trade Contractors
 - Initial cost data for their scope of work
 - Cost options for applicable scope of work
 - Constructability for applicable scope of work
 - Initial schedule data for applicable scope of work
- Suppliers
 - Specific cost data
 - Identification of long lead items
 - Product data sheets
 - Life cycle and energy efficiency data
- Agencies
 - Input regarding project constraints, code requirements, and testing and inspection requirements
 - Validation of application/review schedule

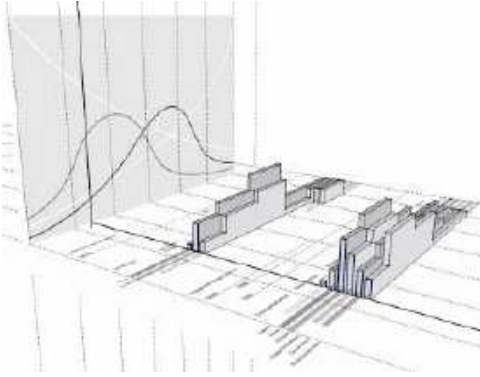


Diagram 2
Criteria Design

5.2.2 Criteria Design [Expanded Schematic Design]

During Criteria Design, the project begins to take shape. Major options are evaluated, tested and selected.

Outcomes

- The following aspects of the project are finalized, allowing the team to proceed with confidence to the next level of detail:
 - Scope
 - Form, adjacencies and spatial relationships
 - Selection and initial design of major building systems (structure, skin, HVAC, etc.)
 - Cost estimate (at appropriate precision)
 - Schedule (at appropriate precision)
- Agreement is reached on tolerances between trades to enable prefabrication.

Primary Responsibilities

- Owner
 - Final arbiter, after consultation, regarding project goals and standards
 - Establish decision criteria to evaluate proposals with respect to current and future operations
 - Decisions based on available options
 - Facilitate site specific/user input and coordinate it with the team
 - Facilitate user group reviews and feedback to team regarding revisions
 - Reviews and approval of criteria documents
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
 - Lead selection of integrated team members
 - Coordinate assignment of responsibilities, actions and completion requirements
 - Coordinate and track integrated team's performance
 - Coordination of overall project schedule
- Prime Designer
 - Integration of design input from all team members
 - Confirm user experience of building as it relates to project goals
 - Form, adjacencies and spatial relationships of the project
 - Coordinate selection of major building systems and performance requirements
 - Regulatory requirements for the building (i.e.: fire/life safety plan)
 - Sustainability targets and proposed systems
 - Outline or Performance Specification
 - Refinement of design schedule

Design Consultants

- Selecting major building systems and setting performance requirements
- Locate major pieces of equipment and routing in the project
- Identify unique conditions that need to be addressed in the next phase as the systems are being detailed

Prime Constructor

- Continuous cost feedback using information extracted from the model. At this phase many items may be conceptual, i.e., based on floor area or unit counts
- Validation of target cost
- Refinement of construction schedule
- Constructability issues
- Initial discussion of tolerances and prefabrication opportunities

Trade Contractors

- Validate target cost for applicable scope of work
- Validate schedule for applicable scope of work
- Provide input for tolerances, prefabrication opportunities
- Assess compatibility with the design and work of other trades

Suppliers

- Validate target cost for specific items
- Validate lead times for long-lead items
- Provide input for tolerances, prefabrication opportunities

Agencies

- Permit application requirements and schedule
- Validation of fire/life safety plan
- Performance-based code analysis can begin using the BIM

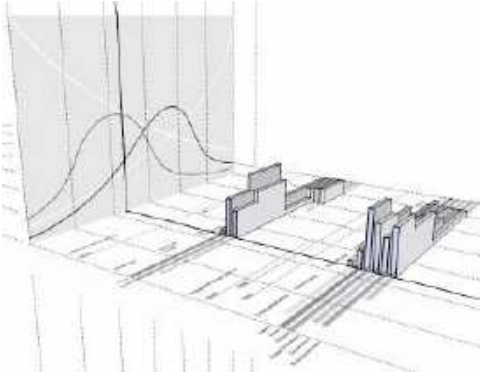


Diagram 3
Detailed Design

5.2.3 Detailed Design [Expanded Design Development]

The Detailed Design phase concludes the WHAT phase of the project. During this phase, all key design decisions are finalized. Detailed Design under IPD comprises much of what is left to the Construction Documents phase under traditional practice, thus the Detailed Design phase involves significantly more effort than the traditional Design Development phase.

Outcomes

- Building is fully and unambiguously defined, coordinated and validated
 - All major building systems are defined, including any furnishings, fixtures and equipment within the scope of the project
 - All building elements are fully engineered and coordinated. The team will have collaborated to resolve any inconsistencies, conflicts or constructability issues
 - Agreement is reached on tolerances between trades to ensure constructability and to enable as much prefabrication as possible.
 - Quality levels are established
- Prescriptive Specifications are completed based on prescribed and agreed systems
- Cost is established to a high level of precision
- Construction schedule is established to a high level of precision

Primary Responsibilities

- Owner
 - Provide decisions and guidance to all alternative options
 - Approve the design prior to implementation documentation phase, allowing the team to proceed with confidence
 - Be the arbiter of changes to the design and overall acceptability as it relates to performance
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
 - Coordinate alternative options for presentation to Owner
 - Coordinate and track integrated team's performance
 - Ensure compliance with project requirements
 - Lead performance checking of building systems from the Integrated
 - Team's stakeholders
- Prime Designer
 - Coordinate and integrate input from project stakeholders and ensure compliance with project requirements
 - Detail concept ideas into constructible form
 - Code compliance
- Design Consultants
 - Complete design of building systems
 - Verify system performance

Prime Constructor

- Provide continuous cost feedback using information extracted from the model; all item quantities are based on quantity survey or lump sums provided by Trade Contractors and suppliers
- Verify that cost is all-inclusive and accurate
- Verify prefabrication decisions
- Verify construction schedule
- Finalize coordination of building systems, including MEPS
- Verify tolerances

Trade Contractors

- Provide input for coordination and conflict resolution.
- Provide detail-level models for applicable scope of work, adjust models to coordinate with other systems
- Verify cost for their scope of work
- Verify schedule for their scope of work

Suppliers

- Provide input for coordination and conflict resolution
- Provide models of specific items
- Verify cost for specific items
- Verify schedule for long lead items
- Verify tolerances for specific items

Agencies

- If performance-based code analysis using the BIM is underway, it is expanded here

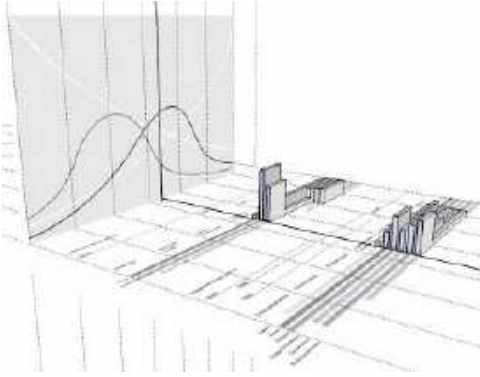


Diagram 4
Implementation Documents

5.2.4 Implementation Documents [Construction Documents]

During this phase, effort shifts from WHAT is being created to documenting HOW it will be implemented. The goal of ID phase is to complete the determination and documentation of how the design intent will be implemented, not to change or develop it.

The traditional shop drawing process is merged into this phase as constructors, trade contractors and suppliers document how systems and structure will be created. In addition, this phase generates the documents that third parties will use for permitting, financing and regulatory purposes.

Because the Detailed Design phase concludes with the design and all building systems “fully and unambiguously defined, coordinated and validated,” the Implementation Documents phase comprises less effort than the traditional Construction Documents phase.

Outcomes

- Construction means and methods are finalized and documented
- Construction schedule is finalized and agreed upon
- Cost is finalized and agreed upon
- Costs are tied to the model
- The specifications are finalized, supplementing the model with narrative documentation of the design intent wherever necessary
- Implementation Documents define and visualize the project for participants who aren’t involved in the development of the model, providing:
 - A “finance-able” project (a completed model that gives “the bank” sufficient detail to finance the project)
 - Bid documents for parties outside the integrated process
- The “shop drawing” phase that in traditional phases occurs after Construction Documents will be largely completed during the Implementation Documents phase
- Prefabrication of some systems can commence because the model is sufficiently fixed (object sizes and positions are frozen) to allow early purchasing and prefabrication to begin

Primary Responsibilities

- Owner
 - Verify project performance targets and business case
 - Final approval of project scope and metrics
 - Coordinate financial requirements necessary to begin construction
 - Facilitate final user reviews and approvals
 - Initiate transition planning to utilize completed project
 - Establish user appeals process
 - Finalize specifications for major equipment
 - Define owners requirements for construction safety programs and controls regarding Interim Life Safety, noise, vibration, infection control
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
 - Coordinate complete information for legal requirements of project as it relates to the owner’s procurement method
 - Coordinate team input and facilitating team buy-in for overall project schedule and budget
- Prime Designer
 - Finalize model for architecturally related design intent for construction
 - Provide descriptive information for fabrication and construction of architecturally related scope
 - Finalize specifications
- Design Consultants
 - Finalize model for consultant’s related design intent for construction
 - Provide descriptive information for fabrication and construction of consultant’s related scope
 - Finalize specifications
- Prime Constructor
 - Control of the BIM may transfer from the Prime Designer to the Prime Constructor at the conclusion of Detailed Design
 - Finalize construction schedule through 4D modeling
 - Finalize construction cost through 5D modeling
 - Complete information for:
 - Procurement
 - Assembly
 - Layout
 - Detailed schedule
 - Procedural information (testing, commissioning)
 - Ensure that all necessary work is accounted for.
- Trade Contractors
 - Finalize cost and schedule for applicable scope of work.
 - Ensure BIM and specifications include sufficient and unambiguous information for completion of applicable scope of work.
 - Technically sophisticated Trade Contractors will augment the design model in lieu of preparing separate shop drawings, or will create a synchronized model for fabrication or installation purposes
 - Develop implementation information for applicable scope to shop drawing level
- Suppliers
 - Finalize cost and schedule for their specific items
 - Technically sophisticated suppliers will augment the design model in lieu of preparing separate shop drawings, or will create a synchronized model for fabrication or installation purposes
 - Develop implementation information for their scope to shop drawing level
- Agencies
 - Verify completeness of permit submittals

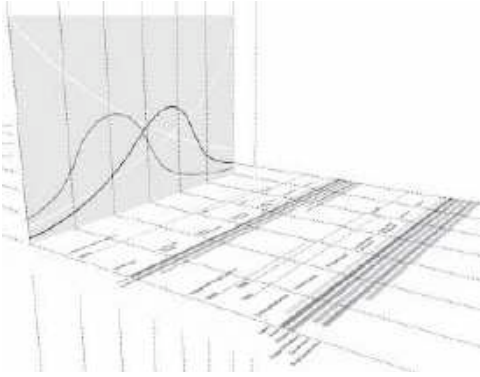


Diagram 5

Agency Review

no design effort in this phase

5.2.5 Agency Review

Use of BIM and early involvement and validation by agencies shortens the final permitting process.

Agency Review commences in Criteria Design and increases in intensity during the final review period. This early involvement minimizes agency comments and required changes to the design as submitted for permit.

Building Information Models have the ability to provide information either directly or through linked databases that can enhance and streamline a reviewing agency's ability to check the design for building code or regulatory criteria. In addition, analysis software can use the model information to generate performance or criteria analyses that validate the design.

Outcomes

- All necessary permits and approvals

Primary Responsibilities

- Owner
 - Final arbiter and lead strategy regarding negotiations with jurisdiction providing permits
 - Facilitate project teams response to modifications required by jurisdiction
 - Obtain permits and approvals
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
 - Overall coordination and management of the Agency Review process
- Prime Designer
 - Interface with agency representative to ensure code compliance of design is understood
 - Coordinate the BIM to ensure code compliance is demonstrated in a mutually agreed interoperable format
- Design Consultants
 - Interface with agency representative to ensure code compliance of their scope of the design is understood
 - Provide scope-specific input to the BIM to ensure code compliance is demonstrated in a mutually agreed interoperable format
- Prime Constructor
 - Coordinate applications for construction-related permits (cranes, street closure, etc.)
- Trade Contractors
- Suppliers
- Agencies
 - Schedule for application submittals and review completion.
 - Review and approval of design and construction plan
 - If performance-based code analysis using the BIM is underway, it is finalized here

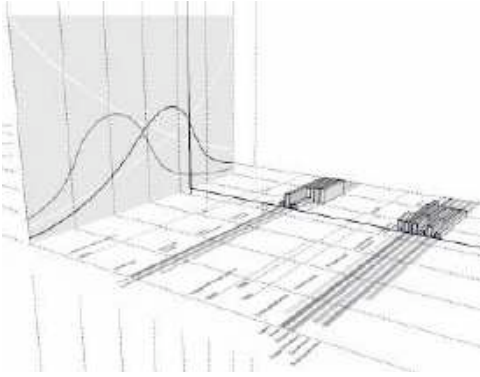


Diagram 6

Buyout

5.2.6 Buyout

IPD assumes early involvement of key trade contractors and vendors, so buyout of work packages they provide occurs through development of prices throughout the design phases, culminating at the conclusion of Implementation Documents. Accelerated project definition during Criteria and Detailed Design allows early commitment for procurement of long lead, custom, or prefabricated items. The IPD Buyout phase is much shorter than under traditional delivery methods, since most work is already contracted for.

Outcomes

- Commitments are in place for all work, materials and equipment needed to complete the project

Primary Responsibilities

- Owner
 - Final arbiter of requirements for pre qualification requirements
 - Define organizations requirements for outreach
 - Participate in pre bid conferences and provide organizations requirements affecting bidders
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
- Prime Designer
 - Respond to questions from remaining trades bidding on the project
 - Respond to pre-fabrication studies to ensure integrity of the design intent.
- Design Consultants
 - Respond to questions from remaining trades bidding on the project
 - Respond to pre-fabrication studies to ensure integrity of the design intent.
- Prime Constructor
 - Ensures that commitments are in place for all work needed to complete the project.
 - A variety of negotiating strategies may be used, based on the level of participation of the provider in the integrated model
 - Work packages can be bid based on quantities extracted from the model
 - Overall coordination and management of the buyout process
- Trade Contractors
- Suppliers
- Agencies

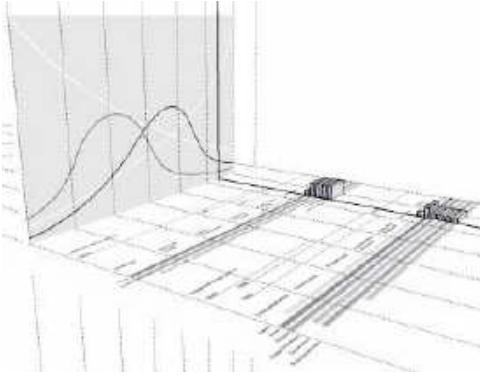


Diagram 7
Construction

5.2.7 Construction [Construction/Construction Contract Administration]

In the Construction phase, the benefits of the integrated process are realized. For architects under traditional delivery models, construction contract administration is considered the final stage of design—the last chance to address issues and achieve solutions. But in Integrated Project Delivery, the design and its implementation are finalized during the Detailed Design and Implementation Documents phases. Thus, construction contract administration is primarily a quality control and cost monitoring function. Because of the greater effort put into the design phases, construction under IPD will be much more efficient.

Outcomes

- Substantial Completion of the project, characterized by:
 - Virtually no RFIs from major trades because prime constructor, key trade contractors and key vendors have been involved in developing the design intent and implementation
 - Less construction administration effort required because submittals for key scopes of work have already been integrated into the model and conflicts have been resolved virtually
 - Better understanding of design intent by all participants because the BIM provides effective visualization
 - More pre-fabrication resulting in:
 - Less waste because more assemblies are factory generated.
 - Fewer injuries because more work is being performed in a more controlled environment
 - A schedule tied to the model to allow visualization of crew coordination and deviations from planned sequences and durations
 - Some elements of current construction administration will remain similar to current practice
 - Quality control, inspection and testing will be relatively unchanged
 - Changes within the agreed project scope will be virtually eliminated, but owner-directed changes will need to be formally negotiated
 - Scheduling and progress will be periodically reviewed

Primary Responsibilities

- Owner
 - Monitor organization need for change based on revisions to business case
 - Manage Owner's contractual obligations
 - Manage Owner's internal review and decision process
 - Manage Owner's transition process to occupy and startup of completed project
 - Organize equipment procurement and staging
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team

— Prime Designer

- Overall responsibility for Construction Contract Administration from a design perspective
- Respond to RFI's and processing of submittals as required to support trades not part of the initial design activities
- Coordinate RFI and submittal responses from all design consultants
- Provide updates to BIM as required responding to field conditions and Design Consultant needs
- Coordinate any changes due to field conditions not foreseen in the BIM.
- Issue design change documents as required to respond to latent conditions and or owner-directed changes
- Review change requests to confirm entitlement
- Work with prime constructor to ensure the construction is proceeding in conformance with design intent
- Issue substantial and final completions documents

— Design Consultants

- Respond to RFI's and processing of submittals as required to support trades not part of the initial design activities
- Provide updates to BIM as required responding to field conditions
- Coordinate any changes due to field conditions not foreseen in the BIM
- Issue design change documents as required to respond to latent conditions and or owner directed changes
- Review change requests to confirm entitlement
- Work with prime constructor to ensure the construction is proceeding in conformance with design intent
- Issue substantial and final completions documents

— Prime Constructor

- Coordinate trade contractors, suppliers, and self-performed work to ensure completion of the project according to budget, schedule and quality goals defined by the project team
- Ensure safety of all personnel on the project site
- Maintain good relations with neighbors
- Coordinate with regulatory agencies for required inspections

— Coordinate required testing

— Trade Contractors

- Coordinate their activities with the overall project to ensure efficient flow of work.

— Suppliers

- Coordinate fabrication and delivery of materials/assemblies/equipment to ensure efficient flow of work.

— Agencies

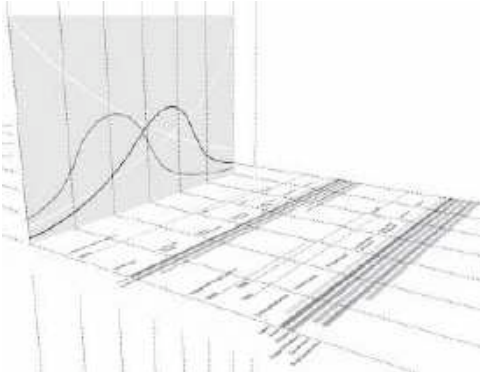


Diagram 8
Closeout

5.2.8 Closeout

An intelligent 3D model can be delivered to the owner.

Closeout of an integrated project greatly depends upon the business terms agreed by the parties. For example, if the business structure contains compensation incentives or penalties, the closeout includes calculation of appropriate credits or deducts. Some issues, however, such as warranty obligations, occupancy, and completion notification, remain unchanged due to statutory and legal requirements. Other issues, such as punch list correction, are not significantly affected by integrated project delivery.

Outcomes

- A complete building information model reflecting “as-built” conditions will be provided to the owner for long term use for building management, maintenance and operation. This model can also be used for:
 - Integration of building monitoring, control and security systems
 - Comparing actual performance of building and systems to planned performance
 - Referencing of warranty, operation and maintenance information
- Traditional warranties will remain for installation quality and defective products.

Primary Responsibilities

- Owner
 - Training of operation and maintenance personnel
 - Complete jurisdictional requirements for occupancy and project completion
 - Initiate continual monitoring of project with respect to project goals and metrics related to performance
- Integrated Project Coordinator
 - Overall facilitation, coordination, organization and direction of the integrated team
- Prime Designer
 - Work with owner on user needs to use the BIM for life cycle benefit.
 - Document and or analyze any Post Occupancy Evaluation feedback
- Design Consultants
 - Work with owner on user needs to use the BIM for life cycle benefit.
 - Document and or analyze any Post-Occupancy Evaluation feedback
- Prime Constructor
 - Finalize the BIM to correspond with built conditions.
- Trade Contractors
 - Provide Operation & Maintenance (O&M) information for applicable scope of work
- Suppliers
 - Provide O&M information for applicable scope of work
- Agencies

In a multi-party agreement (MPA), the primary project participants execute a single contract specifying their respective roles, rights, obligations, and liabilities. In effect, the multi-party agreement creates a temporary virtual, and in some instances formal, organization to realize a specific project. Because a single agreement is used, each party understands its role in relationship to the other participants. Compensation structures are often open-book, so each party's interests and contributions are similarly transparent. Multi-party agreements require trust, as compensation is tied to overall project success and individual success depends on the contributions of all team members. For a MPA to be successful, the participants must be committed to working as a team to achieve team goals.

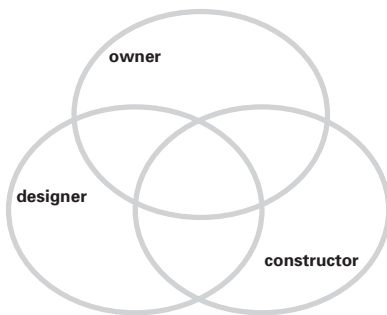
The tight integration of MPAs combined with project-based decision making and compensation promotes excellent team performance. Although important on all projects, the supportive qualities of multi-party agreements are well suited to projects that are complex or uncertain, because tightly integrated teams are flexible and creative.

Multi-party agreements require thorough planning, careful negotiation, and intensive team building efforts. This process can be costly and must occur during the earliest stages of project conception. This is especially true if the participants have little prior experience with multi-party agreements or with each other. Although this overhead cost is easily absorbed on large projects, on smaller projects the overhead can be reduced by using team members with prior collaborative experience.

Multi-party agreements vary in form, responding to the specific needs of a project and its participants. However, these variations share several key attributes:

- ☐ The parties are bound together by a single agreement or an umbrella agreement;
- ☐ The agreement creates a temporary, virtual or formal, organization complete with management and decision making processes;
- ☐ Processes are tailored to support the team environment;
- ☐ Decisions are arrived through consensus and seek “best for project” outcomes;
- ☐ Some portion of compensation is tied to project, not individual, success; and
- ☐ Roles are assigned to the person or entity best capable of performing.

Diagram 1
Multi-Party



6.1 Contractual Agreements

Despite the custom nature of multi-party agreements, three general forms have emerged: Project Alliances; Relational Contracts; and Single Purpose Entities. Each will be discussed in greater detail below.

6.1.1 Project Alliances

Project Alliances were developed to support oil exploration in the North Sea. To meet these challenges, the parties created a project structure where the owner guaranteed the direct costs of non-owner parties, but payment of profit, overhead and bonus depended on project outcome. This compensation scheme bound the parties to succeed or fail together. To reinforce Alliance teamwork, all significant decisions were made by facilitated consensus and the parties waived any claim between them, except for willful default. Since their development by the North Sea oil industry, Project Alliances have been extensively used in Australia for large civil works and vertical construction, have seen continued use in the United Kingdom, and are beginning to be adopted in the United States. An excellent description of the Australian experience that contains detailed implementation recommendations, is found in the Project Alliancing Practitioners' Guide (2006) published by the Government of Victoria.

6.1.2 Single Purpose Entities

A Single Purpose Entity (SPE) is a temporary, but formal, legal structure created to realize a specific project. The SPE can be a corporation, limited liability company, limited liability partnership, or other legal form. In an integrated SPE, 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 any services they provide to the SPE. However, an additional element of compensation is tied to overall project success.

The creation of a new, independent legal entity raises additional issues regarding taxation, corporate formalities, and management. Because the SPE is a separate entity, it must also be adequately insured.

6.1.3 Relational Contracts

Relational Contracts are similar to Project Alliances in that a virtual organization is created from individual entities. However, it differs in its approach to compensation, risk sharing and decision making. In a relational contract, the parties may 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. Decisions are developed on a team basis, but unlike the Project Alliance, the owner usually retains final decision rights in the absence of team consensus.

Because the balance of accountability, risk and control in Relational Contracts more closely follows traditional project structures, they may be better suited to the needs and risk profiles of certain projects and participants. In addition, Relational Contracts may offer a transitional structure to a more completely integrated approach.

Relational contracts are more common in other areas of commercial activity. Strategic alliances among commercial firms grounded on trust arrangements often proceed on a relational contracting basis. These combinations are governed more by personal relationships than by the terms of any formal contract. See Stewart Macaulay, *Non-Contractual Relations in Business: A Preliminary Study*, 28 Am. Soc. Rev. 55 (1963); Stewart Macaulay, *An Empirical View of Contract*, 1985 Wis. L. Rev. 465; David Campbell, Ian MacNeil, *Relational Theory of Contract* (2004).

6.2 Process Design

Process design is critical in Multi-Party Agreements. Incentives, accountability, communications, decision structures and many other factors are balanced and blended on a project-by-project basis. Paragraphs 3-5 below set forth the factors to consider in evaluating MPAs. Where these factors differ among Project Alliances, Relational Contracts or SPEs, those variations are separately discussed.

6.3 Decision Making

Ultimate decision making varies between multi-party project models. In Project Alliances, upper level decisions are made by facilitated consensus. There are no “tie-breakers” or dispute resolution. This structure forces the parties to negotiate. In a SPE, ultimate authority vests in a board of directors or board of control. The membership of this board and its authority are determined on a project-by-project basis. In Relational Contracts, decisions are discussed and resolved by consensus at the team level, but the owner retains ultimate authority.

However, decisions need to be made on a micro, as well as a macro, level. For that reason, the project protocols determine areas of responsibility for decision making. For example, structural integrity remains the structural engineer’s province and while other parties may recommend, the structural engineer decides whether a proposed modification is acceptable. Collaboration needs flexibility, but it also needs structure.

6.4 Sequencing and Phasing

With two exceptions, the tasks performed by each party during the project are very similar to the tasks performed by the parties under the Construction Manager as Constructor (CMc) project delivery approach. A detailed discussion of those tasks is contained below in Paragraph VII. b.

The two exceptions occur during Conceptualization and Closeout. At the beginning of Conceptualization, the team is formed and engages in an intense process design effort that creates the structure and team work for all that follows. Closeout is the mirror of process design. It is the stage where the project’s success is evaluated and the fruits of collaboration distributed. These two efforts form the core of MPAs and are described in detail in Paragraph VI. 5. iv.

6.5 Risks and Rewards

6.5.1 Compensation

6.5.1.1 Project Alliance

Compensation in the Project Alliance model is used to allocate the risk of poor project outcomes while creating incentives to achieve project success and thereby control risk. The owner bears primary responsibility for major cost overruns. Responsibility for minor overruns is borne by the non-owner participants who also share in potential gains. These goals are accomplished through a three-limb compensation system.

The first limb is the direct cost of designing and executing the project, including direct costs and field overhead. The second limb, the pain share, is the normal overhead and profit each non-owner participant usually receives based on auditing historical projects. The third limb, the gain share, is a bonus the non-owner participants obtain if the project is more successful than initially planned. Whether a non-owner participant will receive compensation under the second or third limbs depends on whether the project meets or exceeds its goals. For example, if a project's direct costs exceed the anticipated Target Outturn Costs (the jointly agreed anticipated project cost), the non-owner participants receive their actual costs, without any corporate overhead or profit. If the project achieves its goals, the non-owner participants receive their normal overhead and profit in addition to their costs. If the project exceeds its goals, the non-owner participants receive a gain share bonus. Because the non-owner participants never place their direct costs at risk, the owner is the primary risk bearer for catastrophic overruns. Compensation is directly tied to project success and thus the participants must cooperate to maximize their individual returns.

The Project Alliance approach has three principal hurdles. First, the anticipated outcomes must be accurately described and quantified. Next, the parties must determine when and how the outcomes are measured. Finally, formulas must be crafted to appropriately reward participants for their contribution to the project.

Quantifying outcomes is critical to Project Alliance success. If the success criteria are quantitative, such as cost-to-budget or duration-to-schedule, formulas can be created to determine the level of project success. But even in these simple cases, care must be taken to correctly set the level for each project criteria. For example, if the principal criterion is cost, the target must not be too low, thus making it very difficult for the participants to achieve the goal, nor too high, which makes achieving the gain share too easy. Moreover, it is important to clearly delineate what project costs will be used when comparing to the project goal. Because this negotiation is sensitive and critical, the assistance of an independent cost estimator may be useful. Although it is convenient to analyze the Project Alliance delivery method using cost as the only success variable, Alliances

have also used indexes based on quality or other performance goals. Qualitative goals are more complex, but an index or scoring system can be used to turn qualitative into quantitative results. To increase objectivity, a third party can use the scorecards to “grade” the qualitative goals.

Contingencies are related to project outcome levels and must be directly addressed. In theory, the Project Alliance approach does not have explicit contingency funds, but setting the target cost higher than absolutely necessary effectively creates a design and construction contingency. Contingency can also be built into the labor rates used for the direct cost calculations, so these need to be audited for their relationship to actual cost. If there are contingencies, they should be explicit, not implicit, and should be managed on a project, not an individual, basis.

Once targets are established, the parties must determine when and how they are measured. If cost is the only criteria, it can generally be determined at project closeout. But if the criteria include energy efficiency or operational costs, time will be required to determine success. In this event, an appropriate duration and testing regime must be developed during process design. It may also be possible to reserve part of compensation for determination at this later date. Timing of final measurement may also be affected by warranty periods.

Measurement of the direct costs is theoretically simple, but practically complex. Manufacturers, fabricators, contractors and design professionals all use differing accounting approaches. Because direct costs can be manipulated to include aspects of overhead, profit or contingency, it is important that all calculations be based on completely open books. In addition, the parties may want to retain an independent accountant to determine how direct costs should be measured for each party. Accurate measurement of direct costs relates directly to creating appropriate gain and pain sharing formulas. If overhead, profit or contingency creep into a party’s direct costs, the compensation and risk allocation are effectively changed.

The formulas for gain and pain sharing should consider the parties’ respective contributions, and not simply be based on a percentage of costs. However, the traditional profitability of different professions and trades may inform, although not control, the discussions. It may also be possible to balance contributions differently depending upon the criterion. For example, the MEP engineers and contractors may share more liberally in energy savings, whereas the constructor and designer would have a larger percentage of overall cost savings.

6.5.1.2 Single Purpose Entity

In a SPE, participant compensation is divided into two tiers. The first tier reflects payments by the SPE to the individual participant, either under a standard contract for services or terms set forth as an exhibit to the entity’s governance documents. Although infinite variations are possible, commonly these agreements are cost-plus or negotiated lump sum-plus fee.

The second compensation tier is tied to the success of the project itself. In instances where the SPE independently owns the project, this second compensation tier is reflected in the value of the participant's equity interest. This value is captured by the participant when the project is sold, or from operational revenues, if the project is held by the SPE after completion.

In instances where the SPE does not own the project, and the entity is instead formed solely to facilitate the design and construction of the project in a fully integrated manner, this second compensation tier will take the form of an incentive program from which the equity owners providing services may receive additional compensation based on a successful project. The methods of compensation in this instance would be similar to the performance-based bonuses discussed below in the Relational Contracts section.

The ratio between the value of this second compensation tier to the amount of direct compensation creates a "spectrum of integration." If the second compensation tier predominates, total compensation is greatly dependent on project success. At this edge of the spectrum, the SPE compensation plan is somewhat similar to a Project Alliance. If direct payments predominate, then project success is a less critical factor and the SPE compensation plan more closely resembles traditional project delivery methods.

As with Project Alliances, the benefit allocations should be based on relative risk and the parties' respective contributions.

6.5.1.3 Relational Contracts

Compensation in a relational contract varies with the parties' needs and creativity. However, the basic approach uses direct cost, a fixed, negotiated sum for overhead and profit for each participating entity, and a variable performance-based bonus. The bonus should be tied to project success, rather than individual goals and can include criteria such as schedule, quality and performance. The compensation method may or may not involve a guaranteed maximum price for the project or any particular scope of work. When guaranteed maximum prices are provided by each trade, parties may try to reduce their risk by including contingencies in their individual contract amounts. However, this artificially raises the estimated project cost because each individual contingency, when summed, exceeds the contingency required for the entire team. Thus, one approach requires the parties to show, through audit if required, that their individual contract amounts have no additional contingency buried in labor productivity or overhead rates. The individual contingencies are replaced with a general project contingency that is available for design or construction errors.

Setting accurate and fair target outcomes is subject to the same issues discussed under Project Alliances. In addition, where aggressive targets are used, i.e., targets that are distinctly better than traditional outcomes, it may be appropriate to include a compensation band that is available as an incentive for innovative solutions to achieve the aggressive targets.

6.5.2 Dispute Resolution

Dispute resolution under the Project Alliance model is very simple. The parties agree to waive any claim against each other except for willful default. As a result, no dispute resolution mechanism is required among the Project Alliance participants.

SPE and relational contract projects require that dispute resolution be addressed. In general, the dispute resolution procedures should form a progression from direct negotiation, to facilitated negotiations (such as mediation) and finally binding resolution (such as arbitration or litigation). Regardless of the specific procedure chosen, every emphasis should be placed on developing a system that encourages and facilitates internal resolution of disputes. The internal resolution of disputes will allow the integrated and collaborative process to continue. As the parties are forced to resort to external dispute resolution procedures, they are taking steps away from integration, toward the adversarial relationship that exists within the traditional delivery process. A critical ingredient of IPD is continuity of purpose among the team members. If the team members must resort to external means of dispute resolution, that continuity of purpose is destroyed.

Regardless of the MPA type chosen, there will be some project participants, such as sub-tier constructors, consultants and vendors, that are not party to the MPA. Contracts with these non-participants should include dispute resolution provisions and the MPA should determine whether claims of specific non-participants are the responsibility of the MPA or its individual members. In addition, all projects have the potential for third-party claims due to structural or operational failures, personal injuries, economic losses or otherwise. In general, these third-party risks should be addressed by appropriate insurance.

6.5.3 Risk Allocation

Risk is a function of the likelihood of a loss weighted by its severity. In contrast, exposure to risk is the number of possible avenues by which loss can occur. For example, the increased interdependence of collaborative projects increases the number of parties relying on another party's contributions and who could potentially initiate a lawsuit. But the same interdependent web can reduce the likelihood and severity of loss. Exposure may increase, although true risk decreases.

Discussions of risk often focus on the liability issues resolved in courts and arbitration proceedings. However, the business risks faced by design and construction entities, such as cost overruns, failure to meet project goals, and market uncertainties, occur far more often and are far more serious than the liability risks. When evaluating project delivery alternatives, parties should determine how the different alternatives mitigate the business risks faced by the project and its participants, as well as how they respond to liability concerns.

6.5.3.1 Project Alliance

6.5.3.1.1 Project Outcomes

The risk of poor project outcomes is shared among Project Alliance participants, but in differing degrees. The non-owner participants are guaranteed their direct costs and thus only risk their overhead, profit and potential bonus. In contrast, the owner's risk is unlimited, tempered only by the cost reduction in payments to the non-owner participants.

In larger projects, owners may be able to offset their risks with insurance related to delay in completion, operational hazards or other economic risks. The owner's risk may also be mitigated by pre-leasing, price guarantees, or other methods of controlling market risks.

6.5.3.1.2 Liability

The Project Alliance participants agree to waive liability among each other except for willful default. Willful default does not occur unless a party abandons the project. For all practical purposes, there are no liability concerns within the Project Alliance. However, the Project Alliance, and its participants, are still liable for damage inflicted on third parties. Job site safety, structural collapse, or other liability concerns must still be addressed. Standard liability insurance will generally be sufficient to address third-party incidents, and the unified structure of a Project Alliance is well suited to Owner Controlled Insurance Plans (OCIP) or similar wrap-up policies. The insurances should, in all instances, be reviewed to identify potential coverage limitations, such as joint-venture exclusions, professional services exclusions, or limitations on coverage for construction level services (i.e. means and methods exclusions in professional liability policies.)

6.5.3.1.3 Dispute Resolution

Because liability is released within the Project Alliance, there are no dispute resolution mechanisms. Decisions made by and for the Project Alliance are by facilitated consensus. The parties have agreed to abide those decisions; as such there can be no further disputes to resolve.

6.5.3.2 Single Purpose Entity

6.5.3.2.1 Project Outcomes

The SPE bears unlimited responsibility for project outcomes. However, SPEs are usually limited liability entities and the risk of catastrophic loss is contained within the SPE and does not flow through to individual SPE participants. SPEs often use project financing where the project value, rather than the participants' credit, secures the lender's investment. If a major loss occurs, the equity participants risk their equity contributions, but nothing more. Depending upon prior history, risk and other concerns, lenders may require individual guarantees, especially on smaller projects.

6.5.3.2.2 Participant Cost Overrun

The participants bear the risk of cost overruns within their individual scopes of work. The cost overrun risk is a function of the terms governing the services each party is providing to the SPE. This risk can be limited, as in a cost-plus contract, or can be severe, if services are contracted for a fixed fee or cost. However, the cost overrun risk should be distinguished from cost increases caused by changes in scope or differing site conditions, which would normally be SPE risks, not participant risks.

6.5.3.2.3 Liability

Participant liability to the SPE and to other participants is theoretically unlimited, but in practice is often adjusted by contract. Typical risk management tools are limitations of liability, consequential damage waivers, waivers of liability, and waivers of subrogation. Liability to third parties is as allowed by law, both on behalf of the SPE and its participants. This is identical to the third-party liability existing on a conventional project.

Risk management in SPEs can be enhanced by broadened insurance coverages. Often, the broadened insurance is obtained through an Owner Controlled Insurance Program that may have expanded builder's risk, professional liability and even delay in start-up or operational risk coverages. In addition to the risk management benefits, the broader insurance may make financing easier to achieve. However, these expanded coverages are available in negotiated policies, not off-the-shelf coverages, and their availability is subject to market conditions and the bargaining power of the project participants.

6.5.3.2.4 Dispute Resolution

Because SPEs are capable of bringing actions against the participants, and the participants can bring actions against each other (perhaps limited by the contractual devices mentioned above), in the absence of a “no suit” provision, dispute resolution tools need to be integrated into the agreements between the SPE and the participants and should be coordinated between agreements.

Decisions of the SPE are normally made by a Board of Control with a structure appropriate to the type of legal entity used by the SPE. Control may be in proportion to equity interest, but that is a decision the parties will make on a project by project basis. When disputes arise between participants or between the SPE and participants, they should be resolved through an escalating program of direct negotiation, facilitated negotiation and then binding resolution by arbitration or litigation. Another approach is to use a standing arbitration panel, project neutral, or a dispute review board, to either resolve, or recommend resolution, of disputes as they arise.

6.5.3.3 Relational Contracts

6.5.3.3.1 Project Outcomes

Under relational contracts, the owner bears the ultimate risk that the project does not meet financial or performance goals. This risk may be mitigated, to the extent that a guaranteed maximum price has been established, a profit participation agreement is reached, or possible recoveries against participants for negligence or breach of their contracts is pursued. The participants also risk the variable portion of their compensation, such as a bonus opportunity or innovation fund.

6.5.3.3.2 Participant Cost Overrun

Participants may or may not bear the risk that their costs will exceed compensation due under their contracts. The more of this risk that is borne by the participants, the more likely that they will seek to protect against this risk by including contingencies in their pricing. If each participant bears the risk of cost overruns, it becomes more akin to conventional project delivery approaches. However, even in these scenarios, the potential for shared gain reduces the likelihood of occurrence.

6.5.3.3.3 Liability

Within the project, parties are responsible for their own errors and omissions. This is a distinctive difference between Project Alliances, where intramural liability is waived, and relational contracts that retain individual accountability. As with SPEs, the extent of liability can be adjusted through indemnity, limitation of liability, waiver of consequential damages, waivers of liability to the extent of insurance coverage, and waivers of subrogation. In addition, if a project contingency is used, some portion of error and omissions risk can be absorbed by the project contingency fund. Liability to third parties is essentially unchanged by the relational contract project delivery approach.

Conventional insurance products are used by the participants in relational contract projects. Each participant purchases its own insurance, which protects it against its own liability. But the policies should be carefully reviewed against the services each party will provide. If a contractor is providing incidental design or design-build services, Contractor's Professional Liability coverage should be obtained. If designers will be assisting with sequencing or other construction level services, the policies should be reviewed for exclusions that might limit coverage for means and methods or construction-related activities.

6.5.3.3.4 Dispute Resolution

Relational contracts use team-based decision processes. However, the team ultimately works for the owner and the owner retains final decision rights. Disputes within the project are resolved through an escalating negotiation process of structured negotiation, facilitated negotiation, and the binding resolution through arbitration or litigation.

6.5.4 Closeout

Closeout of a MPA mirrors the complexity seen in process formation. Timing, substance and process issues must be addressed when crafting the closeout process.

Closeout will be used to determine whether the project has met its initial goals. If time and price are the only criteria, it should be possible to close out these financial aspects shortly after substantial completion. However, if the criteria also include longer term goals, such as energy efficiency, maintenance costs, or productivity, then final assessments must be deferred until the project has been commissioned and operated through a full season or other operational cycle. Qualitative goals, such as quality, aesthetics, or creativity may require additional time to determine as well.

Warranty periods should be correlated with Closeout procedures. If there are adequate guarantees of warranty compliance, Closeout may proceed before warranties expire. However, if complying with warranties is a concern, Closeout may need to be deferred until after the warranty period expires.

Where quantitative criteria are used, the Closeout procedures should be determined during process design. Specific commissioning protocols and calculations should be developed during project design. Criteria such as money and time, should be agreed to by the parties, or if agreement cannot be reached, verified by independent audit.

Qualitative criteria must be reduced to quantities before they can be used in compensation formulas. This has been accomplished using weighted scoring sheets completed by independent advisors.

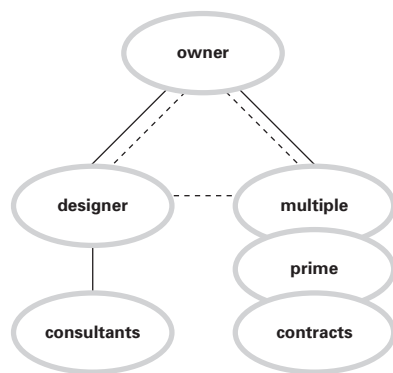
The Principles of Integrated Project Delivery set forth in Paragraph III, the issues identified in Paragraph IV, Setting Up an Integrated Project, and the implementation techniques set forth in Paragraph V, Delivering an Integrated Project, can be applied to any delivery model on any project. The topics above are common to any project seeking to become more integrated. However, certain characteristics of a particular project or delivery model may affect the level of integration that can be achieved. In some instances, participants may be required to use a delivery model that does not allow a constructor to be involved early in conceptualization (i.e. Design-Bid-Build). Other models, however, rely on earlier constructor involvement and would be more amenable to utilizing IPD methods (i.e. Construction Manager at Risk and Design-Build). In any event, each of the traditional delivery methods presents unique challenges to integration.

The following section addresses some of the more popular traditional delivery models, their inherent challenges to integration, particular issues for consideration, and potential ways to address these challenges and issues.

7.1

Multi-Prime

Diagram 1
Multi-Prime



contracts

communications

Multi-Prime is commonly utilized within a Design-Bid-Build process. In Multi-Prime project delivery, the owner contracts directly with multiple contractors or trades to complete construction. Thus, the owner acts as the general contractor/construction manager on its own project. The method optimizes the owner's control over the trades and reduces construction cost by eliminating the general contractor/construction manager's fee and general conditions costs. In essence, the owner is thought to get the project "wholesale."

Multi-Prime project delivery requires that the owner provide substantial management services of the various participants' efforts. Accordingly, the owner must have extensive experience and internal resources to write individual trade contracts, facilitate buy out, verify and process progress payments, respond to RFI's, address and execute change orders, prepare lien releases, insurance claims, safety programs disputes and claims typically managed by a general contractor or construction manager.

7.1.1 Opportunities for IPD

The traditional Multi-Prime model may be modified to achieve many of the benefits of Integrated Project Delivery. Though typically used for Design-Bid-Build project delivery, Multi-Prime can be adapted into Design-Build, Negotiated Select Team, and other models depending on when it is advantageous to select the trade contractors, the degree of risk to be transferred

to each trade contractor, the jurisdictions overseeing the project and the degree to which the owner wants to adopt an integrated process. In all organization models, however, the owner maintains the central role in the design and construction process.

Opportunities for integration are increased in delivery methods where the constructor can be brought early into the project, such as Design-Build. Within this model, the owner and designer can develop a bridging document, competitively bid completion of the design and construction to individual trades, and hold separate contracts for each Design-Build trade contractor. The same opportunity exists for both public and private projects. In addition, however, private projects can also utilize aspects of Select Negotiated Teams. In this scenario, owners can negotiate with individual trades to provide pre-construction services on a fee basis and construction services on a fixed cost or cost-plus basis.

7.1.2 Challenges to IPD

Integration relies heavily on a collaborative team in which the team members have a certain level of equality in decision making. In this regard the primary benefit of Multi-Prime, the optimization of owner control, can serve as its biggest challenge to integration. In Multi-Prime, the owner stands in a naturally authoritative position and garners an extensive amount of responsibility by virtue of its experience and familiarity with the construction process. The owner's authoritative position, coupled with its ability to go forward with limited input from those it has contracted with, has the potential to stifle the collaborative process.

If the parties wish to implement an integrated form of Multi-Prime, the owner must pay special attention to team building and avoid creating a barrier to collaboration between the design side and construction side (which is directly related to the owner in multi-prime). To achieve integration in Multi-Prime, given the owner's position with the virtual organization, the owner must have or acquire expertise in team formation and building for creating a collaborative enterprise.

An additional challenge Multi-Prime presents to implementing IPD, which is not unique to this delivery model, is the separation of contracts. The owner is required to negotiate separate contracts with the designer and the various prime contractors it has decided to utilize. Not only does this present a potentially disjointed team, it necessitates additional care on the owner's part to ensure identical processes and procedures are part of the various contracts. When faced with a potentially large and disjointed project team, contract terms establishing common processes and performance requirements aids in aligning behavior among the team members. In order to address this need for commonality among the various agreements, the owner must either negotiate coherency of all agreements or a set of general conditions all the parties agree to be governed by apart from their individual contracts. The owner may also, as opposed to adoption of general conditions, choose to negotiate a teaming agreement among the parties to control their interrelated activities.

Finally, when Multi-Prime is used for Design-Bid-Build, which is the typical scenario, it offers few opportunities for IPD, as detailed in Paragraph VII. d.

7.2

Construction Manager at Risk

“Construction Management” is a generic phrase applied to a variety of project delivery scenarios in which specific Construction Management services are called for in addition to the general services a constructor traditionally provides. The construction manager is hired early in the design process to deliver an early cost commitment and to manage issues of schedule, cost, construction, and building technology. CMc (Construction Manager - Constructor) differs from CMa (Construction Manager - Adviser) by virtue of the construction responsibilities assumed. When the construction manager and constructor are one and the same, the construction manager assumes all the liability and responsibility of a general contractor, which is why this particular delivery system is known not only as CMc but also as Construction Manager at Risk.

7.2.1 Observations/commentary on characteristics of model

CMc offers the same direct owner-architect and owner-contractor contractual relationship as Design-Bid-Build: the advisory benefits of CMa, and the early cost commitment characteristic of Design-Build. It differs from Design-Build in that design remains the responsibility of an architect, who has contracted independently with the owner. The CMc delivery model introduces the constructor prior to construction to oversee scheduling, cost control, constructability, and to bring additional expertise to project management, building technology, and bidding or negotiation of construction contracts. In the CMc model, the constructor is typically selected through a qualifications-based selection early in the design phase and paid a fee for services performed in the design phase (although owners sometimes competitively bid CMc contracts, the AIA doesn't encourage that practice). The principles of integration suggest that the construction manager should be involved in the project as soon as feasibly possible. Indeed, in one variation of CMc, Negotiated Select Team (NST), the owner contracts with the CMc at the beginning of design, if not even earlier.

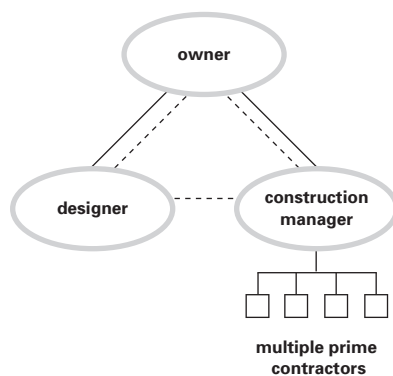
7.2.2 Opportunities for IPD

The CMc delivery model is particularly well-suited to IPD. The constructor already serves as construction manager during the preconstruction portion of the project, thereby achieving a primary goal of IPD, bringing all relevant parties into the delivery process early, when decisions have the greatest impact on performance.

The difference between the traditional and integrated CMc delivery models is not a difference in the structural models themselves, so much as it is an enhancement of the collaborative opportunities between the parties. Whereas the traditional CMc delivery model, in which the CMc is brought onto the project prior to construction but otherwise follows traditional service scopes for both architect and constructor, might be considered at least partially integrated, a fully integrated CMc project might see the architect and the constructor working with the owner to establish project goals, utilize BIM, and adopt other principles of integration and implementation techniques.

Construction management is appropriate to public and private projects of almost any scale, on which budget or schedule must be closely monitored; or extensive coordination of design consultants or trade contractors is required. Because work performed by trade contractors is typically bid, CMc

Diagram 2
Construction Manager at Risk



—— contracts
 - - - - communications

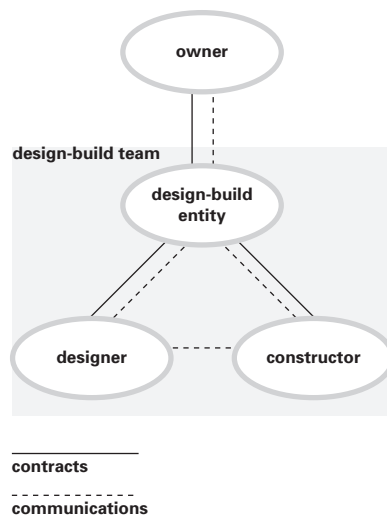
satisfies the bidding requirements of most public procurement codes. As a result, in instances where a bid delivery method is required, CMc offers the best potential for approximating fully integrated delivery.

7.2.3 Challenges to IPD

The principal criticisms of Construction Manager/Advisor (CMa), in which the Construction Manager is a fourth party to the project, have historically been the ambiguous assumption of responsibilities conventionally held by architect and constructor, and the insertion of a fourth party to serve as a filter between the owner and the architect or contractor; but when the construction manager is also the constructor, these concerns are minimized.

Similarly to Multi-Prime, separation of contracts poses a challenge to implementing IPD in the CMc delivery model. The owner must negotiate separate contracts with its designer and constructor. As with Multi-Prime, in order to achieve commonality of purpose and processes to achieve that purpose, the owner will either negotiate coherency among the agreements or require adoption of a set of general conditions or teaming agreement controlling the parties' behavior.

Diagram 3
Design-Build



7.3 Design-Build

Design-Build is characterized by a single point of responsibility for both design and construction activities. The owner often chooses Design-Build to transfer risk and coordination effort to one contractual entity and to assure a higher level of coordination. The owner's role in Design-Build has typically required heavy involvement early in defining the project criteria, followed by less management later on as the design-builder executes the project in conformance with the established criteria.

Many owners choose Design-Build in order to reduce project-based risk. By combining design and construction under a single entity, coordination, constructability and cost-of-change is presumed to be improved. Most of the risk is borne by the design-builder, often in exchange for retaining some or all of any savings identified.

The design-builder accepts the owner's design criteria and exerts greater control over the project from thereon. Project success is often measured by improved project delivery time or cost savings found by the design-builder as compared to the agreed-upon Guaranteed Maximum Price. The burden is on the owner to be clear on the acceptable level of quality expectations through descriptive, quantitative or performance requirements in the owner's design criteria.

Design-Build procurement may take many forms including, but not limited to: 1) qualifications only selection, 2) best value selection with criteria documents provided by the owner, or 3) price driven selection with detailed bridging documents provided by the owner. This broad spectrum sets the stage for various levels of integration that may be possible under design-build.

7.3.1 Opportunities for IPD

Design-Build is contractually very well-suited for increasing collaboration among the design and construction team members. The designer and constructor are both retained at the same time so can implement IPD principles from the start. Also, members of the Design-Build team often have self-selected

to work together and have established a rapport and methodology for working together. The owner is also a part of the Design-Build team and may require any level of involvement desired.

7.3.2 Challenges to IPD

Like many of the other traditional models, one of the more common characteristics of Design-Build serves as one of its largest challenges to IPD. Under traditional Design-Build, the owner usually participates through completion of the design and then seeks to minimize input and involvement to protect the clear silos of responsibility and risk. As a result, opportunities for project improvement and innovation are, unfortunately, also minimized. Accordingly, in order to achieve integration, the owner must adjust its traditional involvement in Design-Build. The increased owner involvement necessary for IPD is a significant shift from traditional Design-Build delivery and should be reflected in the owner/design-builder agreement.

Beyond mere increased involvement on the project, the owner may consider other changes that will increase the level of integration on the project. In addition to initiating, funding and establishing design criteria for the project, the owner may want to alter the compensation model to create incentives for the Design-Build team to seek project improvements rather than reduced first cost. Linking compensation to project goals such as building performance, sustainability, and accelerated delivery can be used to promote greater collaboration and better outcomes. Establishing a target cost, deferring or eliminating a GMP, and using open book accounting for project costs fosters owner collaboration throughout the project cycle.

Integrated Design-Build becomes a shared, multi-point responsibility. The input, responsibility and decision making is distributed among the team as appropriate and coordinated by the design-builder. The architect does not hold the same contractual relationship to the owner under Design-Build, unless the architect serves as the design-builder. However, there is still a duty to deliver the owner's defined project, assist the design-builder in achieving project success, and safeguard the public. The open, collaborative nature of integrated Design-Build makes the task easier.

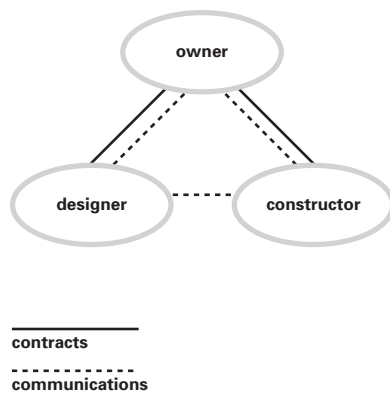
Existing standard form contracts for Design-Build can be easily modified to reflect an integrated delivery approach. Single point responsibility of the Design-Builder allows collaboration among parties under the design-builder's control with little modification. The Design-Build delivery method has been established long enough to be a well-understood baseline. Achieving an integrated approach is mostly a matter of adding clarity of roles and scope of service rather than altering the fundamental structure of the Design-Build agreement. Inclusion of additional early participants and their roles and responsibilities should be clearly stated. Requirements for design consultants to collaborate, transfer model data and incorporate input from related trade contractors and vendors should be added.

Costing under the traditional Design-Build agreement is usually fixed early in the form of a Guaranteed Maximum Price (GMP) or lump sum, with most of the risks borne by the design-builder. Deferring the GMP until later in the process allows the benefits of the early trade involvement, model-based decision making, and collaborative efforts to be achieved before costs are finalized. The agreement should reflect flexibility in the agreed-upon process and timing for establishing and maintaining the project budget.

Compensation for the design-builder is often determined on a percentage of construction cost either fixed or subject to a GMP. A formula for sharing any achieved savings below the GMP cost may be determined. The efficiencies of an integrated approach may identify savings over a traditional baseline approach. That savings may form part of the design-builder's compensation. As integrated projects become prevalent or even the norm, such comparative savings may become less useful as a project metric for determining shared savings.

A portion of compensation attributed to achieving (or missing) project goals is another possible incentive compensation method. The design-builder may put portions of anticipated profit at-risk against the goals or additional compensation may be made available for going beyond a baseline measure. Portions of the design-builder's services such as criteria development, evaluating alternatives, and other work prior to establishing the GMP or lump sum may be compensated on a time and material basis.

Diagram 4
Design-Bid-Build



7.4 Design-Bid-Build

Design Bid Build (DBB) is unquestionably the most prevalent delivery model for a construction project in the United States' construction industry. One reason is that the delivery model offers the owner the market advantage of open competition through a regimented design phase followed by separate bid and construction phases. Additionally, many governments dictate that "open bidding" be used in state construction projects, thus substantive early involvement of the eventual constructor is prohibited.

In a DBB project the owner initially enters into a contract with the designer for design services. The designer works with the owner to develop the owner's project requirements, from which point the designer develops a design. That design is then put out for bid, allowing the owner to select a constructor for the project. Upon the owner's selection of a contractor based on the bids received, the project proceeds to construction. The project is designed with little, if any, input from the parties actually constructing the project. As a result a significant amount of constructability and/or coordination issues are not discovered and resolved until construction.

7.4.1 Opportunities for IPD

DBB offers very few opportunities for true integration. Based on its structure, the DBB delivery model does not permit early involvement of the constructor in the design process.

7.4.2 Challenges to IPD

As noted above, due to DBB's rigid phase system, DBB does not naturally lend itself to integration. Indeed, of all the current delivery models, DBB offers the least possibility for integration. The hallmark of IPD is early involvement of all the primary project participants. Under a traditional DBB process, the constructor is not involved until after the design is completed. While DBB cannot be integrated, it can be improved through the utilization of some of the principles and tools of integration discussed above.

IPD requires the earliest possible involvement of the constructor. While a DBB structure will not allow the constructor to be involved from the beginning of the project, there are options. For example, the owner and the

architect can consider bidding the project at the earliest stage possible. As part of the request for bids, the owner and architect would express their intent and desire to proceed in an integrated fashion upon acceptance of bids. At that point, the parties would proceed, to the greatest extent possible, as set forth in the implementation phase described above.

Owners that choose to proceed under this adaptation of traditional DBB must be aware that the project will be bid on less complete construction or bidding documents than is the case in traditional DBB projects. This early bid process, however, allows the owner to reap the greatest benefit from integration by allowing the constructor to bring its expertise on constructability, etc to bear on the project at a much earlier stage in design.

The consequence of early bids is a loss in their accuracy and the receipt of bids containing large contingencies. The bottom line impact of this fact can be alleviated by adjusting the manner in which hard budgets are established, allowing then to be reset following the constructors contribution to developing more complete implementation documents. The owner will also have to expect that there will be added amounts of redesign that the designer will have to perform as a result of this process, which will require an adjustment to the traditional ways designers are compensated for such redesign services.

It should also be noted that a standard DBB project, or any project for that matter, would benefit from developing a strong team following bid acceptance. Byproducts of a strong team are a greater commitment to the project, improved communications and a willingness to work through disputes rather than resorting to an adversarial mentality. Although a traditional DBB project cannot be integrated, it can still benefit from the principles of integration.

“People seek change, but do not want to be changed”
—Peter Senge, “The Fifth Discipline”

While change is never easy, it is achievable.

The industry is changing. Technologies are allowing great advances in efficiency and accuracy, but changes in processes are even more significant in new delivery methods. To be successful, an integrated project requires that the designer, constructor, owner and other participants in the enterprise take on new roles and competencies. This is a significant change in culture for all team members.

However, the change may not as daunting as one might think. Generational skill sets (i.e. communication skills of baby boomers vs technology skills of the X or Y generations) yield surprising depth in necessary talent within existing firms in all areas of industry. The leveraging of those talents with the addition of effective collaboration with key project participants earlier than is traditional yields a formula for success.

What is next?

Clearly defined new business models that provide a collaborative framework for the integrated project team, clearly defining new roles and responsibilities of each participant, minimizing risk, maximizing shared respect, reward and recognition, and providing incentives for taking on new processes.

What is the AIA doing?

The AIA is collaborating with a number of organizations to enhance technology and interoperability platforms and develop industry wide processes, standards and metrics. Listed below are a just a few such examples:

- ☐ *National BIM standards*—The AIA is working with the National Institute of Building Science (NIBS) on the important topics of National BIM standards and interoperability through buildingSMARTalliance. These are efforts open to all; the input of practitioners is essential to their success.
- ☐ *Construction Users Roundtable relationships*—Through the 3xPT Strategy Group and Productivity Committee, the AIA is working on delivering guidelines and metrics for integrated delivery.
- ☐ *McGraw Hill SmartMarket Report on Interoperability*—Sponsored in part by the AIA, released in October 2007, this report builds the business case for interoperability in a transformed industry.
- ☐ *IPD Presentations*—The members of the AIA’s Integrated Practice Discussion Group and AIA California Council give many informational presentations each year, at component events across the country.
- ☐ *IPD Pre-Convention Events*—The AIA holds an event focused on IPD-related topics each year on the day(s) before the National Convention, offering a number of sessions valuable to all project participants.

What can you do?

Break down traditional barriers or silos of effort. Develop a confidence in information sharing. Actively participate in discussion groups that push toward an effective, collaborative approach to information sharing.

Require the project team to utilize integrated Building Information Modeling technology. Consider a full-team work area with multiple screens for display of project images for real-time collaborative issue resolution. Propose new approaches to team compensation based on value and long term outcomes. Seek resources.

Talk. Share. Collaborate. Experiment.

Change is happening. Change is now.

4D Building Information Model

A model that incorporates the dimension of time used to visualize a construction schedule.

5D Building Information Model

A model that incorporates cost data, used to automate quantity takeoffs for cost estimating. Coupled with 4D, it can be used to predict cash flow.

Best-for-Project

Describes a decision making standard where decisions are measured against shared goals / objectives about what's best for the project vs individual stakeholder outcomes.

Building Information Model

A Building Information Model, (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward. A basic premise of BIM is a collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.

Source: National Building Information Model Standard (NBIMS) committee. For a more complete definition, see <http://www.facilityinformationcouncil.org/bim/faq.php#faq1>.

Buyout

Buyout is the process of obtaining price commitments for all work packages in a project. There are several methods by which this can be accomplished, ranging from sealed bids to direct negotiations. In the IPD approach most of the price commitments are developed through a continuous effort, with many of the trade contractors and suppliers participating in the design and refining their prices as the project progresses.

Buyout Phase

The Buyout phase in IPD is limited to obtaining price commitments from subs and suppliers who weren't involved during the design phases.

Constructor

The party on the project responsible for performing and overseeing construction by its own and/or hired forces.

Cost Model

A breakdown of the construction and project budget into detailed "cost targets." The construction budget is developed in both a detailed component(s) based format and a CSI based format based on the project's goals, detailed program and performance requirements. The cost targets are developed collaboratively by the integrated team prior to commencing the conceptualization phase of the project process. The structure provides the benchmark for the team to support continuous cost management as the project progresses to ensure that it will be completed within the targeted budget.

Designer

The design professional on the project responsible for performing and overseeing overall project design.

Design Consultant

The professional consultant(s) on the project responsible for performing and overseeing design in specific areas of the work (i.e., structural, mechanical, landscape, electrical, civil, etc.)

Integrated Project Coordinator

An individual responsible for overall facilitation, coordination and direction of the integrated team. This role may or may not shift among members of the team depending on delivery model and project phase. Leadership and consensus building skills are critical to this role. In some instances, this role may be filled by an outside party.

Key Supporting Participant

A person or organization whose contribution is critically necessary to achieve project goals but is not a primary participant.

Integration

The coming together of primary participants (which could include owner, designer, constructor, design consultants, and trade contractors, key systems suppliers, etc.) at the beginning of a project, for the purpose of designing and constructing the project together as a team.

Open Book

Common usage term for the contractual rights owners have to review and audit the financial records of contractors performing cost-plus contracts.

Open Interoperability Standards

Non-proprietary protocols and data structures that support the exchange or joint use of digital information by differing software tools.

Owner Controlled Insurance Program (OCIP)

A comprehensive, project specific insurance program obtained by the owner and intended to cover all key project participants. An OCIP can include coverages for builder's risk, workmen's compensation, comprehensive general liability and professional liability. The specific details of coverage, and the allocation of premium cost, are unique to a specific project. In some instances, similar coverage can be obtained by the contractor on behalf the project as a Contractor Controlled Insurance Program (CCIP). OCIP and CCIP are sometimes generically referred to as "wrap insurance."

Primary Participant

Core group of team members involved in and responsible for the project from inception through completion.

Process Design

The crafting of the process and protocols which the IPD will follow throughout the course of the project. Process design is facilitated by the IPC.

Project Alliance Agreement

In a Project Alliance, the key participants collectively assume responsibility for agreed project performance. The profit (or loss) to each participant is determined by the team's success in meeting project goals, not individual performance. The shared opportunities and responsibilities align the parties' interests and provide an incentive for collaboration and blame-free performance. To further enhance the collaborative process, all decisions

must be unanimous, disputes must be resolved without litigation and within the Alliance, and compensation is determined on an open-book basis.

Relational Contracts

Construction contracts that focus on communications and relationships between the parties as well as their specific rights, obligations and deliverables.

Single Purpose Entity (SPE)

An independent legal entity created to accomplish a specific project. Often a limited liability company or a limited liability partnership, the single purpose entity is generally dissolved once the project is completed and its financial goals achieved.

Target Value Design Process

The process of establishing early financial targets for the project, and then designing to an associated detailed estimate rather than estimating a detailed design. Iterative in nature.

Virtual Organization

Refers to the assembled project team in an IPD. While not a business entity, it is project specific, organized around project goals not participants and may use co-location to increase efficiencies in communication.

National Institute of Building Sciences, National BIM Standards (NBIMS) Committee

many related articles on Integrated Project Delivery, Building Information Modeling
<http://www.facilityinformationcouncil.org/bim/publications.php>

U.S. General Services Administration

the Nation's largest facility owner and manager's program to use innovative 3D, 4D, and BIM technologies to complement, leverage, and improve existing technologies to achieve major quality and productivity improvements.
<http://www.gsa.gov/bim>

The American Institute of Architects

Integrated Practice information
www.aia.org/ip_default

The American Institute of Architects, California Council

resources related to IPD including Frequently Asked Questions
www.ipd-ca.net

Associated General Contractors of America

BIM Guide for Contractors
<http://agc.org/>

McGraw-Hill Construction

source for design and construction industry information regarding IPD
http://www.construction.com/NewsCenter/TechnologyCenter/Headlines/archive/2006/ENR_1009.asp

Construction Users Roundtable (CURT)

owners' views on the need for Integrated Project Delivery
<http://www.curt.org/>

Open Standards Consortium for Real Estate

standards related to information sharing/BIM
<http://oscre.org/>

Open Geospatial Consortium

an international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services
<http://www.opengeospatial.org/>

FIATECH

a consortium of leading capital project industry owners, engineering construction contractors and technology suppliers that provides global leadership in development and deployment of fully integrated and automated technologies
<http://fiatech.org/>

LEAN Construction Institute

a non-profit corporation dedicated to conducting research to develop knowledge regarding project based production management in the design, engineering, and construction of capital facilities.
<http://www.leanconstruction.org/>

National Institute of Standards and Technology (NIST)

Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry

<http://www.bfrl.nist.gov/oae/publications/gcrs/o4867.pdf>

National Institute of Standards and Technology (NIST)

UNIFORMAT II Elemental Classification for Building Specifications, Cost Estimating, and Cost Analysis

<http://www.bfrl.nist.gov/oae/publications/nistirs/6389.pdf>

OmniClass

a classification structure for electronic databases

<http://www.omniclass.org/>

Construction Specifications Institute

MasterFormat

http://www.csinet.org/s_csi/docs/9400/9361.pdf

Design Build Institute of America (DBIA)

library of information and case studies related to design build

<http://www.dbia.org>

Center for Integrated Facility Engineering (CIFE)

research center for Virtual Design and Construction AEC industry projects

<http://www.cife.stanford.edu>

International Alliance for Interoperability (IAI) / buildingSMART Alliance

an international organization working to facilitate software interoperability and information exchange in the AEC/FM industry

<http://www.iai-na.org/>



THE AMERICAN INSTITUTE OF ARCHITECTS

C191™–2009, Standard Form Multi-Party Agreement for Integrated Project Delivery

Frequently Asked Questions

Q1: What is the C191–2009, Standard Form Multi-Party Agreement for Integrated Project Delivery

A: AIA Document C191–2009 is a standard form multi-party agreement through which the owner, architect, contractor, and perhaps other key project participants execute a single agreement for the design, construction and commissioning of a Project. C191–2009 provides the framework for a collaborative environment in which the parties operate in furtherance of cost and performance goals that the parties jointly establish. The non-owner parties are compensated on a cost-of-the-work basis. The compensation model is also goal-oriented, and provides incentives for collaboration in design and construction of the project. Primary management of the project is the responsibility of the Project Management Team, comprised of one representative from each of the parties. The Project Executive Team, also comprised of one representative from each of the parties, provides a second level of project oversight and issue resolution. The conflict resolution process is intended to foster quick and effective resolution of problems as they arise. This collaborative process has the potential to result in a high quality project for the owner, and substantial monetary and intangible rewards for the other parties.

Q2: Why deliver a project using C191–2009, Standard Form Multi-Party Agreement for Integrated Project Delivery?

A: C191–2009 utilizes the principles of Integrated Project Delivery (IPD). See www.aiacontractdocuments.org/ipd. IPD will appeal to an experienced and sophisticated project owner who is looking for a way to reduce claims on projects and to achieve important project-specific goals. Such goals are likely to be achieved by a high degree of collaboration and information sharing among project participants.

Q3: How does C191–2009 handle resolution of disputes among the parties?

A: The parties are required to endeavor to resolve all disputes amicably and through the normal management of the Project. Any issue that arises is first raised with the Project Management Team. If the Project Management Team is unable to reach a unanimous resolution of the issue, it is submitted to the Project Executive Team. If the Project Executive Team is unable to unanimously resolve the matter, it is then subject to the dispute resolution procedures outlined in the agreement. In the meantime, however, the Owner may issue a directive, by which the Parties must abide, subject only to the results of the dispute resolution process.

If the parties are unable to resolve an issue through the Project Executive Team, a dispute is initiated. Upon initiation of a dispute, the matter is referred to the Dispute Resolution Committee, which is comprised of representatives from each party plus a Project Neutral. Within fifteen days of initiating a dispute, the Project Neutral must attempt to mediate the dispute with the other members of the Dispute Resolution Committee. If that is unsuccessful, the parties then proceed to the method of binding dispute resolution identified in the Agreement. At the time the C191–2009 is executed, the parties elect the method of binding dispute resolution to be employed, and may choose arbitration before the Project Neutral; arbitration otherwise administered as required in the General Conditions; or any other method of binding dispute resolution, including litigation.

Q4: How does the Project Management Team make decisions?

A: All authorizations, approvals, or other actions of the Project Management Team require the unanimous affirmative vote of each team member. Any matter upon which the Project Management Team cannot reach a unanimous decision is referred to the Project Executive Team for resolution.

Q5: How does the Project Executive Team make decisions?

A: All authorizations, approvals, or other actions of the Project Executive Team require the unanimous affirmative vote of each team member. Any matter upon which the Project Management Team cannot reach a unanimous decision may be referred to the Dispute Resolution Committee. Pending resolution of an issue by the Dispute Resolution Committee, the Owner may issue a directive on the matter so long as such directive is generally consistent with the scope of the agreement. The parties must abide by the Owner’s directive subject to any subsequent decision by the Dispute Resolution Committee.

Q6: How does C191–2009 differ from C195–2008?

A: C191–2009 and C195–2008 are similar in many respects. Both utilize many of the same mechanisms to execute and integrate the project, including use of a Target Cost model, Incentive Compensation and Goal Achievement Compensation. Unlike C195–2008, however, C191–2009 does not require the parties to form an LLC, and project management is through the Project Management Team and the Project Executive Team.

Q7: Why did you create the C191-2009 in addition to the C195-2008?

A: C191-2009 simply provides another contractual alternative for parties interested in IPD. The industry is just starting to utilize IPD, and a clear preference for an IPD contracting model has yet to emerge. Accordingly, it is important to offer a number of options so parties can choose the agreement that works best for them. These documents serve as another way for parties to begin working within an IPD framework. They are meant to spark conversation among industry stakeholders and help lead the way to IPD implementation.

Q8: What services are required of the non-owner parties in C191–2009?

A: C191–2009 initially requires the non-owner parties to provide services described in the agreement in order to develop a Target Criteria Proposal for the owner’s review and approval. The specific services are set forth in both the C191–2009 agreement as well as Exhibit A, General Conditions. Upon the owner’s acceptance of the Target Criteria Proposal, the parties execute the Target Criteria Amendment, which includes a table in which the parties’ responsibilities for services are assigned. The non-owner parties are then required to perform the services set out in the Agreement, including the Target Criteria Amendment and the General Conditions.

Q9: What obligations does the owner have under C191–2009?

A: C191–2009 requires the owner to furnish certain information as well as any services required of it by the Target Criteria Amendment. Additionally, the owner is required to identify representatives to serve on the Project Management Team, Project Executive Team and Dispute Resolution Committee. Most significantly, the owner pays for the Cost of the Work, including design and construction.

Q10: How are risks and rewards handled under C191–2009?

A: C191–2009 provides incentives for the architect and contractor to perform in the best interest of the Project. The architect and contractor are required to provide their services at cost with any potential profit tied to the achievement of project-related goals that the parties mutually establish. The first form of potential profit is tied to the Target Cost. If the Actual Cost of the project as delivered by the architect and contractor is below the Target Cost, any savings is shared in accordance with the terms of C191–2009. The second form of potential profit is tied to specific Project Goals the parties agree upon at the time the Target Cost is established. If the architect and contractor achieve any of the Project Goals, they are entitled to receive compensation as set forth in the Agreement. If any Project Goal is not achieved, the parties do not receive any compensation related to that Project Goal regardless of who was at fault.

Q11: Under C191–2009, what is the “Target Cost”?

A: The Target Cost is the estimate of all costs the architect and contractor may incur to plan, design, construct and commission the project. The parties establish the Target Cost at the conclusion of the Criteria Design Phase. The Target Cost is set forth in the Target Criteria Amendment to C191–2009.

Q12: What is the Target Criteria Amendment?

A: The Target Criteria Amendment is an amendment to C191–2009, Standard Form Multi-Party Agreement for Integrated Project Delivery. It is executed at the conclusion of the Criteria Design Phase. The Target Criteria Amendment itself consists of seven exhibits. The first exhibit is the Target Cost Breakdown, which allows the parties to set forth the various elements of the Target Cost in detail. The second exhibit is the Project Definition, which allows the parties to state the Project Definition upon which the Target Criteria are based. The third exhibit is the Project Goals. In this exhibit, the parties identify and define the mutually agreed upon Project Goals. The Project Goals exhibit also allows the parties to identify how the non-owner parties will be compensated for achievement of such goals. The fourth exhibit is the Integrated Scope of Service matrix. This exhibit consists of an extensive matrix of services that allows the parties to allocate responsibility for each such service throughout the project. The fifth exhibit is the Project Schedule, which allows the parties to identify the schedule upon which the project will be completed. The sixth exhibit is the Digital Data Protocol Document. This exhibit will allow the parties to identify how electronic data will be used and exchanged on the Project, and will likely consist of AIA Document E201–2007, Digital Data Protocol Exhibit, or another similar digital data protocol document. The seventh and final exhibit is the Building Information Modeling Protocol Document. This exhibit will allow the parties to identify and determine how they will utilize building information modeling on the Project, and will likely consist of AIA Document E202–2008.

Q13: Can there be additional parties to C191–2009 other than the owner, architect and contractor?

A: C191–2009 contemplates that the owner, architect and contractor are the initial Parties, although it is possible that other project participants may be initial parties if their role on a particular project is significant enough to warrant their involvement as a party. If there are additional parties to the Agreement, however, the American Institute of Architects encourages users to consult with an attorney for the careful review and modification of C191–2009 and its exhibits in order to appropriately coordinate the roles and responsibilities of additional parties with those of the owner, architect and contractor.

Q14: How was the C191-2009 created?

A: AIA Contract Documents pioneered the concept of working with industry stakeholders to help create and update documents to ensure the documents are fair and balanced. In particular, the AIA Contract Documents Committee consulted with insurance companies and several prominent attorneys in the industry to solicit comments and feedback on the draft document before release.

Q15: Who can I contact if I need document support?

A: For answers to your questions about the content or usage of AIA Contract Documents, call 202-626-7526 Monday—Friday from 8:30 a.m. to 5 p.m. Eastern time or send an e-mail to docinfo@aia.org. Also, get with help with AIA Contract Documents content by reading document commentaries and comparisons, and using guides to amendments and supplementary conditions.

A Working Definition

Version 2 Updated 06.13.2007



Integrated Project Delivery



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CONSTRUCTION

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Integrated Project Delivery – A Working Definition

Preface

This report, *Integrated Project Delivery – A Working Definition*, contains the recommendations of the Definitions Committee of the Integrated Project Delivery Task Force. It represents the combined efforts of architects, engineers, contractors, sub-contractors, owners and attorneys and intends to describe the key elements of an integrated process.

The recommendations are a work-in-progress, and must be applied with consideration to the project delivery method used for a specific project. The Integrated Project Delivery Task Force is an interdisciplinary group sponsored by McGraw-Hill Construction and The American Institute of Architects, California Council.

The *Working Definition* contains three sections. First, integrated practice is defined. At its essence, it is a deeply collaborative process that uses best available technology, but goes beyond merely the application of digital tools, such as Building Information Modeling. Second, the Essential Principles are set forth as necessary assumptions in this collaborative process. Unless all parties are committed to these principles, integrated practice will not succeed. Finally, the *Working Definition* characterizes project workflow beginning with Building an Integrated Team and concluding with Integrated Closeout. The primary activities and participants are outlined, and where appropriate, compared with traditional processes. Review of the process sections reveals fundamental changes in participants, timing and intensity. Moreover, the processes are flexible and iterative. Information transferred between participants guides development and design optimization.

The Task Force will use the *Working Definition* as the basis for developing recommendations for best practices, integrated project delivery models, and risk allocation. These will form frameworks that can be used to implement integrated project delivery on specific projects. The group invites comment regarding the *Working Definition*, which should be sent to IPD@aiacc.org.

"This revolution is already changing my firm, and it will change yours...
Our profession will be utterly different, transformed, within the next 5-10 years."

Norman Strong, FAIA

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DEFINITION

Integrated Project Delivery (IPD) is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction.

Integrated Project Delivery principles can be applied to a variety of contractual arrangements and Integrated Project Delivery teams will usually include members well beyond the basic triad of owner, designer and contractor. At a minimum, though, an integrated project includes tight collaboration between the owner, architect/engineers, and builders ultimately responsible for construction of the project, from early design through project handover.

OVERVIEW

Integrated Project Delivery uses business structures, practices, and processes to collaboratively use the talents and insights of all participants in the design, construction and fabrication process. Beginning when the project is first conceptualized, the integrated process continues throughout the full life cycle of the facilities.

Integrated Project Delivery encourages early contribution of knowledge and experience and requires proactive involvement of key participants. Responsibility is placed on the most able person with decisions being made on a “best for project” basis. Although it is possible to achieve Integrated Project Delivery without Building Information Modeling, it is the opinion and recommendation of this study that Building Information Modeling is essential to efficiently achieve the collaboration required for Integrated Project Delivery.

ESSENTIAL PRINCIPLES & BUSINESS MODELS

Integrated Project Delivery is built on collaboration. As a result, it can only be successful if the participants share and apply common values and goals.

ESSENTIAL PRINCIPLES

In its ideal state, the Integrated Project embodies, in varying proportion, many of the following attributes.

- 1 **Mutual respect:** In an integrated project, owner, architect, consultants, contractor, subcontractors and suppliers understand the value of collaboration and are committed to working as a team in the best interests of the project. To harness the collective capabilities of the integrated team, all key participants should be involved as early as possible with multiple disciplines and interests represented. Roles are not restrictively defined, but assigned on a "best person" basis.
- 2 **Mutual Benefit:** All members will benefit from integrated project delivery. Because the integrated process assumes early involvement by more parties, the compensation structure must recognize and reward early involvement. Compensation should be based on the value added by an organization and **risk should be equitably allocated.** Integrated projects will use innovative business models to support, rather than discourage, collaboration and efficiency.
- 3 **Early Goal Definition:** Project goals are developed early and agreed upon by all participants. Insight of each participant is valued in a culture that promotes and drives innovation and outstanding performance. True value engineering is obtained by collaborative focus on the project goals, including system performance throughout the facility lifecycle.
- 4 **Enhanced Communication:** Focus on team performance is based on communication among all participants that is open, straight and honest. Responsibilities are clearly defined in a **no-blame culture leading to identification and resolution of problems, not determination of liability.**
- 5 **Clearly Defined Open Standards:** Open and interoperable data exchanges based on a disciplined and transparent data structure is essential to support integrated project delivery. Enhanced communications between all participants is made possible with open standards. All technologies used on an integrated project should use open standards to eliminate the costly practice of integrating every application (and version) with every other application (and version). Interoperability exists on the human level through transparent business exchanges, supporting these exchanges with open standards completes the goals of integrated project delivery.
- 6 **Appropriate Technology:** Integrated projects will often rely on cutting edge technologies. Technologies should be specified at project initiation, to maximize functionality, generality and interoperability.
- 7 **High Performance:** Integrated projects will lead to optimized design solutions, higher performance buildings, and sustainable design.
- 8 **Leadership:** Although each participant is committed to achieving project goals, leadership should be taken by the person or organization most capable with regard to specific work and services. Often, the design professionals and contractors

BUSINESS MODELS

Although Integrated projects can proceed using various business models, some approaches are better suited to an integrated project, than others. The benefits of integrated practice are built on early collaboration between designers, contractors and fabricators. Under design-bid-build key participants can not be identified until bids are received – far too late to meaningfully participate in developing the integrated design. For this reason, traditional design-bid-build is inconsistent with an integrated approach and can not achieve the efficiency and performance benefits of an integrated process.

Thus, integrated project delivery projects are best suited to business models that:

- 1 **Promote early involvement of key participants.**
- 2 **Equitably balance risk and reward.**
- 3 **Have compensation structures that reward "best for project" behavior, such as "open book" or incentives tied to achievement of project goals.**
- 4 **Clearly define responsibilities without chilling open communication and risk taking.**
- 5 **Implement management and control structures built around team decision making with facilitation, as appropriate.**

BUILDING AN INTEGRATED TEAM

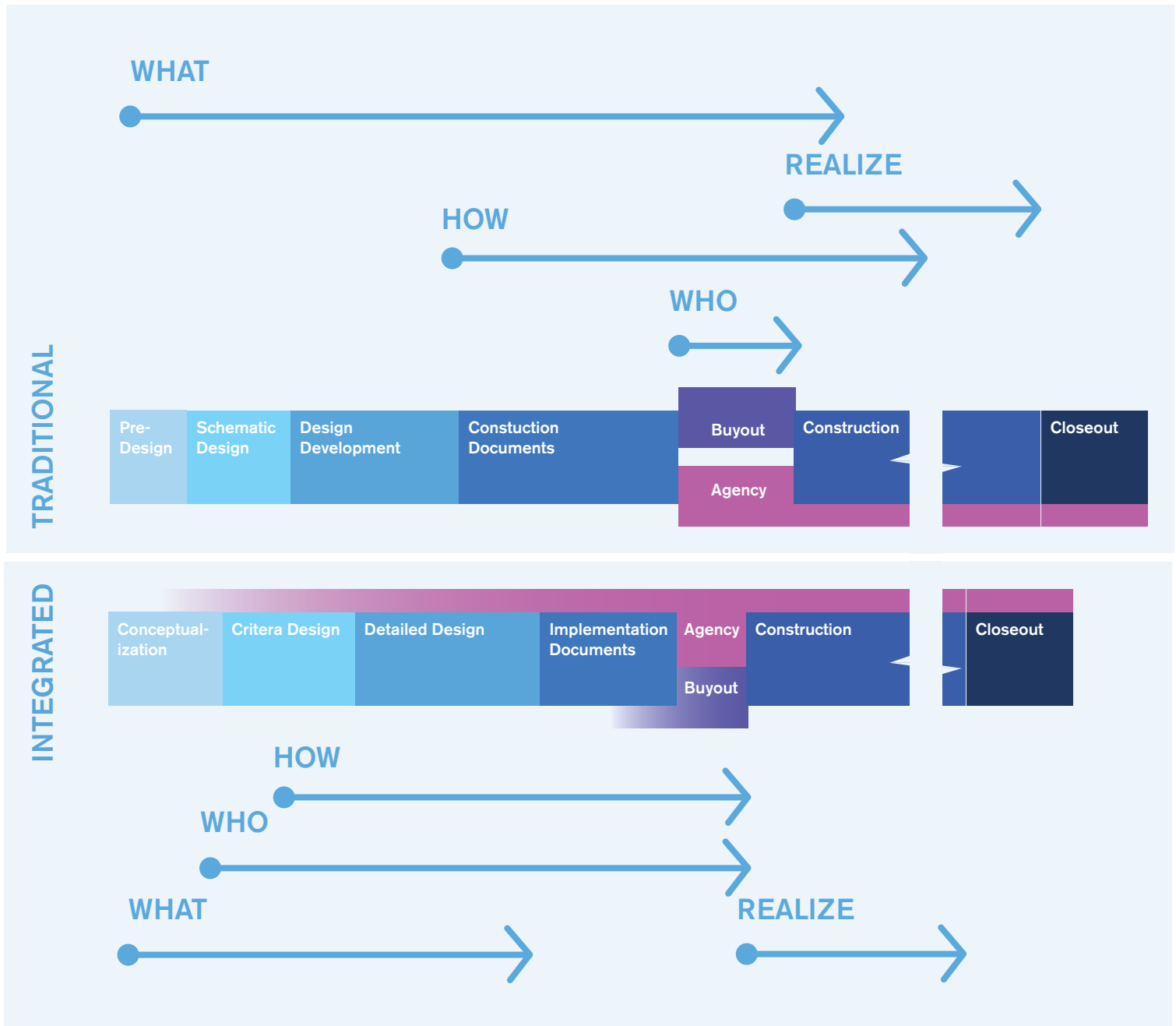
The key to successful Integrated Project Delivery is assembling a team that is committed to collaborative processes and is capable of working together effectively.

- 1 Identify, at the earliest possible time, the participant roles that are most important to the project.**
 - 1.1 Owner
 - 1.2 Operator/user
 - 1.3 Designers (architects/engineers)
 - 1.4 Contractors
 - 1.5 Subcontractors
 - 1.6 Suppliers
 - 1.7 Equipment manufacturers
 - 1.8 Systems integrators
 - 1.9 Lenders
- 2 Pre-qualify members (individuals and firms) of the team based on:**
 - 2.1 Technical competence
 - 2.2 Commitment to integrated practice
 - 2.3 Experience and track record
 - 2.4 Proven integrity
 - 2.5 Commitment to a collaborative process
- 3 Consider interests and seek involvement of select third parties, such as building official(s), local utility companies, insurers, sureties, and other stakeholders.**
- 4 Identify the organizational and business structure best suited to Integrated Project Delivery consistent with the participants' needs and constraints. The choice should not be bound to traditional project delivery methods, but should be flexibly adapted to the project.**
 - 4.1 Design-build
 - 4.2 CM at risk
 - 4.3 Single purpose entities
 - 4.4 Multiple prime
 - 4.5 Design assist
 - 4.6 Bridging
 - 4.7 Alliancing
- 5 Develop project agreement(s) to define the roles and accountability of the participants. The project agreements should be synchronized to assure that parties' roles and responsibilities are defined identically in all agreements and are consistent with the agreed organizational and business models. Key provisions regarding compensation, obligation and risk allocation should be clearly defined and should encourage open communication and collaboration. Issues to be considered include:**
 - 5.1 Compensation and use of incentives**
 - 5.1.1 Profit sharing
 - 5.1.2 Open book accounting
 - 5.1.3 Performance bonuses
 - 5.2 Communication and information exchange
 - 5.2.1 Technology
 - 5.2.2 Standards/protocols
 - 5.2.3 Gate keeping
 - 5.2.4 Audit and archiving
 - 5.3 Obligations and oversight
 - 5.4 Project decision processes
 - 5.5 Professional responsibility
 - 5.6 Risk allocation**
 - 5.7 Insurance program

DIFFERENCES IN INTEGRATED AND TRADITIONAL PROJECT DELIVERY

In a truly integrated project, the project flow from conceptualization through implementation and closeout differs significantly from a non-integrated project. Conventional terminology, such as schematic design, design development and construction drawings, creates workflow boundaries that do not align with a collaborative process.

In general, integrated project delivery will result in greater intensity with increased team involvement in the early phases of design. In the integrated project, design will flow from determining what are the project goals, to what will be built to how the design will be realized. To provide a basis for comparison, however, the description below uses conventional project terms and phases to highlight the differences between a conventional and an integrated project. Terms in brackets throughout this document are the traditional equivalents, and are provided for context.

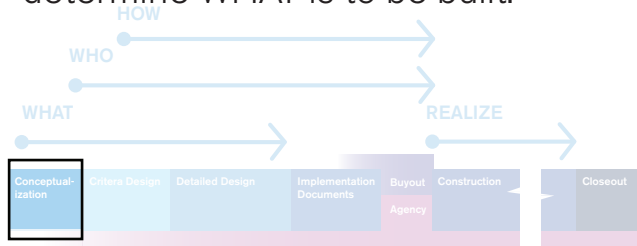


Input from the broader integrated team coupled with BIM tools to model and simulate the project enable the design to be brought to a higher level of completion before the documentation phase is started. Thus the Conceptualization, Criteria Design, and Detailed Design phases involve more effort than their counterparts in the traditional flow.

This higher level of completion allows the Implementation Documents phase to be shorter than the traditional CD phase, and the early participation of regulatory agencies, subcontractors, and fabricators allows shortening of the Agency review and Buyout phases. The combined effect is that the project is defined and coordinated to a much higher level prior to construction start, enabling more efficient construction and a shorter construction period.

CONCEPTUALIZATION [Programming]

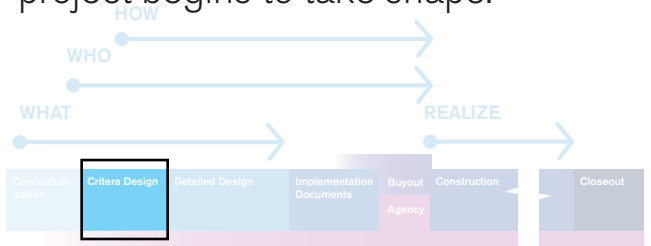
Conceptualization begins to determine WHAT is to be built.



- 1 **Involve all key stakeholders in the programming process; obtain input from as many participants as possible.**
- 2 **Identify key technologies, such as Building Information Modeling, and begin to capture key parameters.**
 - 2.1 Size
 - 2.2 Time
 - 2.3 Sustainable or green criteria or goals defined
 - 2.4 Economic performance is based on the complete building life span including operation
 - 2.5 Perform interoperability review including data transfer, level of detail and tolerances
- 3 **Cost structure is developed earlier and in greater detail than a conventional project. Costs may be linked to Building Information Model to allow rapid assessment of design decisions.**
 - 3.1 The budget is developed with significant detail
 - 3.2 Detailed by system
 - 3.2.1 System component
 - 3.2.2 Provide an understanding of where the variance is and the importance
 - 3.2.3 Initial benchmarking comparison
 - 3.3 Cost structure is available to key parties to assess areas where greatest improvements are possible
- 4 **Performance goals are developed, including metrics for determining performance.**
- 5 **In alliance or incentive projects, successful outcome metrics (e.g. cost, schedule, quality, etc.) are developed and by consensus.**
- 6 **Preliminary schedule is developed and linked to developing model.**

CRITERIA DESIGN [Schematic Design]

During Criteria Design, the project begins to take shape.

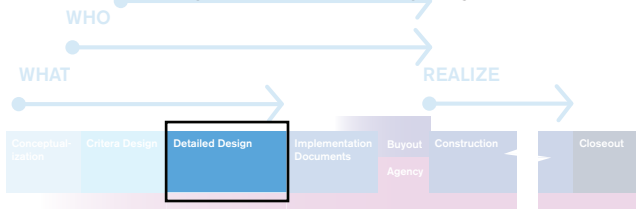


During this period, different options are evaluated and tested. In a project using Building Information Modeling, the model can be used to test "what if" scenarios and determine what the team will accomplish. During this phase, the following tasks will be accomplished:

- 1 **Design decisions are made on a "best for project" basis.**
- 2 **Visualization of building model is tied to cost model.**
- 3 **Scope is fixed, price is fixed, owner signs off on what will be built allowing the team to evolve and optimize the design.**
- 4 **Further develop preliminary schedule – schedule is better informed due to collaborative approach and commitments to schedule are more firm.**
- 5 **Earlier recognition of inadequate building performance, but assessing responsibility is more difficult because of the number of participants and overlap of roles.**
- 6 **Agreement is reached on tolerances between trades to enable prefabrication.**

DETAILED DESIGN *[Design Development]*

The Detailed Design phase concludes the WHAT phase of the project.



During this phase, all of the key design decisions are finalized.

- 1 At the end of design development, the design intent is fully, unambiguously defined, coordinated and validated.
- 2 The integrated detailed design phase period is longer and more intense than traditional design development because more is accomplished.
- 3 All major building systems are defined, including furnishings, fixtures and equipment.
- 4 By the end of integrated design development all building elements are coordinated and fully engineered, representing a significant change to current practices. The team will collaborate to resolve any inconsistencies or conflicts.

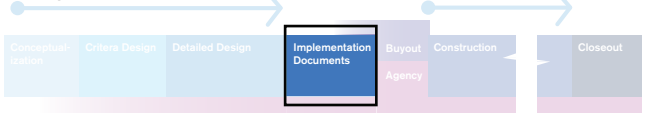
If Building Information Modeling is used, the following will likely occur.

Each group that is contributing to the model will be responsible for their piece of the model.

- 4.1 Models and tools must be interoperable to support checking for inconsistencies/conflicts.
- 4.2 Protocols must be developed to control data interchange. The prime design professional should determine the acceptability of changes to the model and lead coordination and performance checking of the Building Information Model with assistance from integrated team stakeholders.
- 4.3 Third parties may administer the central models or other collaborative information store(s).
- 4.4 In some instances, control of the model will transfer from prime design professional to the contractor at the conclusion of design development. Subcontractors might complete full 3D model of building systems. Everything related to their system will be detailed, excluding fabrication data.
- 4.5 Estimating is done by extracting accurate information from the model at quantity survey level (no longer conceptual). The confidence in the cost estimate is greater and the model is repeatedly checked to determine cost impact of changes and support "cost tuning."
- 4.6 Specifications for the building become prescriptive since the objects in the model are representations of the real object.
- 5 Subcontractor and vendor insight is integrated into design and used for coordination and conflict resolution.
- 6 Quality levels should be established.
- 7 Specifications are developed based on prescribed and agreed systems.

IMPLEMENTATION DOCUMENTS *[Construction Documents]*

During this phase, focus shifts from WHAT is being created to documenting HOW it will be implemented.

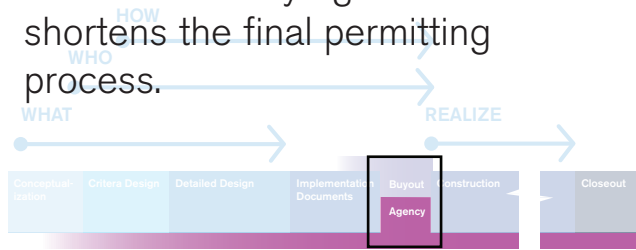


The traditional shop drawing process is merged into the design as contractors, subcontractors and suppliers document how systems and structure will be created. In addition, this phase generates the documents that third parties will use for permitting, financing and regulatory purposes.

- 1 At the beginning of Implementation Documents (ID) the entire building and systems are fully defined and coordinated and therefore, the construction document phase is significantly shortened.
- 2 The goal of ID phase is to document how the design intent will be implemented, not to change or develop it.
- 3 Where a Building Information Model is used, the "shop drawing" phase that typically occurs later in the process will be substantially reduced or eliminated. Technically sophisticated subcontractors and vendors will augment the design model in lieu of preparing separate shop drawings, or will create a synchronized model for fabrication or installation purposes.
- 4 Prefabrication of some systems can commence because the model is sufficiently fixed (object sizes and positions are frozen) to allow prefabrication to begin.
- 5 Rehearsal of construction is enabled through 4D.
 - 5.1 Allowing the building team to validate the baseline schedule
 - 5.2 Allowing the building team to explore and validate sequencing and logistics
 - 5.3 Allowing the building team to offer refinements that will improve efficiency
- 6 Cost is finalized through 5D.
 - 6.1 Component costs of the building are demonstrated in the model
 - 6.2 All trades on the team (based on project type) finalize their costs in this phase based on the certainty of the building information model
- 7 The specification provides narrative documentation of the design intent wherever necessary.
- 8 Implementation Documents visualize the project for participants who aren't involved in the development of the model.
 - 8.1 A "financiable" project (a completed model "the bank" can see to finance the project)
 - 8.2 Created as a bid document for parties involved outside the integrated process
- 9 Implementation Documents include information for
 - 9.1 Procurement
 - 9.2 Assembly
 - 9.3 Layout
 - 9.4 Detailed schedule
 - 9.5 Procedural information (testing, commissioning)
 - 9.6 Legal requirements (whatever needs to be included to be legally binding)

AGENCY REVIEW

Use of BIM, early involvement and validation by agencies shortens the final permitting process.

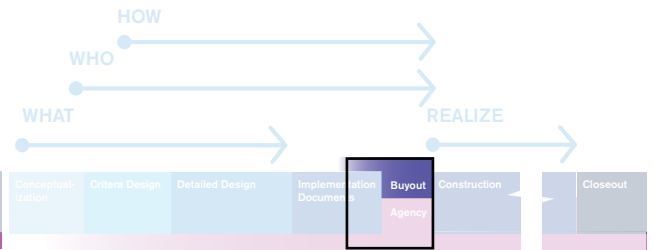


Under current practice, reviewing and permitting agencies require traditional deliverables. However, Building Information Models have the ability to provide information either directly or through linked databases that enhance and streamline a reviewing agency's ability to check the design for building code or regulatory criteria. In addition, analysis software can use the model information to generate performance or criteria analyses that validate the design. With these developments in mind, the integrated agency review will differ from current practice as follows:

- 1 Performance-based code analysis within the Building Information Model, if regulatory agency supports, can allow for communication and processing of plan checking electronically.
- 2 The integrated process will require builders and trades to be involved in preliminary and submittal reviews of documents and responses to comments because they will have developed portions of the model.
- 3 Agency review commences in criteria design with increased intensity in the final review period.

BUYOUT

Complete buyout of remaining contracts.

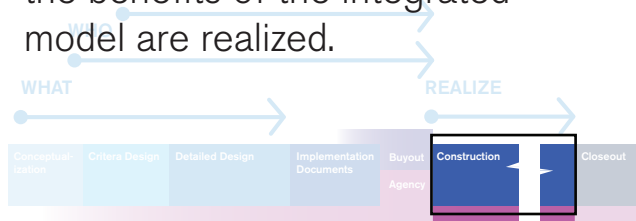


The fully integrated project assumes early involvement of key subcontractors and vendors. In most instances, this cannot occur unless the subcontractors and vendors have some assurance they will be selected for the project. With this understanding:

- 1 Project definition during criteria and detailed design allows early commitment for procurement of long lead, custom, or prefabricated items.
- 2 Key participants prices will already be defined. Bidding and negotiation will primarily occur with parties that were not included in the integrated team.
- 3 The integrated model provides an opportunity to bid to a quantity within the model.
- 4 The integrated model employs a variety of negotiating strategies based on the level of participation in the integrated model.
- 5 Early contractor involvement requires some guarantee that the contractor participants will actually construct the project.

CONSTRUCTION *[Construction Administration]*

The Construction phase is where the benefits of the integrated model are realized.



For architects, construction has traditionally been considered the final stage of design where issues are addressed and solutions achieved to actual real-life problems. But in Integrated Project Delivery, this “final design stage” is completed during Detailed Design and Implementation Documents phases. Thus, construction administration will be primarily a quality control and cost monitoring function. Because of the higher intensity of preceding phases, integrated construction will have:

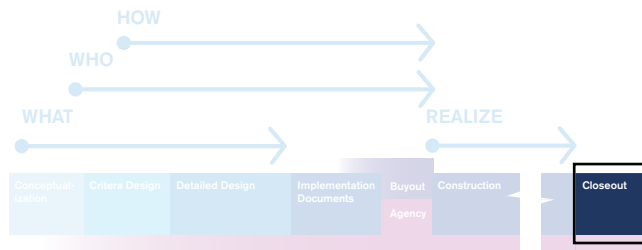
- 1 Less on-site construction administration effort because conflicts have been resolved virtually.
- 2 Fewer RFIs because contractor, subcontractor and vendors have been involved in developing the design intent and construction documentation for their respective portions of the design. The model maybe used to augment, manage or enhance the RFI process.
- 3 Less office construction administration effort is required because submittals have already been integrated into the model.
- 4 Better understanding of design intent because consistent information and documentation will be available to all participants.
- 5 More pre-fabrication because the design was developed earlier and in collaboration with the fabricator.
- 6 Less waste because more material is factory generated.
- 7 Less injuries because work is being performed in a controlled environment.
- 8 An adjusted model based on “as built” conditions.
- 9 A schedule tied to the model to allow visualization of deviations from planned sequences and durations.
- 10 Warranty operation and maintenance information may be added into the model.
- 11 Some elements of current construction administration will remain similar to current practice.

For example:

- Quality control, inspection and testing will be relatively unchanged
- Change orders, particularly for owner directed changes, must be formally negotiated and documented
- Scheduling and progress will be subject to periodic review

CLOSEOUT

An intelligent 3D model can be delivered to the owner.



Closeout of an integrated project will greatly depend upon the business terms agreed by the parties. For example, if the business structure contained compensation incentives (or penalties) the closeout will include calculation of appropriate credits and bonuses. Some issues, however, such as warranty obligations, occupancy and completion notification, will, in the short term, remain unchanged due to statutory and legal requirements. Other issues, such as punch list correction, will not be significantly affected by integrated project delivery. Some issues that will be different are:

- 1 A more complete building information model will be provided to the owner for their long term use for building maintenance and up-keep.
- 2 Traditional warranties will remain for installation quality and defective products.
- 3 The BIM model will be integrated into the building operating system.
- 4 The BIM model can be used to compare actual to planned performance.

Building Information Modeling

A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward. A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.

Source: National Building Information Model Standard (NBIMS) committee. For a more complete definition, see www.facilityinformationcouncil.org/bim/faq.php#faq1.

Buyout

Buyout is the process of obtaining price commitments for all work packages in a project. There are several methods by which this can be accomplished, ranging from sealed bids to direct negotiations with pre-selected or shortlisted subcontractors or suppliers. In the IPD approach most of the price commitments are developed through a continuous effort, with many of the subcontractors and suppliers participating in the design and refining their prices along the way. Here the explicit Buyout phase is limited to obtaining price commitments from the remaining subs and suppliers – those who weren't involved during the design phases.

Collaboration

The process or mind-set by which all integrated parties involved in a project are willingly doing whatever it takes to work together in concert to, design, construct, and make decisions solely for the good of the project.

Construction Management at Risk

In this delivery method, the CM is hired at the beginning of the design phase to act as the project coordinator (not at risk) and general contractor (at risk). At the time the construction manager serves as constructor the construction manager assumes all of the liability and responsibility of a general contractor. Construction managers are hired in various capacities by owners seeking continuous management of the project delivery process.

Coordination (Construction Process)

Oversight and management of individual firms or persons working together to resolve the spatial relationship between components, with the aim of improving the efficiency of the installation and maintenance of the systems.

Cost Structure

A breakdown of the construction and project budget into detailed "cost targets". The construction budget is developed in both a detailed component(s) based format and a CSI based format based on the project's goals, detailed program and performance requirements. The cost targets are developed collaboratively by the integrated team prior to commencing the conceptualization phase of the project process. The structure provides the benchmark for the team to support continuous cost management as the project progresses to ensure that it will be completed within the targeted budget.

Design-build

A delivery method that offers the owner the ability to contract with a single entity to provide both design and construction services. It is characterized by a single contract with the owner and the overlapping of design and construction services.

4D

A model that incorporates the dimension of time used to visualize a construction schedule.

5D

A model that incorporates cost data, used to automate quantity takeoffs for cost estimating. Coupled with 4D, it can be used to predict cash flow.

Integration

The coming together of all key participants, at the beginning of a project, for the purpose of designing and constructing the project together, as a team.

Key Participants

A person or organization whose contribution is critically necessary to achieve project goals.

Multi-Prime

A method of contracting for construction wherein an owner contracts directly with several (usually major) building trades under separate contracts to perform their work either simultaneously or sequentially. The owner may provide the management of the project, or hire a construction manager or general contractor (not at risk) to provide construction administration, coordination, and scheduling of the work of the different trades.

Open Interoperability Standards

Non-proprietary protocols and data structures that support the exchange or joint use of BIM information by differing software tools.

Project Alliance Agreement

In a Project Alliance, the key participants collectively assume responsibility for agreed project performance. The profit (or loss) to each participant is determined by the team's success in meeting project goals, not individual performance. The shared opportunities and responsibilities align the parties' interests and provide an incentive for collaboration and blame-free performance. To further enhance the collaborative process, all decisions must be unanimous, disputes must be resolved without litigation and within the Alliance, and compensation is determined on an open-book basis.

For information on existing project delivery methods, see the AIAAC's *Handbook on Project Delivery*

National Institute of Building Sciences, National BIM Standards (NBIMS) Committee – many related articles on Integrated Project Delivery, Building Information Modeling
<http://www.facilityinformationcouncil.org/bim/publications.php>

U.S. General Services Administration – the Nation's largest facility owner and manager's program to use innovative 3D, 4D, and BIM technologies to complement, leverage, and improve existing technologies to achieve major quality and productivity improvements.
<http://www.gsa.gov/bim>

The American Institute of Architects, California Council – resources related to IPD including Frequently Asked Questions
www.aiacc.org

The American Institute of Architects – Integrated Practice information
www.aia.org/ip_default

Associated General Contractors of America – *BIM Guide for Contractors*
<http://agc.org/>

McGraw-Hill Construction – source for design and construction industry information regarding IPD
http://www.construction.com/NewsCenter/TechnologyCenter/Headlines/archive/2006/ENR_1009.asp

Construction Users Roundtable (CURT) – owners' views on the need for Integrated Project Delivery
<http://www.curt.org/>

Open Standards Consortium for Real Estate – standards related to information sharing/BIM
<http://oscre.org/>

Open Geospatial Consortium – an international, voluntary consensus standards organization that is leading the development of standards for geospatial and location based services
<http://www.opengeospatial.org/>

FIATECH – a consortium of leading capital project industry owners, engineering construction contractors and technology suppliers that provides global leadership in development and deployment of fully integrated and automated technologies
<http://fiatech.org/>

LEAN Construction Institute – a non-profit corporation dedicated to conducting research to develop knowledge regarding project based production management in the design, engineering, and construction of capital facilities.
<http://www.leanconstruction.org/>

National Institute of Standards and Technology (NIST) – *Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry*
<http://www.bfrl.nist.gov/oaef/publications/gcrs/04867.pdf>

National Institute of Standards and Technology (NIST) – UNIFORMAT II Elemental Classification for Building Specifications, Cost Estimating, and Cost Analysis
<http://www.bfrl.nist.gov/oaef/publications/nistirs/6389.pdf>

OmniClass – a classification structure for electronic databases
<http://www.omniclass.org/>

Construction Specifications Institute – MasterFormat
http://www.csinet.org/s_csi/docs/9400/9361.pdf

Design Build Institute of America (DBIA) – library of information and case studies related to design build
<http://www.dbia.org>

Center for Integrated Facility Engineering (CIFE) – research center for Virtual Design and Construction AEC industry projects
<http://www.cife.stanford.edu>

National Institute of Building Sciences, National BIM Standards (NBIMS) Committee – many related articles on Integrated Project Delivery, Building Information Modeling <http://www.facilityinformationcouncil.org/bim/publications.php>

International Alliance for Interoperability (IAI) buildingSMART Alliance – an international organization working to facilitate software interoperability and information exchange in the AEC/FM industry <http://www.iai-na.org/>

Project Alliancing Practitioners' Guide, Government of Victoria, Australia
[http://www.dtf.vic.gov.au/CA25713E0002EF43/WebObj/CompleteProjectAllianceGuideforweb/\\$File/Complete%20Project%20Alliance%20Guide%20for%20web.PDF](http://www.dtf.vic.gov.au/CA25713E0002EF43/WebObj/CompleteProjectAllianceGuideforweb/$File/Complete%20Project%20Alliance%20Guide%20for%20web.PDF)

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As this is a complex issue, the Integrated Project Delivery program is focused on several issues, simultaneously. In addition to the Definition Task Group effort, the following areas are also under development/review.

We welcome your involvement in any of these areas – to participate in this effort, contact IPD@aiacc.org

IPD Public Policy Group – Chair: Phil Bona, AIA

Define legislative barriers to IPD and identify advocacy efforts to support the implementation of IPD in publicly funded building projects.

IPD Legal/Risk Group – Chair: Howard Ashcraft

In coordination with the Business Models Group, assess the business structures, risk allocation, key contractual terms, and related legal issues.

IPD Business Models & Practice Group – Chair:

Zigmund Rubel, AIA

In coordination with the Legal/Risk group, define alternative business and organizational models, skill sets and training required to support Integrated Project Delivery for various project/ownership configurations.

IPD Technology Group – Chair: Jim Bedrick, AIA

Define the electronic collaborative tools, systems and software available, the specifications, standards and protocols required to support IPD.

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INTEGRATED PROJECT DELIVERY: **AN UPDATED WORKING DEFINITION**

VERSION 3 UPDATED 7/15/14

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INTRODUCTION

This document, *Integrated Project Delivery: An Updated Working Definition*, contains the recommendations of the AIA California Council's Definitions Committee of the Integrated Project Delivery Task Force. Several years have passed since the initial development of this document in 2006. While the original document, on the surface, is surprisingly intact, there is recognition that the document could benefit by refreshing the definition and principles based on implementation of actual Integrated Project Delivery projects. To date, we are aware of over 200 projects that use multi-party contracts to incentivize and reward their teams in project execution, with likely 100s or even 1,000s that use the principles of Integrated Project Delivery to improve project outcomes.

It is largely this proliferation of projects using IPD principles that has prompted this Updated Working Definition. Projects using incomplete models of integration, often called "IPD-ish," have caused much confusion in the industry. This document proposes drawing a line in the sand as to what is IPD and what is not IPD. This document identifies what IPD is; either a project is providing all the ingredients and it is IPD or it is not.

"Projects using incomplete models of integration, often called "IPD-ish," have caused much confusion in the industry. This document proposes drawing a line in the sand as to what is IPD and what is not IPD."

The organization of the *Updated Working Definition* is similar to that of the original document, with the addition of a section containing a comparison between Integrated Project Delivery and more traditional delivery models. This document also amends the text with real world experiences from the use of Building Information Modeling, large collaborative project spaces, aka "the big room", and implementation of risk sharing/incentive rewards on projects that have gone well.

The Task Force will continue to use the *Updated Working Definition* as the basis for developing recommendations for best practices, integrated project delivery models, and risk allocation. Why is the document still a "Working Definition?" Integrated Project Delivery is still in its infancy.

When this delivery model is being used more commonly, there will be sufficient data to clearly define the boundaries of Integrated Project Delivery. Until then, the group invites you to comment on the *Updated Working Definition*, by writing to IPD@aiacc.org.

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IPD—THE DEFINITION:

Integrated Project Delivery (IPD) is a project delivery method that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction. The Integrated Project Delivery method contains, at a minimum, all of the following elements:

- **Continuous involvement of owner and key designers and builders from early design through project completion**
- **Business interests aligned through shared risk/reward, including financial gain at risk that is dependent upon project outcomes**
- **Joint project control by owner and key designers and builders**
- **A multi-party agreement or equal interlocking agreements**
- **Limited liability among owner and key designers and builders**

IPD requirements, as a project delivery model, are noted above. Projects using components of IPD, not in its entirety, are not IPD. This document's goal is to state that projects wanting to use IPD must incorporate all aspects of the definition for it to be considered IPD.

Note: Integrated Project Delivery teams will usually include members well beyond the basic triad of owner, designer and contractor. At a minimum, though, an integrated project includes tight collaboration between the owner, architect/engineers, and builders ultimately responsible for construction of the project, from early design through project handover.

Many of the essential elements of Integrated Project Delivery may be applied to a variety of collaborative project delivery methods, such as Design-Build or CM at Risk, that may not inherently contain every required IPD element mentioned above.

FURTHER EXPLANATION:

- **Integrated Project Delivery (IPD) is a project delivery method:** IPD is a unique and separate project method, distinctly different from Design-Bid-Build, Design-Build, CM at Risk, and Multiple Prime. All benefits for innovation and efficiency return to the project team as opposed to the individual firms. All parties agree to the business terms to share the financial savings for optimizing the Owner's business case.
- **Integrates people, systems, business structures and practices:** The foundation for IPD is the development of a virtual project organization. The organization of "the firms" includes the individual team members for the owner, designer(s), consultants and builder(s). The project organization's mission and responsibilities are committed to "best for project" decision making, and this commitment is supported by alignment of the firms' business interests through shared risk and reward.
- **Collaboratively harnesses the talents and insights of all participants:** The primary purpose of the virtual organization is collaboration. The project firms and individuals are committed to create a team culture of joint decision-making. Team members are formally organized in multidisciplinary clusters responsive to the project goals. Team members are individually accountable to contribute alternatives to design and construction issues. Builders' input is not left until the construction phase, when it is typically too late to benefit the design.
- **Reduce waste and optimize efficiency:** IPD incentivizes minimization of waste. In addition to integration and collaboration, the method utilizes formal tools to achieve maximum results. Typical tools include: Building Information Modeling (BIM), prefabrication, manufacturing of larger integrated units, process improvement metrics and LEAN design and construction techniques.

IPD—THE VALUE PROPOSITION:

The owner's "business case" defines the need for and the requirements of a capital project. The ultimate goal for an owner is to complete a project to meet very specific business goals within very specific constraints. Typically these constraints, at the highest level, are budget, schedule and a level of quality required to support operations, all within a predictable level of risk. Generally speaking, the industry suggests that the owner can expect to optimize any two of the three constraints but not all three; Integrated Project Delivery enables optimizing all three.

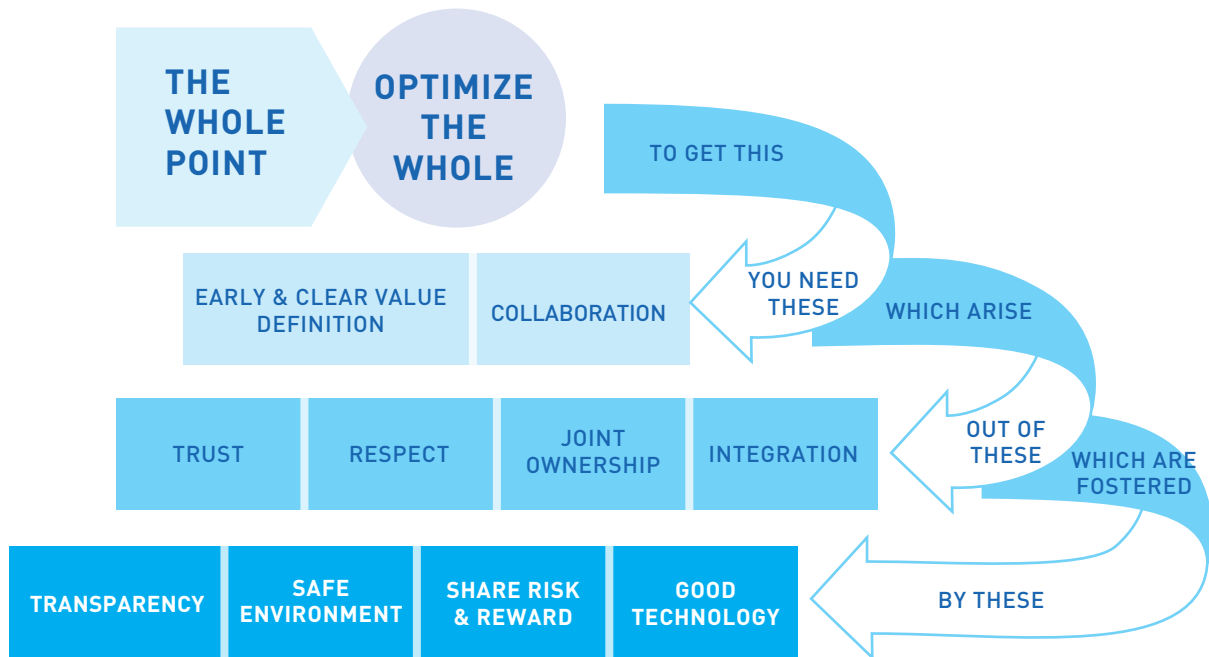
Previously, there were four main project delivery models available to owners: Design-Bid-Build, Design-Build, CM at Risk, and Multiple Prime. Each offers a different level of predictability to project outcome and risk.

Integrated Project Delivery (IPD) is a fifth delivery model that is gaining momentum. IPD offers owners the maximum opportunity to optimize their business case within predictable risks.

WHAT IS THE VALUE PROPOSITION FOR IPD?

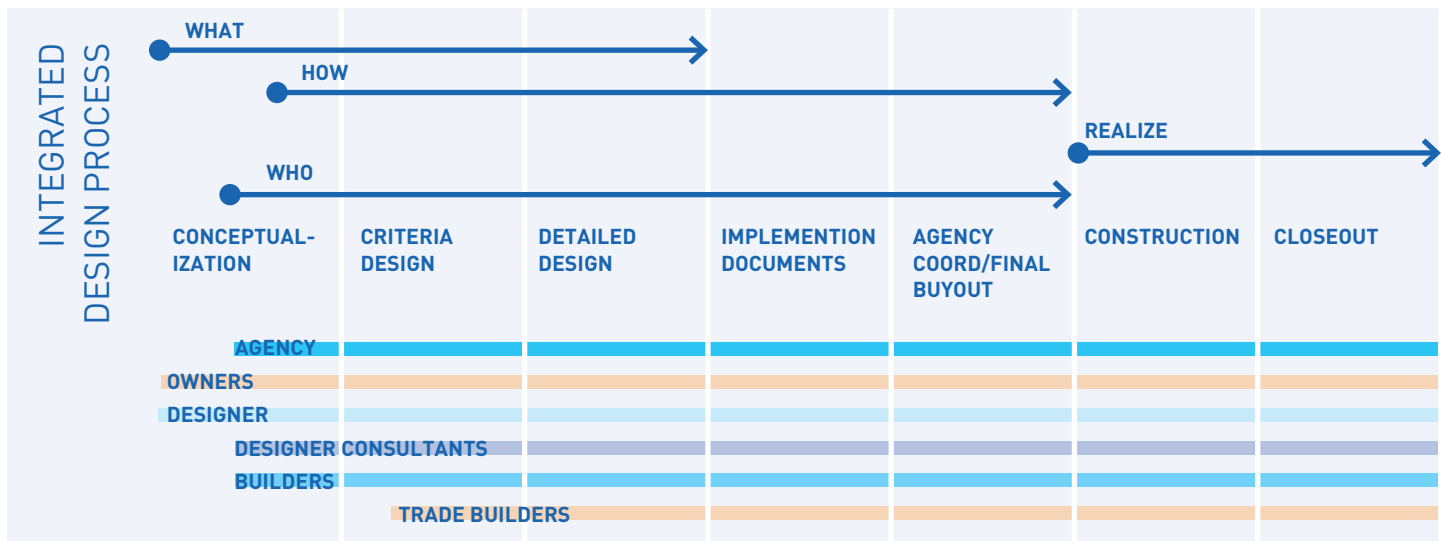
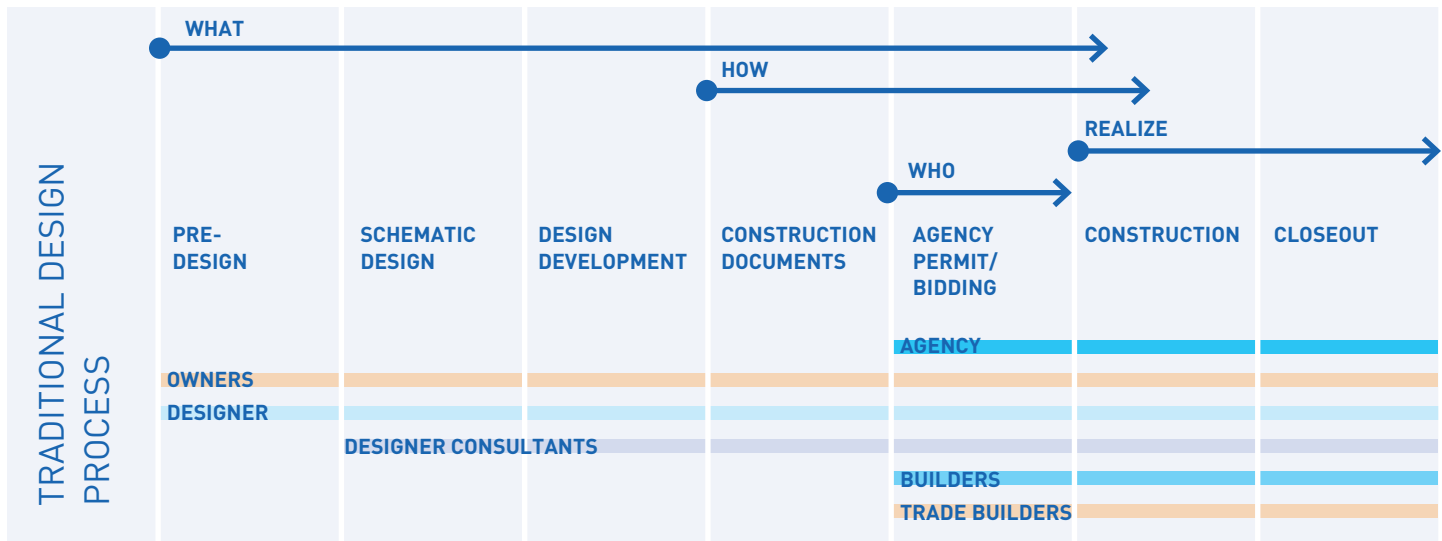
1. **Flexibility:** Consider for example, that a business case includes additional goals and constraints such as: aesthetics, sustainability, operating efficiency, life cycle costs, community relationships, local workforce, and numerous others specific to an owner's project. Often not considered, however, is the need for flexibility to accommodate change during design or construction without sacrificing the owner's constraints! Projects are becoming more complex; technology, equipment, innovations in products, manufacturing, and prefabrication are becoming available faster than projects can be completed. The owner may require late incorporation to stay competitive or respond to an unanticipated change in their business environment. IPD's shared financial incentives between owner, designer(s) and builders(s) and integrated and collaborative processes enable the team to collectively find the project solution to optimize and support the business case.
2. **Speed:** After an initial investment in learning how an integrated team works, The information flow on IPD projects moves more quickly for the following reasons: First, designers and builders coordinate directly during design, thus preventing the misunderstandings and poorly informed design decisions that typically create delays during construction. Secondly, by fostering an environment in which the team collaborates well, questions get answered in the speed of a conversation instead of a paper trail that starts with an RFI and ends with a change order, typically taking weeks to process.
3. **Less litigation:** At the date of publication, no IPD project has gone into litigation. This is because IPD projects create a structure wherein all core team members benefit or suffer together, incentivizing them to help each other prevent problems. Disputes that typically would lead to claims are either prevented or settled in a collaborative manner.

IPD—ESSENTIAL PRINCIPLES:



- 1 Optimize the Whole, not the parts:** The point of integrating the project team is to deliver the whole project in a way that gives owners what they value. Whether that is optimized design solutions, increased efficiency over the building's lifetime, or a fast track schedule, higher performance requires that all parties make decisions that are best for the project, rather than their own slices of the pie.
- 2 Early and Clear Goal Definition:** In order to optimize the whole, the team must agree on what the "whole" is. Project goals are developed early and agreed upon by all participants. Project budget is set early and the team designs to the price, rather than pricing a design.
- 3 Collaboration:** In order to optimize the whole, the project team must collaborate closely, deeply, and continuously.
- 4 Integration (people and systems):** People can't collaborate unless they can easily share information, find appropriate times and spaces to communicate, understand how their different design processes interact, get their billing departments to work in harmony, and get many other systems (big and small) integrated together across company lines.
- 5 Joint Ownership:** Meaningful collaboration requires participants to have a sense of ownership over the project and end goals.
- 6 Respect:** Collaboration also requires respect. The project team mutually commits to treating each other with respect and valuing each professional's input. Innovative solutions can come from any team member, so roles are not as strictly defined as on traditional projects, but rather assigned to the best qualified person.
- 7 Trust:** Meaningful collaboration cannot occur without trust. Trust is fostered through experience together, as well as purposeful decisions.
- 8 Transparency:** Trust requires transparency. Communication among the team is not limited to traditional silos or top-down distribution. Information of all types, from design rationale to Building Information Modeling (BIM) lives in a central location so all team members have access to accurate and current information. Often an investment in technology compatibility will be necessary to ensure that all team members have access to the information they need to coordinate.
- 9 Safe Environment:** Trust also requires a project environment in which team members are safe to experiment and suggest innovations without fear of being wrong.
- 10 Shared Risk and Reward:** An integrated project depends on best-for-project decision-making. However, it is very rare that a firm will actually sacrifice its own profitability for the good of a project. Under IPD, risk/reward sharing structures are set up to cost or benefit the participants according to *project* outcomes rather than *individual firm* contributions. This aligns the decision-making influences – a decision that is best for the project will benefit all participants, one that attempts to benefit one firm at the expense of the project will reduce profitability for all participants.
- 11 Good Technology:** Integrating systems together across company lines becomes much easier when using good technology. For projects requiring high levels of integration, technology like Building Information Modeling (BIM), cloud servers, teleconference tools, and others become crucial to making it all work. It is important to factor in the investments in both money and time to get these up and running smoothly.

IPD—PHASES:



- **Who:** The project participants
- **What:** The physical and functional requirements of the project
- **How:** The means and methods that will be used to make the "What" real
- **Realize:** The act of making the "What" real – i.e. construction

The phases of an Integrated Project differ from traditional phases (Schematic Design, Design Development, Construction Documents, etc.) in order to take advantage of two critical factors:

- In addition to the design expertise of a traditional design team, expertise in construction aspects (cost, scheduling, material performance and availability, means and methods, etc.) is available throughout the design process.
- Building Information Modeling (BIM) tools and processes enable the team to integrate this broader range of knowledge in order to provide effective support for design decisions.

These factors enable the team to make better-informed design

decisions earlier in the process and to optimize the design for construction means and methods. In essence, *how* and *who* are addressed much earlier in the process, enabling elimination of the traditional overlap of *what* and *how* with *realization* that is typically a source of expensive changes and rework during construction.

This is not to suggest that there is a rigid, sequential order to phasing in an integrated project. The expanded knowledge base and enhanced collaboration tools in an integrated team allow a great deal of flexibility in the sequencing of the design effort. A major advantage of the integrated approach is that the team makes the decisions regarding this sequencing. In traditional projects design decisions are often deferred – sometimes even until after start of construction – at the sole discretion of the designers, without complete knowledge of the impact on construction. In an integrated project, however, the availability of both design and construction expertise enables the team to sequence the design effort to better accommodate such issues as fast-track delivery or procurement of long-lead items.

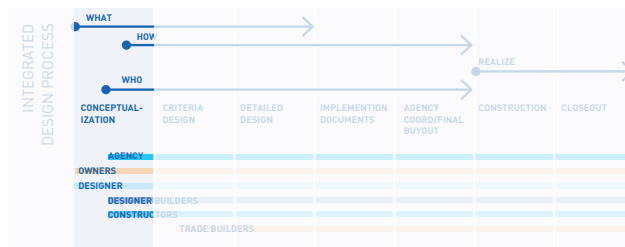
SETTING THE STAGE

Prior to actual kickoff of the design process, or concurrent with the very earliest steps, significant preparatory work will need to be done.

- **Key project participants are selected and brought on board.** The actual personnel should be brought in.
 - Owner
 - Prime Designer
 - Key Design Consultants
 - Prime Builder
 - Key Trade Builders
 - Key Regulatory Agencies
- **Team communication/coordination processes are set up.**
 - Collaboration training
 - Communication technologies
- **The business model for the project is determined**
 - The risk/reward structure that will best incentivize the accomplishment of the Owner's goals for the project is developed
 - IPD contract(s) is (are) negotiated
 - Project management structure is set up
- **Key technologies are identified and protocols are set up for their use. Examples:**
 - Building Information Modeling
 - Change control protocols
 - Model management responsibilities
 - Performance simulation tools
 - Document Management System
 - Data exchange protocols
- **Extent of co-location is determined, and co-location facility is designed and set up**

1 CONCEPTUALIZATION

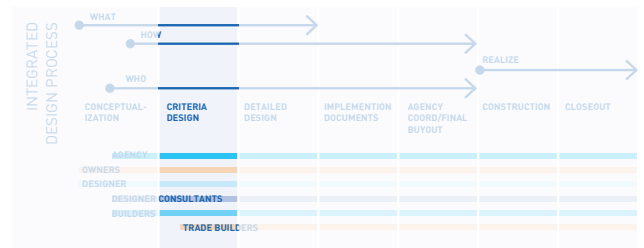
Conceptualization begins to determine WHAT is to be built.



- All key stakeholders are involved in the programming process; input is obtained from as many participants as possible.
 - Key project parameters are captured, such as:
 - Size
 - Schedule
 - Sustainable or green criteria or goals
 - Performance metrics (economic, energy, maintenance efficiency, operational, etc.)
- **Initial cost structure is developed. Benchmarks by which cost targets for the project will be determined are identified.**
- **Preliminary schedule is developed.**

2 CRITERIA DESIGN

During Criteria Design the project is defined and the targets and metrics by which the success of the project will be measured are agreed upon.

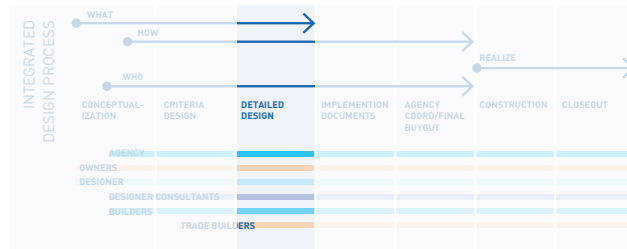


- **Key project parameters such as the following are fixed:**
 - Scope
 - Basic design (massing, elevations, floor plans, etc.)
 - System selection (structural, skin, HVAC, etc.)
 - Quality levels for finishes
 - Target Cost
 - Overall schedule
 - Building components to be prefabricated
 - Sustainability targets
- All key trade contractors are engaged.
- Procurement schedule is developed.
- Cost structure is refined to a system level, in a manner that enables the team to use the cost information to guide the design.

3 DETAILED DESIGN

The Detailed Design phase concludes the WHAT phase of the project. Note that the Detailed Design phase is longer and more intense than traditional Design Development because more is accomplished. The team will decide the level of detail required.

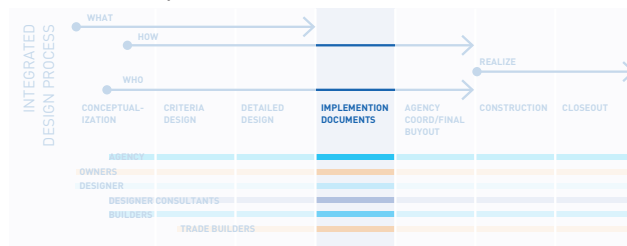
During this phase, all design decisions necessary to ensure that changes during construction will not be necessary are finalized, and the design is fully and unambiguously defined.



- All building elements are defined.
- All building systems are fully engineered and coordinated. This includes final system coordination that in traditional delivery models is usually deferred until the construction phase because trade contractor input is not available until then.
- Specifications are developed based on agreed and prescribed systems.

4 IMPLEMENTATION DOCUMENTS

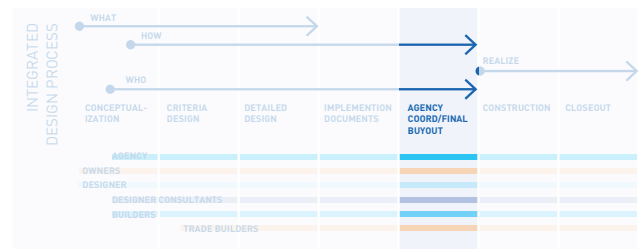
During this phase, focus shifts from WHAT is being created to documenting HOW it will be implemented. At the beginning of this phase the entire building and all systems are fully defined and coordinated, so it is significantly shorter than the traditional Construction Documents phase.



- The traditional shop drawing process is merged into the design as the contractor, trade contractors, and suppliers document the construction intent of building systems and components.
- Prefabrication of some systems can commence because the design is fixed.
- Specifications are developed to provide narrative documentation of the design intent wherever necessary.
- Documents are generated where needed for processes such as:
 - Financing
 - Procurement
 - Permitting
- Implementation Documents include information for
 - Assembly
 - Layout
 - Detailed schedule
 - Procedural information (testing, commissioning)
 - Legal requirements (whatever needs to be included to be legally binding)

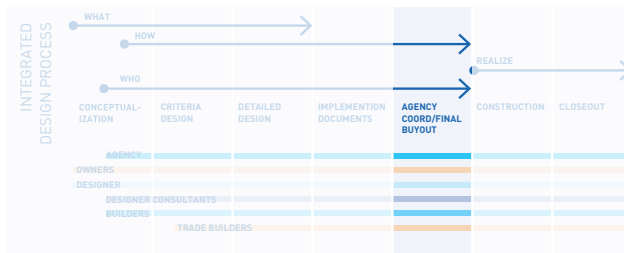
5 AGENCY REVIEW

This phase actually runs concurrently with Criteria Design, Detailed Design, and Implementation Documents. During the earlier phases the regulatory agencies provide high-level compliance information and work with the team to develop a mutually agreeable permit submittal schedule. Because of their involvement in the design process, builders and trade builders will need to be involved in submittal preparation and response to agency comments.



6 BUYOUT

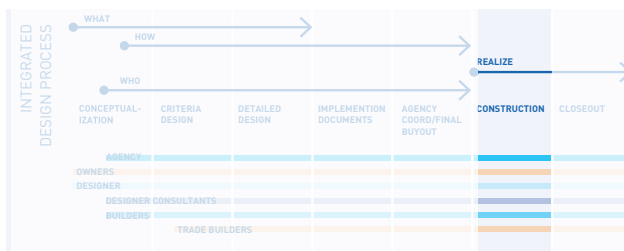
The bulk of an IPD project is not “bought out” as in traditional projects because the major trades develop their prices during the design process. In addition, long-lead items are identified and defined during design and their procurement is begun as early as necessary. This Buyout phase completes the buyout of remaining contracts.



7 CONSTRUCTION

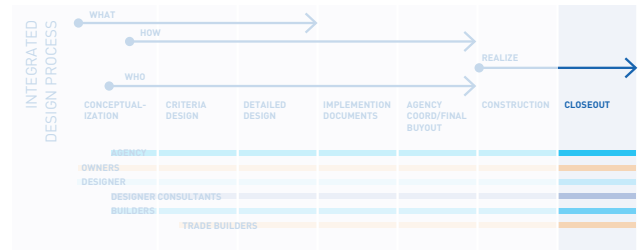
In traditional projects construction is often treated as the final stage of design where issues that were not addressed during the design phases are worked out. In an Integrated Project, due to the availability of construction expertise as well as the ability to integrate this expertise into the design using BIM, final design is completed during Detailed Design and means and methods are worked out during Implementation Documents.

Some elements of IPD construction administration will remain similar to traditional practice. For example:



- Quality control, inspection and testing will be relatively unchanged.
- Change orders, particularly for owner directed changes, must be formally negotiated and documented.
- Scheduling and progress will be periodically reviewed.

8 CLOSEOUT



Many aspects of the closeout of an Integrated Project will be similar to those of traditional projects. Some examples:

- Finalization of as-built models or other documentation
- Punch list correction
- Warranty obligations
- Occupancy and completion notification

In addition, the painshare/gainshare arrangement will be resolved.

OPTIMIZED IPD

The elements of IPD listed on page 4 are at IPD's core. Below is a discussion of the key constructs that enable an optimized IPD project. These constructs comprise the optimal business model, contractual structures and team behaviors. Also included is the critical discussion as to how each construct contributes to enabling an IPD team to be more successful than other delivery models. These constructs are characteristics that are specific to those members directly signatory to a single or multiple interlocking IPD agreement(s).

BUSINESS MODEL

Separate Profit from Cost

Establish a fixed profit. Separating profit from units of labor or materials eliminates the incentive to increase the number of units to increase profitability. Instead, the incentive should be to increase margin by reducing the underlying costs while maintaining a fixed profit amount. Ideally, 100% of a parties' profit should be at risk. Moreover, the at-risk profit provides the owner with a buffer against cost overruns, and less than full profit at risk can result in an inadequate buffer.

Guaranteeing Costs To Perform The Work

There are several reasons for the owner guaranteeing costs without a cap. First, whenever a cap is placed on costs, the capped party wisely includes contingencies in its costs to protect against the potential cost overrun. Second, if there are any project disruptions, the parties will begin the claims/change order process to avoid losing claim rights that may be important if the project continues to suffer additional costs. This creates an antagonistic project atmosphere—often from early in the project. Finally, the variable cost guarantee is a fair trade for the fixed profit being at risk and the limits on change orders.

Profit Based on Agreed Project Outcomes

Tying profit to achieving agreed project outcomes assures goal alignment and increases the likelihood of aligned action. The agreed outcomes can be whatever is most important to the owner and the team. Often this will be cost and schedule, but can also be quality, sustainability, functionality, life cycle costs, owner satisfaction or whatever else the team may agree upon. By tying profit to project, instead of individual outcomes, the team is incentivized to collaborate in pursuit of common objectives and disincentivizes selfish behavior.

Limited Entitlement for Change Orders

Increasing project costs by change orders is limited to owner elected changes. Team caused impacts, such as errors and omissions in the drawings, construction errors or productivity issues are issues for the team to resolve, not opportunities for additional revenue. This attribute, in conjunction with limited liability and profit based on project

outcome, creates a closed system. If problems arise, the team must collaboratively resolve them regardless of cause. Entitlement for change orders and claims is largely eliminated in IPD. Once understood, this attribute leads to more effective constructability evaluations, coordination and response to problems as they occur.

CONTRACT STRUCTURE

Early Involvement of Key Participants

The key parties are contractually engaged at the earliest responsible moment. Key parties are those that have a substantial stake or material effect on project outcome. Involving these parties early has many beneficial effects. First, it increases the overall knowledge base before design is developed, allowing for coordination and constructability to be built into the process rather than applied after the fact, enabling target value design, and eliminating value engineering. This improves the designer's understanding of systems, equipment, alternatives and costs implications before they initiate design. It also increases the diversity of opinions and perspectives—a key determinant of creativity. It avoids much of the rework inherent in the transfer of design information to builders and can allow for an efficient distribution of design effort between the licensed design professionals and the design/assist or design/build trades.

Joint Project Control & Decision Making

Joint project decision making is an essential step in creating a virtual organization. By empowering the team to jointly manage the project, decision making is accelerated and situated closer to the sources of knowledge and information. Because major decisions are not unilateral, there is a check-and-balance that reduces the likelihood of errant decisions. Joint project decision making also increases overall ownership of the project, leading to higher levels of commitment. It is also fair. Parties that have placed their profit at risk should have a voice in project management.

Shared/Risk Reward Based on Project Outcomes

This is the contractual tie between profit based on agreed outcome and limitations on change orders. By putting both of these attributes in an enforceable agreement, the business model becomes an obligation, not an aspiration. This is one

of the distinctions between true IPD and other collaborative approaches, such as partnering, that seek to achieve behavioral changes—but these can be abandoned mid-project because they are not a contractual obligation.

Jointly Developed Validated Targets/Goals

The jointly developed and validated targets/goals are an enforceable “mission statement” for the project. Because they are used to determine project success—and compensation—they align the team’s actions to the agreed goals. Agreement to goals also leads to commitment to achieving them. In addition, they provide a check, through the validation process, on the feasibility of the project. Aggressive goals also create the stress that leads to behavioral change, but because the stress is felt by all project members, it becomes a shared incentive to jointly develop new and more effective approaches.

Reduced Liability Among Risk/Reward Members

Reduced liability is an element in closing the system, forcing the participants to take responsibility for the project rather than attempting to blame other participants in an attempt to escape the impact of a problem. But perhaps more importantly, it removes disincentives to direct and continuous communication between the parties. Because parties that suffer because of incorrect information can often claim against the information provider, project participants (particularly the design professionals) have become wary of providing early and incomplete information to contractors. But without an understanding of where the designers are headed, the builders cannot effectively plan. Similarly, builders are chary of providing advice about design that might draw them into a design issue. But if the team is to be effective, communication must be rapid, direct, and continuous. Reducing liability among risk/reward team members removes much of the anxiety around communication.

ENABLING BEHAVIORS

Optimize the Whole, Not the Parts

essential change in IPD is that the project is viewed as an indivisible whole. Every action, every decision should be judged by whether it will lead to improving the overall project outcome. This is the critical difference from other project delivery methods as compared to IPD. All participants, including the owner, designers and builders, in an IPD arrangement work together to optimize the project result rather than benefit the individual firms.

Trust

Trust is a critical element of IPD. But it is not blind trust. It is trust built on transparency and respect and measured accountability to meet commitments. When trust is created, the entire project is accelerated. The parties can trust their colleagues to perform as they promised allowing everyone to plan based on those promises. Moreover, the parties can trust that their colleagues will respect their interests and ideas, creating a safe environment to extend their capabilities. Earned trust catalyzes every transaction between the parties.

This kind of trust is seen with firms that have proven track records, renown reputations or past experiences working on previous projects before with other team members.

Integration (information, people and systems)

High performance projects and project delivery requires integration throughout the process. Integrated information provides a means for information exchange and developing a common understanding. Integrated organization melds the disparate companies and individuals into a virtual organization. Integrated processes lead to coordinated and efficient action. Integrated systems enable optimization of the entire project. Integration creates the possibility of utilizing the capabilities of the entire team and creating results that are greater than the sum of the parts.

Continuous Improvement/Learning

IPD is not a static concept. It is a process of continual examination and improvement. In IPD, learning is not just the subject of retrospectives. It is a daily process where learning is turned into action, tested, modified, tested again, throughout the project. Processes are studied and challenged, experiments undertaken, and the results immediately fed back into the project. The goal of IPD is to deliver this project better than originally envisioned.

Appropriate Technology

IPD does not demand any specific technology and technology should not be seen as a crutch for failed procedures. Systems and procedures should be optimized before being automated. But most IPD projects will rely on appropriate technologies, particularly Building Information Modeling. BIM is an important vehicle for collaboration. It is a platform for rapid prototyping and simulation, creates a common understanding between the parties and is a tool for identifying and resolving conflicts. Astute IPD teams take advantage of project websites, simulation and optimization software, 3, 4 and 5D models, and any appropriate tool that will increase understanding, promote communication, collaborate virtually, and better achieve the project objectives. Thus, while no specific technology is required, not using technology appropriately violates the principles of continuous improvement and optimizing the whole.

Collaboration

IPD requires collaboration, not just cooperation. Collaboration is working together to achieve the agreed goals by building on and improving each others’ ideas. It is synergistic and creates results that exceed what can be achieved by coordination, alone. Collaboration in IPD is most visibly shown through co-located activity, where the parties are not just meeting together, they are performing their daily work together in cross-functional groups composed of the best suited individuals drawn from all of the IPD participating firms. They engage in a vigorous exchange of ideas and perspectives to develop solutions to project problems and to achieve the common goals. Peter Senge and others referred to this exchange as dialogue. It is not an exchange seeking to win a debate, but a joint exploration leading to solutions.

IPD—IN COMPARISON WITH OTHER DELIVERY MODELS

IPD allow for a dynamic, transparent and holistic process that benefits all project participants. These charts represent qualitative assessments of how IPD can be differentiated from other delivery models. The delivery models show traditional delivery methods, but do not take into account various contract models such as Guaranteed Maximum Price (GMP). The delivery models chosen are comparators to IPD; Design Bid Build, Multi-Prime, Construction Manager at Risk (CM at Risk) and Design Build represent the predominant delivery models used in the industry. We did not include Turnkey or Public Private Partnerships as they embrace one of the four models to deliver the design and construction of the building within the umbrella of the longer contract for the building operation. The charts were developed from the broad experience of the IPD Steering Committee members and contributors and do not represent any research or collected field data from any specific projects. The overarching message, we believe, will not change with any significant research, in that the only delivery model where all the project stakeholders can benefit in all the studies is Integrated Project Delivery, and sometimes Design Build.

CHART 1: Who benefits if the costs comes in lower or the schedule shorter depending on delivery model type?

	Owner	Designer	Builder	Trade
Design Bid Build	No	No	Yes	Yes
Multi-Prime (hard bid)	No	No	Yes	Yes
CM at Risk	No	No	Yes	Yes
Design Build	No	Yes	Yes	Yes
IPD	Yes	Yes	Yes	Yes

In **chart one**; one might not understand why the owner does not benefit with the costs coming in lower than initially contracted. Traditional contracts do not require the sharing of savings on a project with the owner. Project stakeholders are incentivized to reduce costs for their own benefit, yet the owner does not always receive this benefit if the contract is not transparent and does not share these outcomes.

CHART 2: Who is incentivized to keep the cost down or reduce the schedule for the owner when changes occur?

	Owner	Designer	Builder	Trade
Design Bid Build	Yes	No	No	No
Multi-Prime (hard bid)	Yes	No	No	No
CM at Risk	Yes	No	No	No
Design Build	Yes	No	No	No
IPD	Yes	Yes	Yes	Yes

Chart two shows that under traditional methods the owner is incentivized to keep costs reduced as project requirements change, but the other project stakeholders are not. This characterization of change is true for both owner generated changes, un-foreseen conditions and errors / omissions. Under IPD, though, the team is incentivized to keep costs down on a project when changes occur because the team is all being supplied from the same source that will reward them. The transparent and single pool of monies in an IPD model enables ownership from all project stakeholders for project success.

CHART 3: Who is incentivized to improve construction processes?

	Owner	Designer	Builder	Trade
Design Bid Build	Yes	No	No	No
Multi-Prime (hard bid)	Yes	No	No	No
CM at Risk	Yes	No	Yes	Yes
Design Build	Yes	Yes	Yes	Yes
IPD	Yes	Yes	Yes	Yes

Chart three begins to identify who wants to improve the quality and methodology of how the project is delivered. Our industry is in a transition to embrace more advanced methods of making buildings, as other manufacturing fields have. IPD, and sometimes Design-Build, offer all the project team stakeholders the benefit when advanced delivery methodologies are coordinated with others and the impact might not be cost neutral.

CHART 4: Who is incentivized to improve building performance for the lifecycle

	Owner	Designer	Builder	Trade
Design Bid Build	Yes	No	No	No
Multi-Prime (hard bid)	Yes	No	No	No
CM at Risk	Yes	No	No	No
Design Build	Yes	No	No	No
IPD	Yes	Yes	Yes	Yes

Chart four aligns project delivery with building performance. We think the main message is that only through dynamic, transparent and holistic process benefiting all project participants will our industry be incentivized to move the needle on how buildings perform. Building system technologies and the actual functional requirements are constantly changing. Traditional contracts are set up where the requirements and functionality are fixed. In addition, design fees are also considered to be part of first cost competitive analysis by owners and do not allow for lifecycle design. Since the lifecycle of a building is a significant portion of the building's cost for the initial capital outlay, our industry needs to provide a methodology where the project delivery can support the eventual operations of the building.

CONCLUSION

This document refreshes and hones what IPD is. Specifically, it requires that for a project to call itself an IPD model it must embody the minimum characteristics previously stipulated on page 4 for all key participants:

- Continuous involvement throughout the project
- Aligned business interest
- Joint project control
- Interlocking agreements or Multi Party Agreements
- Limited liability

We believe this is a necessary clarification to distinguish IPD from other delivery models that offer some of these improvements, but do not use the whole system to achieve full integration.

As stated in the introduction, this is a working definition, and in the future, we might find reason to further define, or broaden the requirements of what stipulates an IPD model. The goal of this document is to be a reference for industry practitioners who want to optimize their projects and have their entire project team participate with them in concert, as opposed to other delivery models that have silos where services and work are traditionally provided. We welcome feedback and hope you can contribute to: ipd@aiacc.org

A GLOSSARY OF TERMS ASSOCIATED WITH IPD

Best-for-Project

Describes a decision making standard where decisions are measured against shared goals / objectives about what is best for the project vs. individual stakeholder outcomes.

Big Room

A shared space which includes at a minimum; the owner, the design team and the constructor to encourage collaboration and communication between all parties.

Building Information Model

A Building Information Model, (BIM) is a digital representation of physical and functional characteristics of a facility. Source: National Building Information Model Standard (NBIMS) committee. For a more complete definition, see: http://www.wbdg.org/pdfs/NBIMsv1_p1.pdf

Buyout

Buyout is the process of obtaining price commitments for all work packages in a project. There are several methods by which this can be accomplished, ranging from sealed bids to direct negotiations. In the IPD approach most of the price commitments are developed through a continuous effort, with many of the trade contractors and suppliers participating in the design and refining their prices as the project progresses.

Builder

Builder refers to the General Contractor who is responsible for the project by providing all of the material, labor, equipment and services necessary for the construction of the project. Builder is also sometimes used to refer to trade contractors.

CM at Risk (Construction Manager at Risk)

Construction Manager at Risk (CM at Risk) is a project delivery method that allows the client to select the Construction Manager (CM) before the design stage is complete. The CM is chosen based on qualifications, and then the entire operation is centralized under a single contract. The architect and CM work together in order to cultivate and assay the design.

Cost Model

A breakdown of the construction and project budget into detailed "cost targets." The cost targets are developed collaboratively by the integrated team prior to commencing the conceptualization phase of the project process. The structure provides the benchmark for the team to support continuous cost management as the project progresses to ensure that it will be completed within the targeted budget.

Designer

The design professional on the project responsible for performing and overseeing overall project design. Designer is also sometimes used to refer to design consultants.

Design Consultant

The professional consultant(s) on the project responsible for performing and overseeing design in specific areas of the work (i.e., structural, mechanical, landscape, electrical, civil, etc.)

Integration

The coming together of primary participants (which could include owner, designer, constructor, design consultants, and trade contractors, key systems suppliers, etc.) at the beginning of a project, for the purpose of designing and constructing the project together as a team.

Interlocking Agreements

Agreement(s) used in an IPD project between the owner and key designers and builders establishing shared risk/reward, joint project control and limited liability.

Multi-party Contracts

Bind all the parties — client/owner, designers, constructor and trade partners — into a single agreement which requires them to share risks and rewards. This encourages everyone in the team to think of the project first as their commercial interests are clearly bound up with the overall success of the project. In turn this means that leadership and decision making is both more inclusive and distributed.

Multi-Prime

A method of contracting for construction wherein an owner contracts directly with several (usually major) trades under separate contracts to perform their work either simultaneously or sequentially without employing a General Contractor to be in overall charge of the work. The owner may provide the management of the project, or hire a construction manager to provide construction administration, coordination, and scheduling of the work of the different trades.

Open Book

Contractual rights owners have to review and audit the financial records of contractors performing cost-plus contracts, may also include key team members.

Trade Builder

The party on the project responsible for performing and overseeing construction for specific building systems on a project.

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THE ST. OLAF COLLEGE FIELDHOUSE PROJECT: A CASE STUDY IN DESIGNING TO TARGET COST

Glenn Ballard¹ and Paul Reiser²

ABSTRACT

Consumer product development uses a technique called 'designing to target cost' to systematically improve product profitability. In brief, a manufacturer sets a cost for a product to be developed that will allow an acceptable profit given the price that product is expected to fetch in the market. That target cost for the product is then split into target costs for each functional system within the product. In effect, the 'buyer' is setting the price he is willing to pay for each system. This can be extended to subsystems and components, and even to parts of components where the relevant buyer is able to impose on or negotiate prices with their suppliers.

Target costing is used in the initial development of a product, in subsequent product modifications, and in the manufacturing of the product throughout its life, where the focus shifts to the production processes themselves.

Designing to target cost is very likely done in some form in construction, but is not well documented and could potentially benefit from a more systematic approach. The Boldt Company very successfully introduced a form of target costing at the facility system level on a design-build project, the St. Olaf Fieldhouse project. This paper presents a study of the Fieldhouse project intended to reveal the potential for positive impact on project performance of designing to target cost, and to support the need for further research into target costing. It concludes with recommendations for next steps in developing a methodology for designing to target cost in the construction industry.

KEYWORDS

Contingency, cost, cost control, cost management, design, designing to target cost, lean enterprise, project financial management, target cost, target costing

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INTRODUCTION

Designing to target cost³ is a product development practice that converts cost into a design criterion rather than a design outcome. As such, it belongs to the more general practice of designing for target characteristics, commonly referred to as DfX, which is currently a hot research topic in mechanical engineering and design⁴.

Designing to target cost has been used most consistently by Japanese manufacturers as a means for systematic reduction in product costs and consequently improvement in profitability (Cooper & Slagmulder, 1997). The practice has been used in construction to some extent, especially by design-build contractors, though details and extent of that practice have not been well documented⁵. There may be opportunity to expand and improve the practice through better understanding its use both in product development and in construction.

This paper will provide such an overview, explore the relationship with value generation, present a case study of target costing in construction, suggest ways in which construction could benefit from a more conscious and comprehensive implementation of target costing, and propose further research.

DESIGNING FOR TARGET CHARACTERISTICS

Cost is but one possible target characteristic of a product to be achieved through design. DfX, Design for X, is the generic name for the process of designing for target characteristics, which may include design for manufacturing, design for assembly, design for sustainability, reliability, constructability, operability, cost, weight, acceleration and many more. DfX faces three primary challenges:

1. How to incorporate the relevant specialists in the design process, both as regards knitting organizations together through contracts and effective processes for collaborative design.
2. How to make tradeoff decisions between the characteristics.
3. How to drive design decisions to achieve the targets.

We limit ourselves to consideration of cost targets and to challenge #3 in this paper.

The traditional practice in construction is to produce design to some degree of supposed completion, estimate its cost, then try to alter the design in order to bring expected cost within budget. This approach is wasteful, yielding rework and frustration, and arguably generates less value for customers and providers⁶ than alternatives. A better approach is to

³ As shorthand, we will occasionally use the expression “target costing” as equivalent to “designing to target cost”. Neither should be confused with “target cost contracts”, in which “...the difference between actual and target cost is shared in a specified way between the client and contractor.” (http://www.dfid.gov.uk/policiesandpriorities/files/africa/ev_s249a.htm and Bös (1996)).

⁴ For example, see Shah, et al. (2004).

⁵ See Knott (1996) for an excellent example of the target costing process applied in construction.

⁶ We use the term “provider organization” to indicate the organization that has responsibility for delivery of the facility to the client. This may be a design-build firm, a joint venture, a construction management firm, etc.

anticipate the cost consequences of different possible designs or design decisions, and limit eligibility to those that fit within the target cost. No doubt, we need to learn better how to do that, but it is done now by conceptual estimators and others who know what things will cost to build, so it can be done. Until designers develop more advanced conceptual estimating skills, designing to target cost will have to be done through cross functional teams. Indeed, given the wide range of desired product characteristics, it is evidently very rare for a single individual to possess all the necessary knowledge and competencies. Hence, cross functional teams will always be required.

Another critical support tool needed for designing to target cost is an integrated product/cost model. When the cross functional teams producing design do so in nD models which quickly reveal the cost implications of potential design actions, it will be much easier to avoid producing design outputs that do not meet target costs.

Value engineering (VE) is used extensively in product development to support achieving cost targets⁷. It is most often used in construction as an after-the-fact review of a previously produced design, rather than as a means for generating and selecting design alternatives that meet or beat target costs. Functional analysis, at the heart of VE, seems best used in the original design process, and should become a competence of the cross functional team rather than an add-on or afterthought.

Granting the need for such tools, nonetheless designing to target cost may be successfully accomplished in construction today without them, though perhaps with varying degrees of success. Consider the example of a design-build specialty contractor who has committed to a guaranteed maximum price (GMP). The contractor is responsible for both design and construction, and has design capability in-house. Ways are found to prevent the project cost exceeding the guaranteed maximum price, else the contractor's profit is reduced. What is not known is the extent to which that GMP is achieved through the traditional process: design-estimate cost-redesign-reestimate cost-and so on. Having both design and construction done by a single company does not necessarily change the way design and construction personnel relate to one another or the way the design process is structured and operates.⁸

Simply having a guaranteed maximum price does not reveal how that price was determined. In true designing to target cost, cost reductions necessary for achieving target profitability are incorporated into the targets. In construction, standard practice seems rather to establish GMPs based on expected costs rather than target costs. Apart from the inaccuracy of estimates due to market uncertainty, costs are taken as given and are not conceived as a variable subject to management action.

Analogically, the provider organization plays the role of the manufacturer that launches a product development project.

⁷ The seminal text in VE is Miles (1961). For its more recent application in manufacturing, see, among many others, Park (1999). A foundation text for VE in construction is Dell'Isola (1975). For the evolution of VE in U.S. construction, see Dell'Isola (2003). For a different evolution in Europe/UK, see Kelly, et al. (2003).

⁸ The Lean Construction Institute and Southland Industries, a design-build mechanical engineering firm, are producing a report on the integration of detailing and engineering, the benefits of which were demonstrated by the unprecedented quality and completeness of design documents produced by Southland for their Glendale Hospital Project.

TARGET COSTING AND VALUE GENERATION (CUSTOMER RELATIONSHIPS)

The relationship between a manufacturer and its customers is typically quite different than that relationship in construction. One consequence is that the manufacturer uses target costing to increase his own profitability, without explicit regard for the interests of their customers. In construction, target costing can be used as a tool for generating both customer value and provider profitability.

There are at least three types of construction industry situations in which designing to target cost could play a role: 1) Where the client has a limited amount of money to spend and wants to spend all of it to the extent that value adding investment opportunities can be found, 2) Where the provider needs or wants to commit to a fixed price or guaranteed maximum price, and 3) Someone developing a product for the construction market targets a production cost to generate a desired profit margin, assuming an achievable sales price; i.e., the traditional product development application. For lack of space, we restrict our consideration in this paper to the first type of situation, which is illustrated by the St. Olaf College case study described here.

TARGET COSTING AND SUPPLIER RELATIONSHIPS

The ability of a manufacturer to extend target costing further down the supply chain, from systems to subsystems to components to parts, is a function of the relationship between the manufacturer and the relevant suppliers. In Japan, where the practice was developed, a manufacturer such as Toyota will typically have long term relationships with its suppliers, and typically not only with the first tier but also second and even third tier suppliers. In construction, long term relationships with even first tier suppliers is still relatively rare. The good news is that target costing can in part be extended more deeply into the product hierarchy working through first tier design-build specialty contractors. The influence however of the first tier specialty contractors with their own suppliers tends to be greater with service providers than with product suppliers, who are often much larger than the specialty contractors, and in many cases, larger than the general contractor themselves.

CASE STUDY

The Boldt Company is committed to the development and implementation of lean principles and practices. Project financial management, production management and designing to target cost are key developmental areas. Boldt's first systematic application of designing to target cost occurred during the design and construction of a fieldhouse (athletic center) for St. Olaf College in Northfield, Minnesota in 2001-2002.

The project was funded by a \$13,000,000 gift from an alumni family, who designated \$1,000,000 for operating expenses. The intent was to spend the remaining \$12,000,000 on value additions to the fieldhouse, as opposed to trying to minimize spending to a pre-established scope.

Boldt has a longstanding relationship with St. Olaf College. Boldt did not attempt to maximize its profit on the job, but rather subordinated any opportunity for additional

profitability to generating value for its customer⁹. Although previous projects at St. Olaf provided high levels of facility value, the Fieldhouse project measured in many ways, a new level of value, customer satisfaction, and success for the entire project team. Key differences in the management of this project included:

1. Boldt held the contract of the architect, Ellerbe Becket, which was a reaction to previous project experiences, where the design was driven by the stakeholders without sufficient regard to budget. Incidentally, Boldt changed from an American Institute of Architects form to a Design Build Institute of America form of contract in an attempt to better balance the interests of the designer and constructor.
2. The design architect was a graduate of St. Olaf, and approached the project not only as a designer but as a stakeholder in the final product.
3. Boldt's interface with the client was formalized in periodic reports and structured through a project Steering Committee.
4. Target costing was introduced at a rudimentary level, after the completion of schematic design, but nonetheless enabled a much more disciplined management of scope and cost together.

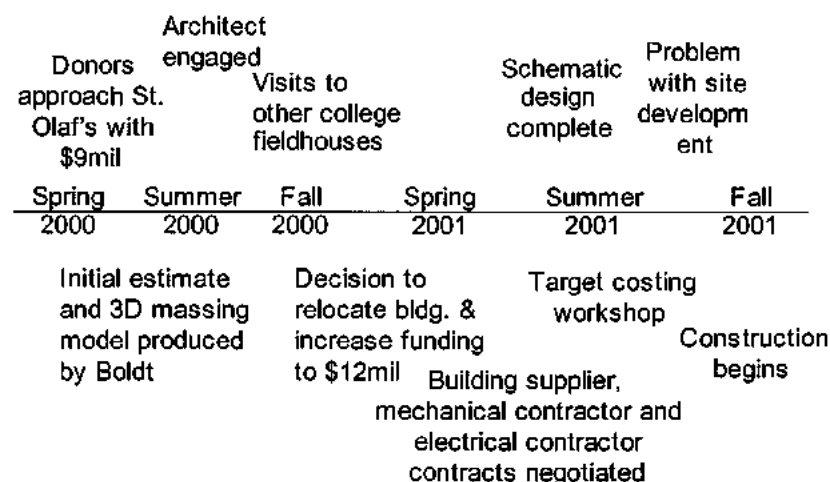


Figure 1: Fieldhouse Project Preconstruction Timeline

The preconstruction period (see Figure 1) was critical in the identification and generation of value to the donor and the College. Boldt was involved from the beginning, providing cost estimates and massing models. Ellerbe Beckett, the architectural/engineering firm, was engaged shortly after on a cost-plus-fee basis, with an amount not to be exceeded. They began exploring alternatives within the College master plan and eventually developed the schematic design. Visits to other fieldhouses were made during the Fall of 2000 involving the donors, St. Olaf's personnel and Boldt personnel. These led to a decision to relocate the building from its initial location and to increase funding from \$9 million to \$12 million, all changes agreed with the donors to be value adding. The prefabricated metal building

⁹ Boldt's fee was a percentage of final construction costs.

supplier, mechanical contractor and electrical contractor were brought on board prior to the completion of schematic design and participated in its final stage.

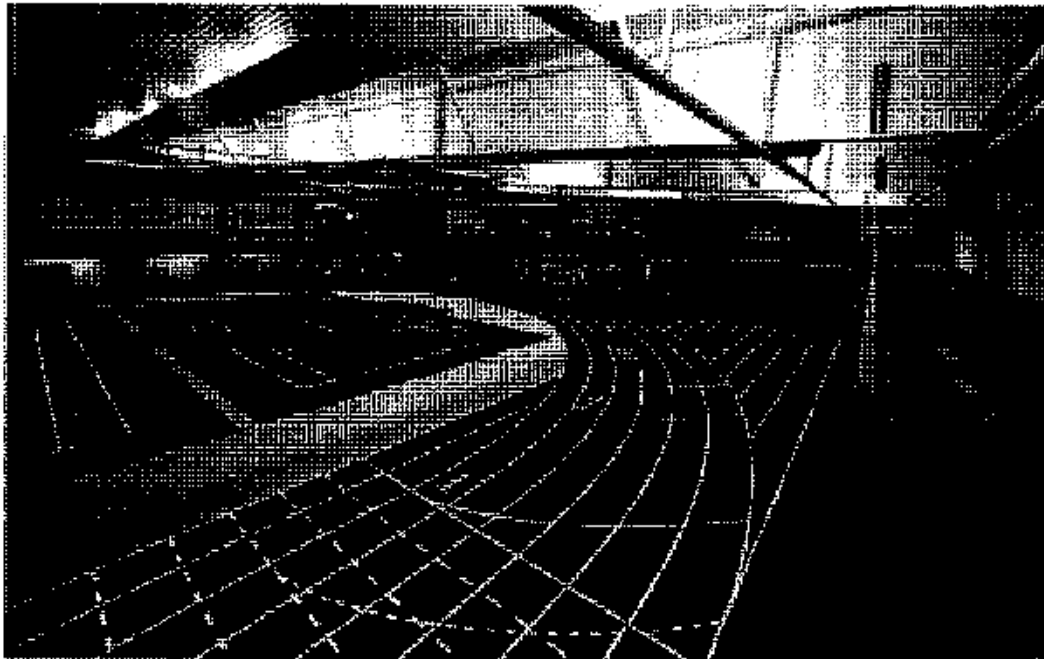


Figure 2: St. Olaf's College Fieldhouse

TARGET COSTING WORKSHOP

The deliverable product resulting from Target Costing is a Scope of Work document that includes a description of quantities, quality and cost. The work of the cross-functional teams translates the Voice of the Customer into technical design, and ultimately aids in defining the scope of the project. By working through a systematic and collaborative process, Target Costing produces a commitment from the entire project team to design and build according to the scope and budget defined by the process. The benefit is maximum value for the customer and minimum waste in the delivery process. (excerpted from Reiser (2003)).

A two-day target costing workshop was held on June 25-26, 2001. Participants included representatives of the electrical contractor (People's Electric), the mechanical contractor (Hi Mech) and the pre-engineered metal building contractor (Ceco), along with the alumni donor, Boldt personnel, St. Olaf's people, and Ellerbe Becket architects, mechanical engineer, electrical engineer and structural engineer. Participants were given an orientation to the project, initiated by the donors describing their vision and challenging them to meet or beat the target costs.

The Last Planner system of production control (Ballard (2000)) was introduced. Although Last Planner was used during construction, it was not used to manage design production¹⁰. Consequently the relationship between designing and constructing often felt like traditional practice.

Bob Huber, Boldt's internal scheduling consultant, did interactive scheduling, a form of the Lean Construction Institute's phase scheduling (Ballard, 1999), at the workshop, then every six weeks thereafter.

On Day Two, the team went directly into target costing. Based on Boldt's estimate of the schematic design, organized in accordance with Uniformat II (Charette and Marshall, 1999) funds were allocated to the various facility 'systems' as shown in Table I. In addition, funds were allocated to design services (\$504,885+\$41,600), owner reserves (343,115), project administration (\$425,179), general conditions (\$585,832), construction management fee (\$326,787), and construction contingency \$587,774). Site, enclosure, interiors, mechanical and electrical teams were formed, each consisting of 3-6 people drawn from Ellerbe Becket, Boldt, specialty contractors, and St. Olaf. Each team was challenged to complete the design with savings beyond their target cost¹¹.

The donors challenged the teams to reduce actual cost below the targets so more money would go to the operating fund. Everyone was given a target costing spreadsheet and quantities without dollars (e.g., x square feet of ceramic tile without the cost per tile). For example, Mechanical was given a target cost of \$1,111,402, with subtargets for Plumbing (\$85,927), HVAC (\$824,160), Fire Protection (\$109,740) and Testing & Special Mechanical (\$91,575).

Design information available at that time included: floor plans, some elevations, only a little if any mechanical and electrical, very preliminary site work, conceptual substructure system consisting of spread footings, and a well evolved schematic design and programming.

The teams worked together during Day Two of the workshop to explore how to fit scope and funds together, but at that time, only one of the teams was able to report a plan that did not require all of their target. Some small things were discovered; for example, that customary tile had been omitted in the bathrooms. St. Olaf College coffee mugs were awarded to the team with the most savings.

IMPACT OF THE TARGET COSTING WORKSHOP

At first glance, the workshop does not appear to have produced very much of importance. However, sharing of explicit cost targets and initiating collaboration across teams and companies proved to be valuable, as is indicated by the project being completed within \$100,000, less than 1%, of its initial target cost, by the quality of the facility produced, and further, by the team players' ability to fund value adding scope changes for St. Olaf.

¹⁰ At that time, Boldt had just begun using Last Planner in the design phase of their projects. It is now becoming standard practice.

¹¹ In traditional designing-to-target-cost, the target cost is set to achieve the desired savings.

Fieldhouse Expansion
St Olaf College Northfield MN
Schematic Target
June 21, 2001

**USDOJ REPORT
ON THE
SITUATION**

Flow:[illegible]

PROJECT EXECUTION

VALUE ENGINEERING

A quote from Pete Sandberg, Facilities Director for St. Olaf:

"Overall, I think that the St. Olaf/Boldt team on this project had VE so ingrained in their way of thinking that a ton of stuff happened "just because" we almost cannot help it. We did on the fly life-cycle analysis of most everything. This resulted in the ceramic floors in all public spaces that didn't have sport floors, the stainless bath fixtures and dividers, the air "socks" for quiet, appearance, and life in an athletic facility (no baseball damage to duct and diffusers). We did a hard core value/life analysis of roof and wall panels and selected the most expensive first cost system, that was wildly less expensive in terms of dependability, service and life cost. The athletic lighting in the fieldhouse volume evolved this way as well. The electrical project manager proposed using an "off the shelf" high bay fixture, but arrayed in such a way that they did not affect over head tennis play and still provided the illumination that was needed, but not more, and inexpensively. This person had been part of two other St. Olaf/Boldt VE teams and that time paid off big time.

The authors agree that most of the project team worked toward collaborative value generation. However, working toward this versus applying a disciplined process is quite different. There was too much opportunity left uncovered through lack of formal process. Despite the accomplishments, more can be done. We return to these opportunities for improvement below.

A CHALLENGE TO TARGET COSTING

Soon after the target costing workshop, site work exploded beyond its \$595,000 target. Existing asphalt could not be reused as intended. There were drainage and storm sewer issues. The increased cost for site work drew down Boldt's contingency by \$300,000, more than half their total contingency. Site work cost exceeded its target of \$600,000 by \$500,000. The remaining \$200,000 was obtained from other teams which had managed to under run their target costs. See the contractor contingency log, Table 3, from which the sum of additions to contingency was \$197,308, some from better market pricing than expected.

USE OF CONTINGENCY

As the project progressed, Boldt was very explicit about scope changes and the impact on client contingency. Boldt's contingency was to accommodate inability to achieve target costs (known unknowns), whereas the owner's contingency was to accommodate scope changes (unknown unknowns). The intended purpose for owner contingency was first to cover scope omissions, then to fund value adding scope changes with any remaining funds. \$343,115 was allocated for this purpose at the time of the Target Costing Workshop. \$298,963 in value adding scope changes were funded by scope reductions and transfers (\$227,377) plus \$71,586 from owner contingency.

Table 2: Owner Contingency—to fund value adding scope changes

Original Guaranteed Maximum Price

\$11,645,250

Progress Report	Use/Source of Funds	Amount	Total Remaining
Oct 01	Add metal panels to Fieldhouse ceiling and interior walls	116,756	11,762,006
Nov 01	Electrical rough-in for running track sound system	12,000	11,774,006
	Reduction in track starting equipment budget	(4,700)	11,769,306
Jan 02	Transfer testing and inspection budget to St. Olaf	(15,000)	11,754,306
	Change elevator cab material to stainless steel	515	11,754,821
May 02	State Fire Marshall occupancy requirements funded through construction contingency	0	11,754,821
	Additional tile at atrium stair North wall	16,405	11,771,226
	Add copper fascia panels at lobby	16,780	11,788,006
	Delete new lockers and relocate existing lockers from Skoglund	(20,088)	11,767,918
	Add bouldering wall at atrium stairs	19,800	11,787,718
	Delete burnished masonry at Stair B	(6,705)	11,781,013
	Relocate existing lockers	8,417	11,789,430
	Omit millwork for reception desks	(6,884)	11,782,546
Aug 02	Addition of 8 operable windows at Skoglund curtainwall	9,600	11,792,146
	Installation of additional batting cage below elevated track	3,500	11,795,646
	Install enclosure wall at Fitness Area	40,000	11,835,646
	Fabricate and install wire screen barriers at sprinkler valve location and AHU platform access	12,000	11,847,646
	Transfer Athletic Equipment/Furnishings from Boldt budget to Owner	(174,000)	11,673,646
	Custom color work and cancelled order for lobby ceiling grid	350	11,716,836

Contractor contingency was intended to first cover cost variability, then to fund value adding scope changes with any remaining funds. \$587,774 was allocated to contractor contingency. Its use is shown in summary form in Table 3. Note the Aug-01 \$303,663 draw for site development.

Table 3: Contractor Contingency—buffer against cost variability

Jul-01 \$587,774

Progress Report	Use/Source of Funds Amount Total Remaining
Aug-01 Further site development	(303,663) 284,111
Sep-01 Site development/Entrance/Link/Fitness	(157,940) 126,171
Oct-01 Buyout savings	67,351 193,522
Nov-01 Various budget changes	(107,852) 85,670
Dec-01 Misc budget adjustments	7,330 93,000
Jan-02 Buyout savings	29,670 122,670
Feb-02 Additional materials/sub revisions	(85,577) 37,093
Mar-02 Reductions in sub/mat/labor	72,994 110,087
Apr-02 Add'l materials/sub revisions	(25,522)

	84,565
May-02	
Struct steel/Conc lbr & mtl/carpentry	(30,132)
	54,433
Jun-02	
Field labor offset by reductions in Proj Mgt	19,963
	74,396

Fortunately, cost varied both down and up. Under-runs added \$197,308 to contractor contingency. After occupancy a number of value adding scope changes were funded by remaining contingency. This practice makes financial contingency more like schedule contingencies that are intended to be spent.

SUMMARY OF ACCOMPLISHMENTS

Implementation of the target costing methodology played a substantial role in the success of the Fieldhouse project. The project was delivered on time and within budget, more value was provided to the client than would otherwise have been provided, and the provider, Boldt, made a reasonable profit.

Redoing the same project with different methods is rarely possible in construction, but a close approximation occurred in the case of the St. Olaf Fieldhouse and another fieldhouse project for a private college in the same city. Carleton College had a new fieldhouse constructed by a different contractor and contracting method, starting in the Spring of 1998 and completing in April 2000. The Carleton project was delivered according to traditional Design-Bid-Build contracting. The St. Olaf Fieldhouse was delivered based on a Design-Build contract integrating Lean Construction principles and practices including target costing and Last Planner production management. The Carleton project took ten months longer to complete compared to St. Olaf Fieldhouse and cost 15% more.

The functional program of the facilities is similar. Both are indoor athletic centers designed for athletic competition, physical education, instruction, student recreation, and campus wellness programs. They both include a 200 meter competition track surface, athletic courts, climbing wall, fitness center, and running track.

Table 4: Fieldhouse comparison

	St. Olaf Fieldhouse	Carleton College Recreation Ctr
Completion Date	August 2002	April 2000
Project Duration	14 months	24 months
Gross Square Feet	114,000	85,414
Total Cost (incl. A/E & CM fees)	\$11,716,836	\$13,533,179
Cost per square foot	\$102.79	\$158.44

OPPORTUNITIES FOR IMPROVEMENT REVEALED BY THE CASE

The following opportunities for improvement were developed in discussions with St. Olaf and with Boldt.

1. Use collaborative workshops to produce schematic design.¹² (As previously noted, on the Fieldhouse Project, target costing and value engineering were started after schematic design.)
2. Be more formal and rigorous about creating the target cost. On the Fieldhouse project the project team really committed to the current estimate and then informally built improvements into the target costs. A more formal and aggressive application of target costing throughout all phases of the project could have created additional savings and generated greater value.
3. Do target costing at every level, beginning at systems, then down into subsystems and components. Use function analysis as a tool for achieving target costs. Note: The donors came with a donation and a vision for the college. At the highest level, perhaps there was no need for examining function, but there was opportunity at lower levels.
4. Learn how to use value engineering to facilitate integrated product/process design. Note: Boldt spent \$10,000 additional to fabricate a structural steel device for placing pre-cast elements below a roof overhang because the installation process had not been thought through in detail. The "king truss" at the climbing atrium is another example of expensive fabrication and installation that did not necessarily create appropriate value.
5. Determine the appropriate use of life cycle costing in the context of target costing. Note: Life cycle costing is more useful in some cases than others; e.g., facility equipment like chillers or air handling units tend to require replacement during the life of the facility, whereas elements like pavers either are rarely replaced or relatively inexpensive.
6. Explore the feasibility of incorporating failure mode analysis¹³, especially for facility equipment, into design processes using a life cycle costing methodology.

¹² See Kristoffersen (2003) for an apparently successful method of doing schematic design, into which target costing and VE might be incorporated.

¹³ See McDermott, et al., p.3: "An FMEA is a systematic method of identifying and preventing product and process problems before they occur."

7. Bring pre-caster and curtain wall contractors on board earlier, along with design-build electrical and mechanical contractors.
8. Explore what subcontracts, if any, should be bid. (On this project, all subcontracts were bid except for the engineered metal building, mechanical and electrical.)
9. Engage suppliers and installers in the search for new ideas and better ways of doing things—the sheet metal foreman on the Fieldhouse Project had the idea of using an ‘air sock’ for air distribution instead of sheet metal duct. That kind of innovation could be increased.
10. Change terminology from ‘conceptual estimating’ to ‘cost modeling’ to stress the desired change from reactive estimating, and use nD modeling for all the benefits it brings, but specifically to facilitate rapid costing of design alternatives.

These recommendations appear to be appropriate for all who try to ‘design to target cost’.

CONCLUSION

We have presented an overview of the designing-to-target-cost methodology and illustrated its application in construction with a case study. The case study, together with previous successful applications (Knott, 1996) suggests that designing to target cost can have a beneficial impact on at least certain types of projects, beneficial both for the client and for the provider. The findings support the need to implement a more complete research program.

There are many research issues and areas that need to be developed. We recommend as next steps:

- Descriptive research
- Translation of concepts and techniques from other domains
- Determining the appropriate applications of target costing in construction
- Understanding the change in roles and relationships
- Understanding the conditions for producing a target cost

As this is a new area of research, descriptive studies are much needed to determine the extent to which designing to target cost is currently done in construction, how and why it is done, and how well it is done. Another area of research needed is in translating/applying concepts and techniques from product development to construction projects, recognizing their differences. For example, in addition to VE’s function analysis, what other tools commonly used in product development can be beneficially applied in construction? Cooper & Slagmulder (1999) mention kaizen costing, various forms of value analysis (Zero-look, 1st-look, 2nd-look), teardown methods, and others. Finally, research is needed on the issue of the proper application of target costing in construction. For example, as one reviewer asked, does it best apply to the design of subsystems rather than to conceptual product development? As regards roles and relationships, the case study revealed a very different relationship between the general contractor and the client than the traditional relationship. How should such changes be understood and what are the implications for contract structures, business

alliances, and such? Finally, what information and what competencies are required to produce a target cost? Who needs to be involved when?

For our part, Boldt and the Lean Construction Institute are continuing their collaborative experimentation with target costing, refining and extending what was done on the Fieldhouse Project. In so doing, we will have the opportunity to contribute to the target costing research. We look forward to sharing our findings with the community of researchers and to learning from what others discover and develop.

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COLLABORATIVE BEHAVIOR IN THE SPANISH BUILDING INDUSTRY: A PRELIMINARY ANALYSIS OF THE DATASET

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The objective of this study is to: (1) evaluate the team behavior in the Spanish building industry; (2) investigate the barriers in adopting more integrated delivery methods; and (3) suggest practices to enhance team integration in the Spanish building industry. To achieve these objectives, project managers (owners and contractors) were interviewed following a questionnaire, which was composed of five parts: characterization, procurement, payment provisions, team characteristics, and team behavior. According to the responses, lump-sum is the main payment approach used. The two-stage RFP and the sole source procurement methods are employed most often. No incentives or partnering (formal or informal) is used by Spanish owners, and communication is considered quite formal. However, owners tend to repeat with project teams, and appreciate the team's prior experience as a unit. Moreover, team's commitment to project's goals is high as well as the team's compromise on project issues. Owners more often favor the timeliness of communications, whereas team chemistry is rated higher by contractors.

Keywords: *Collaborative; Construction Project; Spain; Team Behavior; Team Integration*

COMPORTAMIENTO COLABORATIVO EN EL SECTOR DE LA EDIFICACIÓN ESPAÑOL: ANÁLISIS PRELIMINAR DE LOS DATOS

El objetivo de este estudio es: (1) evaluar el comportamiento de las partes involucradas en la obra en el sector de la edificación español; (2) investigar las barreras para adoptar métodos de contratación más integrados; y (3) sugerir prácticas que mejoren la integración de las partes en el sector de la edificación español. Con la finalidad de conseguir estos objetivos, se entrevistó a gestores (promotores y constructores) según un cuestionario, compuesto de cinco partes: caracterización, licitación, condiciones de pago, caracterización de las partes, y comportamiento de las partes. Según las respuestas, el precio cerrado es el principal método de pago utilizado. El concurso restringido y el candidato único son los métodos de licitación más empleados. Los promotores españoles no incentivan ni se asocian (formal o informalmente), y la comunicación la califican como formal. No obstante, los promotores tienden a repetir con las partes, y aprecian la experiencia anterior como equipo. Además, el compromiso de las partes con los objetivos de la obra es también alto, así como el compromiso con los aspectos de la obra. Los promotores suelen favorecer la puntualidad de las comunicaciones, mientras que la química entre las partes es altamente valorada por los constructores.

Palabras clave: *Colaborativo; Obra, España; Comportamiento del Equipo; Integración del Equipo*

1. Introduction

The construction industry is characterized by the adversarial relations among different stakeholders that lead to cost overrun, schedule overrun, or low quality of finished facilities. These antagonist relationships are attributed to contradictory objectives of different parties as well as the disintegration and fragmentation of the construction industry (e.g.: Nam & Tatum, 1992; Koskela, 1992; Latham, 1994). One of the factors that influence the behavior of the parties and defines their roles and responsibilities in a project is the delivery method. The traditional project delivery method (design-bid-build) and selection of parties based on the lowest price are often criticized to discourage collaboration among team members (Nam & Tatum, 1992; Latham, 1994; Pocock et al., 1996).

To address this challenge, different type of delivery methods are introduced into the construction industry providing various levels of team integration: construction management at risk (Barrie & Paulson, 1978), design-build (Beard et al., 2001), partnering (Baker, 1990), or integrated project delivery (Ballard, 2000). There is an emerging approach to more integration and collaboration among parties (El Asmar et al., 2013). For example, in the case of the integrated project delivery, the legal framework is provided by the multiparty relational contract (Macneil, 1980; El Ballard, 2000; Asmar et al., 2013). The basis of this contract is a relationship of trust between the contractual parties. Macneil (1980) also suggested including integrity, reciprocity, flexibility and solidarity in the contract to enhance performance. Some authors (Kumaraswamy et al., 2005; Rahman & Kumaraswamy, 2008) indicated that cooperative team-working is improved by moving from classical to relational contracting; the main barrier to collaborative team-working is mainly the lack of trust. According to these authors there are four factors that encourage cooperative team-working: owner's competencies, prior interactions, compatible organizational culture, and better selection of project partners.

However, the studies analyzed in the previous paragraphs were developed in English-speaking countries. In the Spanish construction industry, the most popular delivery methods among public agencies are the traditional design-bid-build (75%) and concession-like contracts (25%) (Asociación de Empresas Constructoras de Ámbito Nacional [SEOPAN], 2012). The design-bid-build is also the most common delivery method used by private developers. The reason stems from the fact that the Spanish Building Act 38/1999 shields the architect and prevents the implementation of other delivery methods (Pellicer & Victory, 2006). In addition, in Spain, integrated project delivery is virtually unknown in the industry, construction management at risk is seldom used (and only by industrial or commercial developers), and design-build was used in the past (starting in the 1970s) but abandoned twenty years ago maybe because of its misuse by some public agencies. Table 1 displays a historical comparison between the United States and Spain regarding alternative project delivery methods.

Table 1: Comparative historical analysis of project delivery methods between the United States and Spain

	United States		Spain	
	Starts	Current Use	Starts	Current Use
Construction Mngmt. at Risk (CMR)	1960s	Used	1970s	Seldom used (by private only)
Design-Build (DB)	1990s	Frequently used	1970s	Seldom used
Integrated Project Delivery (IPD)	2000s	Seldom used	---	Unknown

Considering the procurement procedures, open bid and one-stage request of proposals (RFP

henceforth) are mainly used in Spanish public contracting. Open bid takes into account the price, whereas the one-stage RFP also considers the technical proposal, the schedule, the team experience, and quality and safety control procedures. For one-stage RFP, the price is weighted 50% or more in public contracts because of the regulations imposed by European Directive 2004/18/EC on the coordination of procedures for the award of public works, supply, and service contracts. The two-stage RFP is seldom implemented by public owners; however, it is used by private owners (Pellicer & Victory, 2006). For two-stage RFP, the technical proposals are received first and pre-qualified bidders are short-listed; then, these qualified bidders submit the economic offer (Molenaar et al., 1999). Private developers sometimes implement other strategies like the qualifications-based or the sole source.

Concerning payment provisions, only unit-price (in accordance with a bill of quantities) and lump-sum are allowed by the Spanish Public Procurement Act 3/2011. The first one is used most of the time in civil engineering works for public owners, whereas lump-sum is seldom used (de la Cruz et al., 2006). As a result, contractors are chosen based on the bid price (Oviedo-Haito et al., 2014). This circumstance incites adversarial relationships among the different agents of the construction process (de la Cruz et al., 2006; Oviedo-Haito et al., 2014). Even though private owners do not have these regulatory constraints, most of the time they use lump sum –in building construction– and unit-price –in civil engineering works– (Pellicer & Victory, 2006). Private developers may use other payment provisions from time to time, such as guaranteed maximum price or cost plus fee.

While alternative project delivery methods to design-bid-build, along with the procurement and payment methods, continue to enjoy greater use in the United States, United Kingdom and other culturally-related countries, the Spanish construction industry is falling behind this trend (de la Cruz et al., 2006; Pellicer & Victory, 2006). Therefore, following Nam and Tatum's (1992) scheme, this paper departs from the literature by analyzing the level of integration and team behavior in the Spanish building industry.

2. Motivation behind the Study

The research developed and explained in this paper is part of the overall research project "Owner's Guide to Maximizing Success in Integrated Projects" conducted by the University of Colorado and Penn State University. The purpose of this project, funded by the Pankow Foundation and the Construction Industry Institute, is: (1) to identify key project success factors from the owner's point of view, and (2) to determine appropriate metrics for measuring performance results; this purpose is to be accomplished by considering innovative concepts such as project integration and team behavior. Within this research we analyze the Spanish building industry and compare it to the United States industry. However, since the Spanish construction industry tends not to use integrated delivery methods due to the specific characteristics of the Spanish scenario (explained previously), the focus of the research is narrowed to include only the design-bid-build delivery method applied to the residential housing sub-sector.

The overall research has two main phases. First, a comprehensive literature review was developed to produce dependent variables (performance metrics) and independent variables (predictors). To execute this, a rigorous content analysis was performed on papers relating to the measurement of project performance. Secondly, a research workshop was held to refine, improve and rank these variables according to their significance and availability; the most important goal of the workshop was to make sure that no variable was missed from the analysis. Experts from the industry and the academia participated in a two-day workshop, structured as a "charrette", to combine techniques used in surveys, interviews and focus groups in an accelerated time frame (Griffith & Gibson, 2001; Gibson & Whittington, 2010).

After analysis and refinement of the results, 11 dependent variables (performance metrics)

and 45 independent variables (predictors) were chosen. A broad survey of owners and contractors was designed to gather the data. The questionnaire was composed of 12 parts: characterization, project costs, project schedule, project quality, project safety, sustainability, procurement, payment provisions, team characteristics, team behavior, process and technology, and lesson learned. A detailed explanation of the steps carried out to design this questionnaire survey can be found in Esmaili et al. (2013).

3. Research Method

This paper aims to present a preliminary analysis of the collaborative behavior in the Spanish building industry. Therefore it only studies the results concerning five of the sections of the overall questionnaire: (a) characterization, (b) procurement, (c) payment provisions, (d) team characteristics, and (e) team behavior. The characterization of the respondents (section #1 of the questionnaire) includes data regarding company type (owner or contractor), square footage, and number of floors (above and below grade). The procurement section (#7) asks about how proposals were solicited and which factors were considered. The payment provisions section (#8) finds out about payment terms, incentivized work, and inclusion of operation and maintenance, and partnering in the contract provisions. The team characteristics section (#9) inquires on owner's type of relationship with the project team, team's prior experience as a unit, project team chemistry, timeliness of owner decisions, owner's ability to make a decision, staff turnover, involvement of end users, and co-location (yes/no). Finally, the team behavior section (#10) requests information on: formal or informal communication, compromise on project issues, timeliness of communication, contingency, setting goals, and commitment to the project goals. The specific questions for each of these sections are displayed in the Results section.

This research can be considered exploratory. In case where the goal of the research is not to generalize but to approach a phenomenon, it could be suitable to purposefully choose individuals that get the most out of the underlying phenomenon (Onwuegbuzie & Collins, 2007). The 60 respondents are Spanish project managers working for private developers (owners) or construction companies (contractors) with, at least, 10 years of experience. There is a pair of respondents (owner and contractor) for every residential building project chosen, being 30 the total number of analyzed projects; all of them were finished after 2006.

With the aim of calibrating the survey properly: (1) the questionnaire was handed out to 10 experts with more than 15 years of experience in the Spanish construction industry to get feedback from them; and (2) a pilot interview with one owner and one contractor was performed to check that questions were properly understood. The process to get in touch with the respondents started with a telephone call explaining the basics of the research and inquiring about the potential respondent's willingness to participate. Then, the research team sent an email asking for the hard data of the project. Finally, it was decided to obtain the answers using face-to-face interviews so any doubts or inconsistencies could be clarified by the interviewer in real time; every interview took around two hours as average.

4. Results

4.1. Scales of Measurement

Several kinds of questions were used in the questionnaire requiring the use of multiple levels of measurement according to the type of variable (Cohen et al., 2000). These include continuous, categorical (e.g. binary response scales), and interval (e.g. 6-point Likert scales) levels of measurement. For the categorical variables relative frequency was calculated. The continuous variables (building gross square footage, and number of floors above and below grade), maximum, minimum and mean values were computed too (displayed in Table 2).

Tables 3 (procurement), 4 (payment provisions), 5 (team characteristics), and 6 (team behavior) present the results for the categorical and interval data collected. Table 7 shows the results from Likert scale questions as well as the cumulated percentages of “low” (grouping 1 to 3) and “high” (grouping 4 to 6) choices.

4.2. Demography

The sample consists of 30 Spanish building residential projects ranging from two-floor single houses (518 m²) to 43-floor tall buildings (25.284 m²), as displayed in Table 2. Two different roles were interviewed per each project (question 1.1 of the survey): owners and contractors.

Table 2: Extreme and mean values for continuous variables

Question	Max.	Min.	Mean
1.2 Building gross square footage (in m ²)	25.284	517	10.068
1.3 No. of floors above grade	43	2	9,7
1.4 No. of floors below grade	5	0	1,6

4.3. Procurement Methods

Regarding the procurement method (see Table 3), sole source and two-stage RFP were the methods implemented by owners. The sole source procurement method was more common in order to hire the architect/designer (85%), whereas the two-stage method was more often used to hire the general contractor (62%). In the case of the 2-stage RFP, the most important factor considered for the selection of the architect was similar project experience (69%); other factors considered were: qualifications (41%), design and functionality (38%), technical proposal (31%), price (21%), and interview performance (7%). Regarding the general contractor, project experience (90%) was the most popular factor too. Qualifications and price were highly considered as well (55% and 62% respectively), whereas technical performance and interview performance were not so commonly used (10% both).

Table 3: Percentage values for categorical variables regarding procurement

7.1 Indicate how proposals were solicited from each project participant:		
Architect/Designer: Sole Source (85%) / 2-Stage RFP (15%)		
General Contractor: Sole Source (38%) / 2-Stage RFP (62%)		
7.2 Which of these factors were considered in the selection of each participant? (check all that apply):		
	Architect/Designer	General Contractor
Price	21%	55%
Qualifications	41%	62%
Design, Aesthetics and Funcionality	38%	0%
Technical Proposal	31%	10%
Project Experience	69%	90%
Interview Performance	7%	10%

The first and second choices made by the owner for both groups (architects and contractors) are project experience and qualifications (see Table 3). Price is important for the selection of the contractor (this factor was chosen 55% of the times), but not the architect (only 21%). The survey also asked about the factors considered to choose, without the inclusion of rank to better ascertain an explanation for why price is not ranked the first for general contractors,

considering the project delivery for all cases is design-bid-build. Moreover, for architects, the technical proposal and design, aesthetics and functionality are important because the owner sometimes asks for alternative designs to the conceptual idea. It is noticeable that performance interviews are seldom used for choosing both agents, relying owners more on facts (past project experience and qualifications) than words (interview).

4.4. Payment Provisions

Regarding the payment provisions (see Table 4), lump sum was the most applied by owners (89% for paying the architect and 76% for the general contractor). This finding seems logical when considering that owners tend to use the same payment provisions for every party involved, and that lump sum is the most commonly chosen. This approach generally simplifies the supervision and control task on the side of the owner, allowing a more in-depth focus on quality and time issues. Guaranteed maximum price was seldom used for both parties (4% for architects and 14% for contractors), whereas unit prices and cost plus fee were only implemented from time to time. A surprising result is that no performance-based incentives or partnering agreements (formal or informal) were used in any of the projects, whether for architects or for contractors (Table 4). The operation and maintenance of the facility was sometimes included in the contract scope of the general contractor (42%).

Table 4: Percentage values for categorical variables regarding payment conditions

8.1 Select the commercial terms used for the following project participants:

	Architect/Designer	General Contractor
Lump Sum	89%	76%
Unit Prices	0%	14%
Guaranteed Maximum Price	4%	14%
Cost Plus Fee (Fixed)	4%	3%
Cost Plus Fee (%)	4%	0%

8.2 Were performance-based incentives used in any contracts?:

No: 100%

Yes: 0%

8.4 Did the project team use a formal or informal partnering agreement?:

No: 100%

Yes: 0%

8.3 Was the operation and maintenance of the facility included in the contract scope of any team member or members?:

No: 58%

Yes: 42%

4.5. Team Characteristics and Behavior

Most commonly the owner repeated work with both the design and construction agents as is indicated in Table 5 (architect 55% and contractor 72%). This finding is only slightly corroborated by question 9.2 in Table 7 by both parties (the owner and the contractor); even though they have worked together previously, it looks like they do not consider their relationship mature enough. End users provided feedback to the project in the pre-construction (10%), construction (38%), and operation phases (13%). Feedback during the construction phase comes mostly from end users that have already bought a unit and want to customize it; whereas during the operation phase is mainly due to complaints regarding the

quality of the work. Anyway, useful feedback, provided during the pre-construction phase, is not abundant. Furthermore, some respondents (21%) considered that there was co-location during the construction phase of the project. The chemistry among the team members was considered good (mean of 4.3 and 4.7 for owners and contractors respectively, in Table 8), whereas the staff turnover was considered low (1.6 and 1.8 in Table 7).

Table 5: Percentage values for categorical variables regarding team characteristics

9.1 Indicate the owner's type of relationship with the project team:

Architect/Designer: First Time (45%) / Repeat (55%)

General Contractor: First Time (28%) / Repeat (72%)

9.5 When was end-user feedback provided to the project? (check all that apply):

Pre-Construction: 10%

Construction: 38%

Operation: 13%

None: 55%

9.6 Was there any co-location (team in shared workspace for extended period) of teams in the project?:

No: 79%

Yes: 21%

Contingency was generally shared, even though some respondents indicated that it was owner-controlled or contractor-controlled (5% each), as displayed in Table 6. Having into consideration that the project delivery approach is very constrained (design-bid-build) as well as the type of product (residential units), it is possible that some of the respondents may have misunderstood the question. The participants in the survey also indicated that almost always (98%) the owner set the goals of the projects; the general contractor (22%) and the architect (27%) participated sometimes too.

Table 6: Percentage values for categorical variables regarding team behavior

10.4 How was contingency managed?:

Owner-Controlled: 5%

Contractor-Controlled: 5%

Shared: 80%

Other: 10%

10.5 Who participated in setting goals for the project (check all that apply)?:

Owner: 98%

Architect/Designer: 27%

General contractor: 22%

Table 7 displays the results of the Likert scale questions from 60 questionnaires gathering the perspective of two groups: owners and contractors. The results show percentages grouped as "low" (from 1 to 3) and "high" (4 to 6). The median and mean also allows for a preliminary comparison of the groups. First, the results show that some of the group responses are quite similar. For example, both groups rate the team's prior experience as a unit (mean of 3.2 vs. 3.2), the frequency of staff turnover (1.6 vs. 1.8) and the team's commitment to the project's goals (4.9 vs. 4.8) in a similar fashion.

Table 7: Percentages, median and mean values for 6-point Likert scale with choices ranging from 1 to 6, differentiating between owner and contractor

QUESTION	OWNER				CONTRACTOR			
	Low (1-3)	High (4-6)	Median	Mean	Low (1-3)	High (4-6)	Median	Mean
9.2 Team's prior experience as a unit	52	48	3	3.2	54	46	3	3.2
9.3 Team chemistry	21	79	4	4.3	12	88	5	4.7
9.4 Relative to your expectations, denote the frequency of staff turnover within the project team	89	11	1	1.6	88	13	1.5	1.8
10.1 Evaluate the formality of communication among the project team	48	52	4	3.7	31	69	4	4.0
10.2 Evaluate the timeliness of communication among the project team	24	76	5	4.6	15	85	4	4.3
10.3 How often did the project team compromise on project issues?	3	97	6	5.4	8	92	5	4.8
10.6 To what extent were all project team members committed to the same project goals?	7	93	5	4.9	4	96	5	4.8

However, other answers show some contrast, like the formality of communication and the team's compromise on project issues. The first variable tested (formality) is perceived as more important by contractors (4.0) than by owners (3.7). This seems reasonable since they are the ones who have to endure most of the paperwork. The second variable tested (compromise) is perceived the opposite way. Owners recognize more compromise (5.4) than contractors (4.8).

Finally, two variables are identified in a different way by each party too. Team chemistry is more appreciated by contractors (4.7) than by owners (4.3). This result is very interesting because it implies that, even though there are no incentives or partnering agreements between both parties, price plays a very important role in awarding a contract. The general contractor may feel comfortable with this status quo; at least, once the work is done. However, the owner does appear to be less comfortable, perhaps because some owners are not so used to this scenario. Regarding the last question, owners appear to place greater value on the timeliness of communication among the project team (4.6) than the general contractor (4.3). This finding seems logical because delay in communication generally harms the main contractor.

5. Conclusions

This paper presents the partial results of 60 interviews to project managers that have worked in 30 different Spanish residential building projects since 2006; one representative of the owner and one construction site manager were surveyed per project. The results are focused on team characteristics and behavior. Results confirm that lump-sum is the main payment approach used in the Spanish residential industry, with the 2-stage RFP and the sole source the procurement methods most employed. They also confirm that price is the primary variable used to award a contract to a general contractor. No incentives or partnering arrangements (whether formal or informal) are used by Spanish owners, and communication is considered quite formal. However, owners tend to prefer repeat work with project teams, and appreciate the team's prior experience as a unit. In addition, co-location of the contractual agents is sometimes used as well.

Furthermore, it can be concluded that team's commitment to project's goals is high as well as the team's compromise on project issues. Other issues present a difference of appreciation between owner and general contractor: timeliness of communication and team chemistry. Owners value better the timeliness of communication among the project team, because delays in communication generally harm the primary contractor. Team chemistry is more appreciated by contractors (i.e. they rate it higher) perhaps because they feel comfortable with this status quo (at least once the work is done). This happens in spite of the fact that there are no incentives or partnering agreement between both parties and that price is a key issue in awarding a contract. However, owners do not seem so comfortable in this scenario. Anyway, this result contradicts part of the existing literature on adversarial behavior in the Spanish construction industry (de la Cruz et al., 2006; Pellicer & Victory, 2006; Oviedo-Haito et al., 2014). This result favors dissemination and future use of more collaborative delivery strategies throughout the Spanish construction industry.

Considering that the study is exploratory and that the sample has only 60 project managers, further research is needed. The project is ongoing and the research team is targeting more questionnaires to consider it complete. Because of the small sample size, it is not yet appropriate to apply means tests between groups (owners and contractors) to detect if there are significant differences between them. Once the sample is large enough, additional statistical analyses will provide more robust results and conclusions that can be applied to the Spanish building industry. In addition, other results from the survey will be analyzed in the future as well. Ultimately the goal is to relate performance metrics (cost and schedule basically) to other variables including procurement methods, payment strategies, team characteristics and behavior, sustainability, and technology. Furthermore, comparison with the ongoing study in the United States will allow obtaining additional lessons.

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DBIA POSITION STATEMENT

INTEGRATED PROJECT DELIVERY

The principles behind the integration of design and construction have been historically used in several different delivery models. **Integrated project delivery refers broadly to an approach in which key participants collaborate on the project from inception to completion.** All projects can benefit from enhanced collaboration and compensation structures that align rewards with overall project success.

DBIA actively promotes integrated project delivery principles. The design-build model is very well suited to take advantage of techniques that can be helpful in achieving effective integration, such as Building Information Modeling ("BIM"), lean principles, incentive compensation structures and other collaborative techniques. These integration techniques in turn help to foster behaviors within the project team that are consistent with DBIA's core values. Those values embrace an environment of trust—characterized by integrity and honest communication, mutual respect for and appreciation of diverse perspectives and ideas, a commitment to innovation and creativity to drive quality, value and sustainability as well as professionalism, fairness and the highest level of ethical behavior. If a team can operate in accordance with these values, there is improved likelihood of superior project outcomes.

"Integrated Project Delivery" or "IPD" has recently come to refer to a contractual model where the owner, constructor, designer and potentially others enter into a single, multi-party contract. Although there have been relatively few projects delivered through the use of this multi-party model, the contract forms currently available anticipate that the owner, constructor and designer will enter into the same agreement, share some of the risks and rewards of the contract and potentially limit the liability among the parties. The multi-party forms also provide that management of the project is governed by a committee that strives for unanimous decision making.

Although both the design-build single entity model and this IPD multi-party model have features in common, including the goal to achieve effective integration, there can be substantial differences between these systems.

- **Selection method.** Best practices in design-build may use either qualifications based selection or a best value model, where price as well as non-price qualification factors are taken into account. In the multi-party model, pure qualifications based selection is essential.
- **Degree of owner involvement.** In the design-build model, while the owner defines the performance expectations for the project, the design-builder is primarily responsible for managing the details of the design and construction effort.

With this foundation, the owner can select its level of participation along a broad spectrum: from fully participatory to a more "hands off" approach. In the multi-party model, the contracting

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INTEGRATED PROJECT DELIVERY

parties form a team which assumes joint responsibility for both the definition of the project and the management of the process. The owner participates on this team and is also the ultimate decision maker when the parties cannot agree. The owner, therefore, must have the willingness, capacity and skill to participate actively and make the decisions.

- **Price and schedule commitments.** In design-build, the owner typically receives a price commitment, either in the form of a lump sum agreement or a guaranteed maximum price, plus a commitment for dates of substantial and final completion. The owner retains the ability to pursue legal remedies against the design-builder to enforce these commitments. Conversely, in the multi-party model, the owner does not receive price or schedule guarantees from the other parties. The owner pays for the cost of the work, even if it exceeds the budgetary goal and even if the project is delivered late. The liability of the other participants is usually limited to the proportion of their fee that they put at risk and the designer and constructor are not otherwise at risk for overruns or delays. These characteristics of the multi-party model may be further reinforced by contract clauses restricting the owner's ability to pursue legal remedies from the other parties.
- **Accountability and risk.** The design-builder accepts risk for designing and constructing the project in accordance with the project criteria. The owner can look to the design-builder as a single point of accountability. In the multi-party model, by contrast, the owner contracts with at least two other parties and yet retains ultimate accountability and risk for decision-making and the project outcome.
- **Availability of model.** Design-build is legally authorized for most public projects, whereas the multi-party form is currently not available to public entities. There is no statutory authority for use of this model and certain features of the model may conflict with public procurement laws. The multi-party model is also much less widely used and accepted in the private sector.

DBIA supports the principles of integration espoused by the multi-party contract—full and open communication; incentive compensation structures; active collaboration among the owner, constructor and designer; and appropriate limitations of liability for the design and construction team. Consistent with a commitment to provide objective education on the various delivery models, and without diminishing the successes apparently achieved by some of the initial multi-party projects, DBIA believes that most owners will find design-build to be a more flexible option. Substantially all the integration techniques used in the multi-party model can be incorporated into the design-build model as desired for a given project. Design-build done right often achieves successful integration among the key project participants, leading to outstanding project results. For these reasons, DBIA promotes design-build performed according to its best practices as the most practical manner in which to achieve integrated project delivery.

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Initiating IPD Concepts on Campus Facilities with a “Collaboration Addendum”

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ABSTRACT

Integrated project delivery (IPD) is attracting the attention of owners, seeking a more collaborative, shared risk, design and construction environment for high-performance building projects. However, the administration of a tri-party or multi-party contract requires a high level of owner involvement and experienced contractors. For owners considering an IPD approach, but unable or unprepared to pursue a multi-party agreement, several “IPD-lite” options are being tested within the construction industry. This research uses quasi-experimental observational case studies of four campus facility projects to follow the progress of the Pennsylvania State University’s facility management organization, the Office of Physical Plant (OPP), through the development and implementation of a Collaboration Addendum as a supplementary contract attachment. Since the selected case studies are planned using traditional delivery methods, the Addendum was designed to integrate desired characteristics of an IPD approach, including: early involvement of project participants, collaborative decision-making, collocation and a performance-based incentive program. The development of the attachment followed a three step procedure of (1) defining the collaborative intent, (2) refining the intent on a project or team-specific basis and (3) outlining the desired process for achieving meaningful collaboration. Metrics for assessing the success of the Addendum were developed to determine the effectiveness of achieved levels of collaboration and included performance measures of timeliness of communication and meeting effectiveness. This paper reports the development and in-process implementation of the Addendum on selected case study facilities, as a means of promoting collaborative team behavior.

INTRODUCTION

Integrated project delivery (IPD) is attracting the attention of owners, seeking a more collaborative, shared risk, design and construction environment for high-performance building projects. However, the administration of a true, IPD contract requires a high level of owner involvement, experienced contractors and paradigm shifts in the perception of team interaction and individual expectations. For owners considering an IPD approach, but unable or unprepared to pursue a tri-party agreement, several “IPD-lite” or “IPD-ish” options are being tested within the construction industry. These options, while serving to allow owners to begin transitioning toward more integrated delivery options, do not typically embodied the central risk – reward elements of the multi-party contract structures. The shared risk and reward aspects of the IPD contracts are the elements which drive the behaviors of the project team to align their interests with the goals of the project (Leicht et al. 2011). The purpose of this study is to begin exploring the relationship of the shared risk and reward element of the integrated delivery by entering shared reward incentives for key interest areas of a large owner, Penn State University’s Office of Physical Plant.

BACKGROUND

Adoption of the integrated project delivery (IPD) organizational structure and similar relational contracting methods have gained recognition recently through the publication of several project and owner success stories, such as the Autodesk Headquarters (AIA 2010) and Sutter Health's Integrated Form of Agreement (Lichtig et al. 2008). The demand from multi-party delivery prompted development of standardized contractual documents from recognized organizations such as American Institute of Architects (AIA) (Bedrick and Rinella, 2006) and Associated General Contractors (AGC) Consensus Documents (AGC 2008). While these early movements by industry leaders indicated support for the IPD concept, there are still few documented uses of the multi-party agreement. Nearly two-thirds of owners with prior IPD experience believe that IPD will become a widely used project delivery method (Kent and Becerik-Gerber 2010). However, interest in collaborative project delivery has sparked new terminology—IPD “lite”, IPD “ish”, and IPD “like”—suggestive of bringing the value of this contracting strategy and organization, without the perceived risk of gambling project success on an unproven and legally untested delivery method (Leicht et al 2011).

The introduction of integrated contract structures has been recognized conceptually in other countries, but using different terminology and slightly different legal relationships. The use of multi-party covenant agreements to align team goals and share incentives (Martin and Songer 2004), along with project alliancing and project coalitions (Pryke 2004) have shown value in promoting collaborative approaches to project goals and incentives. Public-Private Partnerships (Robinson et al, 2010) have been used to create flexible design and construction teams on public project delivery in the UK. Framework agreements have also been used by owners to prequalify design and construction teams and allow for greater freedom in how they approach problems and projects (Goodier et al. 2006). The most closely aligned organizational structure to the integrated project delivery (IPD) arrangement in the United States is project alliancing—a system used in Australia for aligning project participants to a shared set of goals and target cost for the project in a manner which allows for innovation from the project team (Walker et al., 2002).

The U. S. has developed several versions of the relational contracting approach through more than one venue (Lichtig, 2005; AIA 2007), with multiple versions of the integrated multi-party contract. The most widely recognized agreement is the Consensus Documents, which was developed by a consortium of agencies, including the Associated General Contractors and Design Build Institute of America (DBIA). Sutter Health developed a customized agreement; the American Institute of Architects has their own form of contract, along with a transitional version, with separated contracts for the architect and general contractor with shared general conditions, nicknamed IPD-lite. The defining feature of “true” IPD is the multi-party contract which creates a single relational contract among the key players in the project design and construction, inclusive of the owner. The contract chiefly defines the project goals, the target cost, the milestone schedule and the incentive breakdown of any shared savings. The other key element is the waiver of liability, which prevents firms from initiated lawsuits against each other. The outcomes from the few documented case studies are strong and persuasive in project outcomes (AIA 2010). The completed projects, in nearly every case, were under budget, on schedule and had developed project teams who were determined to remain a team of future projects. Owners and contractors experimenting with this form of integrated delivery are looking for ways to replicate the IPD environment on all of their projects.

Penn State's Office of Physical Plant

This Collaboration Addendum study is being conducted through a mutually-beneficial research partnership with The Pennsylvania State University's Office of Physical Plant (OPP) at the University Park campus. OPP manages the daily operations and maintenance of over 700 buildings and the supporting infrastructure on the University Park campus, as well as administering real estate and overseeing the planning, design and construction of capital facilities for the entire University and the Commonwealth Campus system of 24 locations. As a multifaceted organization and public institutional owner, OPP is most experienced with delivering projects using a construction management at risk, and construction manager agency with multi-prime contractors. Despite expressing interest in IPD, OPP is not currently structured to administer a true multi-party agreement involving the owner, designer and contractor. This research endeavor represents a collaborative effort with OPP to deliver Penn State's projects with an IPD mindset and culture within a traditional delivery, with the intent of developing the experience and potential of moving to a multi-party contract at some point in the future.

RESEARCH METHODOLOGY

The goal of this research was to assist Penn State's Office of Physical Plant (OPP) in transitioning toward more integrated forms of project delivery by developing a flexible contract attachment, which incorporates several key IPD principles, including goal validation, cooperative decision-making, collocation, process transparency and mutual benefit and reward. This contract attachment takes the form of a "Collaboration Addendum" and was incorporated into the design and construction contracts of four recent campus projects, ranging in scope from a dormitory renovation to a water treatment facility. Once implemented, this research is in the process of tracking and measuring changes in project team behavior to answer two research questions: (1) Are the outcomes different from OPP's prior pre-Collaboration Addendum projects? (2) If so, are the differences beneficial and worth adopting on future projects?

Campus Project Selection

Penn State's Office of Physical Plant (OPP) managed the construction or renovation of 8 capital projects in 2010 and 10 in 2009 at the University Park campus. For this research, OPP identified seven projects, with design and construction manager selection between June 2011 and January 2012, as potential test cases for the Collaboration Addendum. From the initial seven project recommendations, three were eliminated from consideration for not meeting one of the following criteria: (1) at least one team member has prior knowledge or experience with IPD or Design-Build and (2) the funding source or delivery method allows the attachment and incentivizing of the Collaboration Addendum. For project involving exclusively public funding, OPP is required by Pennsylvania law to solicit low bids for a multiple prime delivery and cannot use contracting incentives to reward performance. Therefore, the remaining four projects, each with different delivery methods summarized in Table 1, were selected to pilot customized versions of the Collaboration Addendum.

Table 1: Case study projects and project delivery summary

	Organizational Structure	Contract Type	Approximate Project Cost
Water Treatment Plant	CM Agency w/ Multiple Prime	Lump Sum	\$30 M
Dormitory Renovations	Design-Build	GMP	\$75 M
Recreational Building	CM at Risk	GMP	\$28 M
Research Facility	CM Agency w/ Multiple Prime	Lump Sum	\$26 M

Quasi-Experimental Design

This research uses observational case studies of four campus facilities to follow the progress of the Pennsylvania State University's facility management organization, the Office of Physical Plant (OPP), through the development and implementation of a Collaboration Addendum as a supplementary contract attachment. Specifically, a quasi-experimental design was implemented to compare the value of measured outcomes across the cases and selecting several sections of the Collaboration Addendum as control variables. Quasi-experimental design is similar to traditional experimental design, but lacks the random assignment of treatment and control. In this instance, the researchers selected four upcoming campus projects planned by OPP and customized the Collaboration Addendum incentives and metrics for each project team. While inferences can be drawn on the relative success of the Collaboration Addendum in impacting project outcomes, a quasi-experimental setup cannot verify if the case projects would have performed similarly without the contract attachment. Despite several differences in the unique goals and performance measures of each version of the Collaboration Addendum, the sections addressing communication and integrated strategies were selected to remain constant and provide baseline comparison metrics on all four projects. These sections were specifically targeted as key IPD elements, which add value to design and construction activities regardless of delivery method. The remaining IPD elements were varied by case to capture project-specific goals and to pilot as points of comparative analysis for evaluating the impact on project performance and evaluation of incentives.

The empirical case study methods for this study follow several recommendations from Taylor et al. (2011) on improving the consistency of case-based research in the AEC industry by controlling for internal and external validity, creating reproducible procedures, involving multiple researchers and including longitudinal data collection over the duration of each project. While the projects selected to pilot the Collaboration Addendum are different in both scope and function, they are managed by the same owner organization, with the same intent to develop collaborative design and construction practices. Similarly, the research team attempted to minimize internal variability by following a consistent and methodical procedure for developing the addendum and collecting project data. Therefore, a case study approach allows the researchers to examine the context of each individual case and assess how the contractual implementation of specific IPD elements impacted the outcomes of traditionally delivered projects.

Addendum Development Process

The development of the Collaboration Addendum followed a three step procedure, shown graphically in Figure 1, of (1) capturing and defining the collaborative intent for each IPD principle, (2) refining the intent on a project or team-specific basis and (3) implementing the addendum as a contract attachment.

Step 1: Creating the Template

A baseline or template Collaboration Addendum was drafted, using IPD contract examples from practice, including ConsensusDOCS 300 and AIA's Single Purpose Entity (SPE) agreement, and similar attachments from several industry partners. This was then analyzed against the six core IPD contract elements as identified by Lichtig and Ashcraft (2009), of (1) early involvement of key participants, (2) mutual trust and respect, (3) mutual benefit and reward, (4) collaborative innovation and decision-making, (5) jointly developed and validated goals and (6) appropriate integration of tools or technology. The template was comprised of six sections, which attempted to capture one or more IPD principles. The section headings of the

template Collaboration Addendum, summarized in Table 2, include communication, integrated strategies, project planning and scheduling, budget and cost modeling, quality of work. The last section, Incentives, will be addressed separately. Several instances of overlap are observed within the Collaboration Addendum sections, where multiple sections re-emphasize the same core IPD element. The most common elements of IPD cited in the addendum were the early involvement of key participants and jointly developed and validated goals.

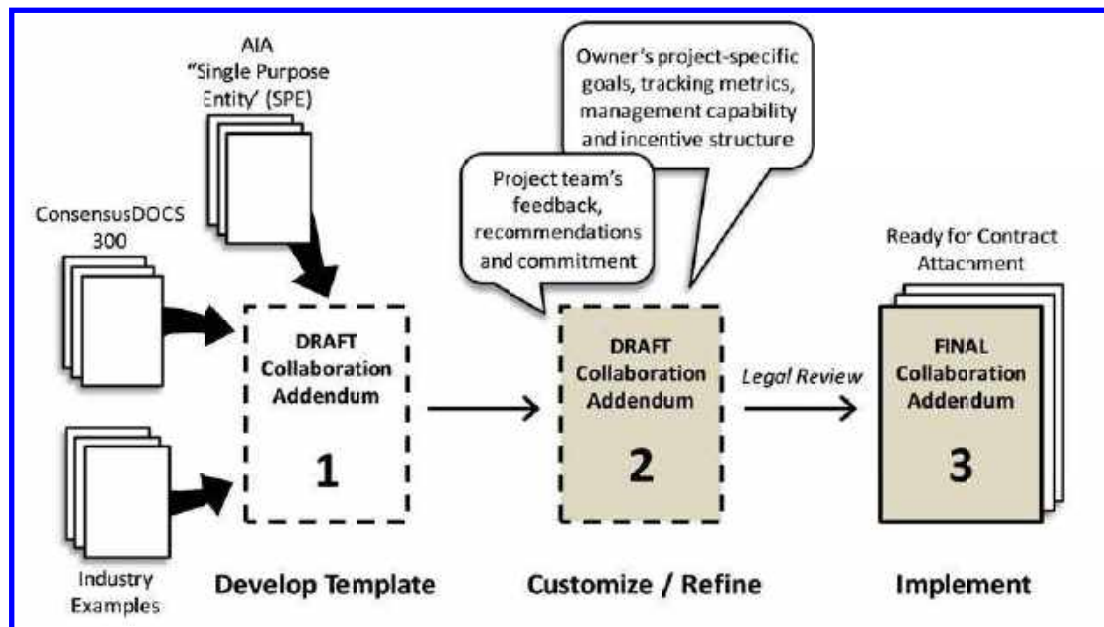


Figure 1: Development process for the collaboration addendum

Table 2: Capturing IPD principles within sections of the Collaboration Addendum

IPD Elements	Collaboration Addendum Section				
	Integrated Strategies	Communication	Project Planning & Scheduling	Quality of Work	Budget & Cost Modeling
Early involvement of key participants	x	x	x	x	x
Mutual respect and trust		x	x	x	
Mutual benefit and reward					
Collaborative innovation and decision making	x	x			
Jointly developed and validated goals			x	x	x
Integrated tools and technology	x				

Step 2: Project-Specific Refinement

The Collaboration Addendum draft was customized and refined for each of the four case study projects to include OPP's project-specific goals, performance metrics, management

capability and incentive structure. When the timing of bidding and contract award allowed, all project teams were also involved in the customization process to provide feedback, recommendations and commitment to the collaboration concept. The refinement process was conducted over a period of several weeks and included a series of meetings with the design and construction teams to introduce the intent and educate the team members to the language and elements embodied before the establishment of measurable goals and realistic, but challenging, expectations for each project. On all cases, the team members assigned to the refinement process consistently included the lead designer, construction manager and OPP project manager.

This stage of development focused on the use of an incentive program, which enabled the created Addendum, from a shared contingency pool, to reward team successes and the meeting of team goals. Under the current model, the shared contingency pool is composed of a combination of designer, contractor and owner contingency funds available for unforeseen conditions, design completion and other scope project coverage. A portion of the shared contingency is reserved for funding the incentive program, which shares risk among the project team and similar to at-risk fee arrangements, cost overruns can eventually reduce the incentive distribution amount. Since the Collaboration Addendum represents a transitional step toward integrated delivery, OPP opted to use this type of reward structure to foster collaboration and cooperation, with the goal of improving the overall quality of each project. The incentive program outlined specific review periods, evaluation categories and detailed criteria with tracking metrics to quickly and accurately assess performance and the success of collaboration encouraged by the addendum. For each case study project, only specific sections of the Collaboration Addendum were incentivized, as shown in Table 3, based on the owner's project goals and ability to manage the assessment process. OPP considers project safety a requirement for all stakeholders, heavily emphasizing safety goals within the prime contracts. To reduce contractual redundancies, a section for safety was specifically excluded from the Collaboration Addendum. Instead, OPP elected to "bake-in" a safety culture within the contract attachment and incentivize project safety as a by-product of successful collaboration.

Table 3: Case study projects and incentivized Collaboration Addendum sections

Case Study Project	Collaboration Addendum Section				
	Communication	Integrated Strategies	Project Planning & Scheduling	Budget & Cost Modeling	Quality of Work
Water Treatment Plant	x	x	x		x
Dormitory	x	x	x	x	
Recreational Building	x	x	x		x
Research Facility	x	x		x	

As control variables in the quasi-experimental design, the communication and integrated strategies sections of the Collaboration Addendum were held constant for all case study projects. The communication section outlined requirements for collaborative decision-making, regular meetings, drafting of a communication procedure and the handling of project documents. The integrated strategies section outlined methods for achieving more meaningful collaboration, including collocation, value analysis strategies and proven tools and technology. Of these methods, only collocation and BIM tools were strongly encouraged by OPP, allowing individual project teams the freedom to select tools and technologies as needed for each specific case. To

monitor this potential variability in control, the current differences in integrated strategies are summarized in Table 4.

Table 4: Detail of integrated strategies emphasized on each case study project

Integrated Strategies	Case Study Project			
	Water Treatment Plant	Dormitory	Recreational Building	Research Facility
Collocation	X	X	X	X
Value analysis		X		X
<i>Tools and technology</i>				
BIM	X	X	X	X
A3 reports		X		X
Choosing by advantage (CBA)			X	
Process mapping	X			X
Value stream mapping	X			X

Step 3: Implementation

Finally, the draft Collaboration Addendum underwent a legal review to ensure the attachment language did not conflict with existing contract language used by OPP. The final version was then attached to the design and construction contracts on each of the four case study projects.

Participation in the Collaboration Addendum

Stakeholders in the Collaboration Addendum varied for each project, but always included the architect and construction manager as the primary participants in the contract attachment. As shown in Table 5, some cases also involved design engineers, MEP subcontractors and vendors. The selection of participants for piloting the Collaboration Addendum was influenced by the delivery method, timing of contracting and identification of key trades, subcontractors or vendors necessary for the successful design and construction of the project. While the customization of the Collaboration Addendum for each case was intended to include feedback from all selected project participants, involvement was frequently limited to the architect and construction manager due to the timing of contract awards.

Table 5: Project stakeholders involved with Collaboration Addendum on each case study project

Project Stakeholder	Case Study Project			
	Water Treatment Plant	Dormitory	Recreational Building	Research Facility
Architect	X	X	X	X
Design Engineer	X	X		X
Construction manager	X	X	X	X
Mechanical, electrical and plumbing (MEP) subcontractors		X		
Façade subcontractors		X		
Vendors	X			

Tracking Performance

Ongoing measurement of changes in project team behavior is central to this quasi-experimental case study in addressing two research questions: (1) Are the outcomes different from OPP's prior pre-Collaboration Addendum projects? (2) If so, are the differences beneficial and worth adopting on future projects? To strengthen the construct validity, measurements included both pre-established metrics and observational data. During the customization process on each project, OPP established several highly specific performance metrics to assess the collaborative project teams. While intended primarily for the administration of the incentive program, these quantitative metrics will be collected by the researchers on a monthly basis to track and trend changes in project outcomes. This metric data will be supplemented by qualitative observational measurements, intended to monitor changes in team behavior and processes on each case.

Metrics

The quantitative metric measurements recorded for this research varied by case study project, based on the project-specific goals established by OPP, architect and construction manager. In accordance with many lean construction and IPD principles, the focus of these metrics was reliability and team efforts, rather than individual performance. For instance, in the Water Treatment Plant case, a metric for timely communication was defined as the percentage of RFI's returned within three days of issuance and submittals returned "Approved" or "Approved as Noted" within two weeks of issuance. To achieve the incentivized goal of greater than 90%, the construction manager, architect and vendors would need to communicate frequently and effectively. By establishing a challenging, but attainable goal, this contract attachment attempts to foster more collaborative team behaviors. An example of the completed goal and metric matrix, developed in cooperation with the project team on the Dormitory building, is shown in Figure 2. Each case study project is developing a similar matrix with comparable metrics, customized to the goals and capabilities of the individual project teams. Researchers will assist the project teams in generating metrics each month to ensure data accuracy and consistency between the case study projects.

Observation

This research intends to collect qualitative observational data of the project team interactions during the regularly scheduled meetings mandated by the Collaboration Addendum. These observations will focus on assessing the effectiveness, efficiency and value of the meetings as the team progresses through the design and construction of each project. Prior research by Garcia et al. (2003) piloted several methods for translating and coding qualitative data into metrics, which may add rigor to these observations.

PRELIMINARY RESULTS

While only one of the four case study projects are progressed enough to conduct monthly collaboration meetings, the process of implementing the Collaboration Addendum generated several observations relating to the customization of section within the contract attachment. First, the quality of work section was generally well-accepted by all project teams. Since quality control and assurance plans are frequently difficult to manage, the team preferred a shared risk approach, wherein quality became the responsibility of all stakeholders. Secondly, multiple sections required significant modification, including:

- *Project-planning and scheduling:* The successful inclusion of IPD planning elements depended on the current status of the bidding and team selection process when

Collaboration Addendum is implemented. When the project team was selected prior to adding the contract attachment, the concepts of pull-scheduling and “Last Planner” techniques were removed.

- *Budget and cost modeling:* Target value design was removed in instances where the relative lateness of stakeholder involvement, due to organizational structure and contracting method, limited the potential level of freedom and influence on project cost.
- *Performance incentives:* Funding sources from OPP dictated if or how incentives were planned for distribution among the project team, since public funding does not permit contract incentives. In these cases, secondary incentives, including opportunities for future work or developing owner relationships, were emphasized as rewards for superior performance.

	Goal	Metric	Target
Safety	“Safety First” culture	Owner evaluated (Pass/Fail)	Pass
	No lost time incidents	OSHA LTC rate	0
	No bystander incidents	Owner evaluated (Pass/Fail)	Pass
Schedule	Timely communication (RFI)	Percentage of RFIs returned within 3-days	90%
	Timely reviews (Submittals)	Percentage of submittals returned Approved or AAN within 2-weeks	90%
	Meet design deliverable and construction commitments	Percentage of milestone dates achieved	100%
Cost	Efficient change management	Percentage of change orders with pricing information provided within 30-days	90%
	Buyout success	Percentage difference between buyout and pre-bid estimate	5%
	Cost tracking below target cost	Percentage difference between actual project cost and target cost	5%
Quality	No field installation conflicts	Number of field installation conflict in new work	0
	Timely resolution of QC items	Percentage of quality control log items resolved within 30-days	100%
Team	Collocation, as planned by Project Team	Collocation planned and executed (Pass/Fail)	Pass
	360° evaluations by Project Team	Team average from evaluations	4 (0 to 5 scale)

Figure 2: Sample goal and metric matrix for Dormitory project

CONCLUSIONS

This paper presented the development and implementation of a research study to analyze the use of a Collaboration Addendum in a quasi-experimental design involving four case study projects. The developed contract attachment relied upon current industry documents and core IPD elements to identify the framework of a collaborative team and seeks to identify the extent

to which mutual benefit and reward can begin to engage teams in integrated practices. The addendum is being implemented on four pilot projects with varying scopes, delivery methods and unique project teams, but seeks to identify the consistency of outcomes for several addendum sections and performance metrics, along with the variation developed from the unique goals, team contexts and independent performance criteria identified and targeted based on the varying project scopes and goals. While this research intends to compare the outcomes of IPD-like or IPD-lite against traditionally delivered projects within a single owner organization, the small number of pilot case studies may limit the ability to generalize the results to other non-institutional owners.

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Transitioning to Integrated Project Delivery: Potential barriers and lessons learned

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Abstract

Research Question: How do architecture, engineering, and construction (AEC) professionals overcome the most prevalent barriers of implementing IPD?

Purpose: To investigate how successful IPD projects overcome legal, cultural, financial, and technological barriers in an effort to achieve wider adoption of IPD by the industry and to provide lessons learned to industry professionals interested in implementing IPD as a delivery method.

Research Design: A brief review of the current situation of the AEC industry; semi-structured interviews with leading AEC professionals in nine IPD projects.

Findings: The study finds that successful IPD projects are achieved through proper selection and involvement of all main players as well as these main players achieving trust in each other. Training, procurement ability, and collaborative technology are also among the key factors for a successful transition to IPD.

Limitations/Implications: Eight out of nine cases are from the state of California.

Value for Practitioners: This paper highlights common barriers that currently exist in implementing IPD and provides lessons learned to practitioners in order to overcome these barriers.

Keywords: integrated project delivery (IPD), barriers, relational contracts, insurance, compensation, collaboration, integration

Paper type: Full paper

Introduction

Traditionally, the architecture, engineering, and construction (AEC) industry employs standard project delivery methods like design-build, design-bid-build, and construction manager at risk. However, many industry professionals are dissatisfied with project outcomes and argue that projects often run over-schedule, over-budget, and are of low quality (Lichtig 2006). The AEC industry is fragmented, inefficient, and adversarial because

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each team is responsible for its own silo of work and attempts to maximize their individual profit in the area of their own expertise. (Pelberg 2009; Lichtig 2006). As a new project delivery method, integrated project delivery (IPD) attempts to address the problems of waste, inefficiency, and adversarial relations in the AEC industry, and to increase the likelihood of project success (Autodesk White Paper 2008; DeBernard 2008; Lichtig 2006).

IPD is a highly collaborative process that integrates the expertise of project teams during the early project stages. Experts from every discipline are present at the project's inception to ensure that overall design decisions meet the needs of all involved entities. Although several professional organizations support the advancement of IPD (AIA 2007; AIA California Council 2008; AGC 2009), and prior research efforts demonstrated its benefits and challenges (Matthews and Howell 2005; Hellmund et al. 2008; Cohen 2010; Becerik-Gerber and Kent 2010), the number of projects using IPD remains relatively small (Kent and Becerik-Gerber 2010; Sive 2009). Researchers also compiled empirical data assessing AEC industry attitudes and experience levels regarding IPD (Kent and Becerik-Gerber 2010) and identified barriers impeding its widespread adoption; these barriers have caused the infancy period of IPD to last longer than expected (Kent and Becerik-Gerber 2010; Cohen 2010). Although much has been written on IPD and its application, few guidelines exist that outline the factors that contribute to the success of multidisciplinary IPD projects.

This paper identifies the best IPD practices that help overcome barriers related to IPD implementation in an effort to achieve widespread adoption by the industry. In order to facilitate a faster transition to IPD, it is necessary to overcome the most prevalent barriers to its implementation (Sive 2009). The paper builds on the identification of four barriers impeding the industry-wide adoption of IPD by Kent and Becerik-Gerber (2010) and Cohen (2010): (1) lack of appropriate legal structure, including allocation of risks and insurance products, (2) cultural barriers within the industry, (3) allocation of financial incentives, and (4) technology limitations.

Differences between ipd and traditional delivery methods

The American Institute of Architects (AIA 2007) 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.*” IPD is a new method by which construction projects are organized and executed, and the following characteristics differentiate IPD from traditional delivery methods:

- A multi-party contract;
- Early involvement of key participants;
- Collaborative decision making and control;
- Shared risks and rewards;
- Liability waivers among key participants;
- Jointly developed project goals.

All the above characteristics must be incorporated in a project for IPD to be realized in its purest form (Sive 2009). Many IPD projects in the U.S. do not employ all of these characteristics; instead, they sample some of the IPD characteristics to achieve higher efficiency. There are fundamental differences between traditional delivery methods and

IPD; the main differences are in terms of contracts, project team relationships, and compensation structures.

Contracts

The current contractual structure causes disputes and inefficiencies because it encourages each party to concern itself with its own interests rather than the interests of the project as a whole (Martin and Songer 2004). Some of the systematic problems with traditional contracts include restraining good ideas, limiting cooperation and innovation, inhibiting coordination, and forcing the team members to optimize their own silos (Matthews and Howell 2005).

Macneil and Williamson define two broad classes of contracts: transactional and relational. Transactional contracts are defined by exchange of goods and services; on the other hand, relational contracts resemble small, nuclear societies, with their own internal system of evolving norms (Williamson 1979).

IPD contracts are known as “relational” contracts because consideration is given to the process, not just to the end product (Pelberg 2009). Macneil suggested that when parties expect to work together again in future, they approach and manage their current transaction with such a future relationship in mind (1975). Below are the characteristics of most widely used relational contracts for IPD projects:

- **AIA C195 (Single-Purpose Entity)** - This contractual model embraces the principles of IPD by creating a limited liability company (LLC) whose sole purpose is to plan, design, and construct the project.³
- **AIA C191 (Single Multi-Party Agreement)** - AIA Document C191-2009 is a standard multi-party agreement through which the owner, architect, contractor, and other key project participants execute a single agreement for the design, construction, and commissioning of a project.⁴
- **ConsensusDocs 300 (TRI-PARTY Agreement)** - This agreement calls for the owner, architect, and contractor to enter into a tri-party agreement and attempts to align the interests of parties through a collaborative process in the design and construction of the project by sharing certain risks and rewards.⁵
- **Integrated Form of Agreement (IFOA) (Single Multi-Party Agreement)** - IFOA binds all the parties involved into a single agreement and requires them to share risks and rewards. Its main purpose is to facilitate integrated practice through collaborative design, construction and commissioning of a project.⁶

Project team relationships

IPD principles rely on encouraging transparency, open communication, honesty and collaboration among the main stakeholders (Pelberg 2009; AIA 2007). Mutual respect and trust is the single most important principle of IPD (AIA 2007). Trust is gained through relationships and commitment; when this kind of trust is present, an individual accepts risks knowing that the intention of others is mutually positive (Martin and Songer 2004).

³ <http://www.aiabookstore.com/aia-documents/aia-documents-c-series/c195-2008-standard-form-single-purpose-entity-agreement-ipd.html> 29 Dec 10

⁴ <http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aia081563.pdf> 29 Dec 10

⁵ <http://consensusdocs.org/catalog/300-series/> 29 Dec 10

⁶ <http://www.thechangebusiness.co.uk/TCB/ifo.html> 29 Dec 10

Briscoe and Dainty's study of supply chain integration in construction found that the lack of trust among the different parties inhibited project teams from achieving the collaboration necessary for an integrated project (Briscoe and Dainty 2005).

The current extent of litigation in the AEC industry illustrates the high level of distrust among project members (Martin and Songer 2004). The Briscoe and Dainty's (2005) study also showed that collaboration on integrated projects required an environment of mutual respect and trust under which teams could share information and knowledge during the decision-making process.

Compensation structures

IPD's compensation structure follows the project alliancing model, with the goal of stimulating efficiency and the alignment of interests for the benefit of the project as a whole (ADTF 2006). In this model, project participants are compensated on a cost-plus basis where the owner guarantees the direct cost, but a portion of the profit and participants' bonuses are dependent on the project outcome (AIA 2007).

Risk management depends on the project outcome and is a challenging aspect of traditional projects (Jaafari 2001). In IPD, the overall risk remains the same (AIA 2007), but IPD leads to a more equitable approach to risk management and a less risky project overall by tying project risk and uncertainty to the outcome and collectively managing it (Darrington et al. 2009). In return, IPD projects compensate team members by providing rewards that are tied to achieving project results (AIA 2007). By aligning the goals of parties around collective project success and making each party accountable for the behavior of others, project teams gain more control of the overall process and better mitigate the overall risk (Cohen 2010).

Research methodology

A qualitative investigation through multiple industry cases was used to answer the research question: what are the barriers and challenges to implement IPD to its full capacity? The interview questions were designed to gather information on existing IPD practices and how each case overcame identified barriers. The questions were developed after an extensive three months long literature review. Interview questions were categorized according to four barriers identified in the literature: legal, cultural, financial, and technological.

Researchers recommend examining multiple cases to manage the validity of the constructs identified (Eisenhardt 1991). Due to the limited number of IPD projects that have been completed or are currently underway, only a qualitative investigation of IPD cases was possible. Interviewees were narrowed down and contacted from a list of 415 participants from the 2009 IPD survey (Kent and Becerik-Gerber 2010) and referrals from the AEC industry.

Participants were considered eligible if they reported experience with IPD and were part of the upper echelon of their firm, that is, company owners, executive managers, and project managers. Participants were contacted by email. Although not all project members from each of the cases were interviewed, the researchers were assured that the interviewees have sufficient information to answer all questions related to the project. Of the firms investigated in this project, three interviewees were from construction firms, two interviewees were from architectural firms, two interviewees were owner/owner's

representatives, and two interviewees were from integrated suppliers providing design and construction services. Formally structured interviews were conducted via telephone and in person; the interviews lasted about an hour each. The interviews were recorded and then analyzed to identify how successful IPD projects had overcome the most prevalent barriers.

Coding of key terms drawn from a literature review allowed for identification of common themes. Headings drawn from this coding system collected the attributes deemed to be most important for the successful implementation of an IPD project. The results of the nine IPD cases are presented below.

Summary of ipd industry cases

For this study, the authors adopted the following definition set forth in AIA California Council (2007): “at minimum, an integrated project includes tight collaboration between the owner, architect/engineer, and builders that are ultimately responsible for construction of the project, from early design through project handover.”

Table 1: The extent to which each case embodied IPD characteristics

Case no.	Early involvement	Shared risk/reward	Multi-party contract	Collaborative decision making	Liability waivers	Jointly developed goals
1	◆			◆		
2	◆	◆	◆	◆		◆
3	◆	◆	◆	◆		◆
4	◆	◆	◆	◆	◆	
5	◆			◆		
6				◆		
7	◆					
8	◆	◆	◆			◆
9	◆	◆	◆	◆		◆

Case 1 - Los Padrinos Juvenile Hall Expansion

The Los Padrinos Juvenile Hall Expansion project was delivered in 2005 and included two 37,000 sq ft, \$29 million additions, each of which consisted of new 120-bed dormitories and a parking structure addition for 85 cars. The design-build firm acted as the architect of record and also provided construction services (25%) in a joint venture along with a contracting firm (75%). This project faced what is commonly known as a “sunsetting” funds problem, in which money would be returned to the state if the project was not completed by a given deadline. In order to combat the additional pressure, the owner brought in the designers and contractors early and set the project goals. In addition, an integrated services team with the participation of an owner representative was formed to make sure the project progressed properly and decisions were made within this period. The main participants were paid on a cost-plus basis, with no shared risk or reward.

Case 2 - Pomona Hospital

The Pomona Hospital project is a three-story, 55,000 sq ft building and a 5-acre site development project. This project started in 2008 and, at the time of this paper, is currently in progress. The project involves a large seismic upgrade and retrofit of the hospital campus. As part of the project, the hospital is also going through a lean process internally to determine the facilities the medical staff needs which are not “critical care”, are permitted by Office of Statewide Health Planning and Development (OSHPD), and can be housed in the less expensive new space. The design-build firm proposed to move these facilities outside of the existing hospital to the new, less expensive 55,000 sq ft space, providing the owner the needed space while the seismic upgrade and retrofitting of the existing hospital take place. The owner selected the design-build firm primarily based on the owner’s long standing working history with this design-build firm. The design-build firm competitively selected the mechanical and electrical subcontractors as part of their IPD team. As they had both design and construction capabilities in-house, integrated practice was not new to the firm, who convinced the owner to implement IPD through AIA 195-295 contracts in June 2008. The main participants are compensated on a cost-plus-fee basis, with a shared risk and reward scheme. This allows participants to share savings and any contingency fees remaining, as well as holding the possibility of increased compensation based on quality of performance.

Case 3 - Sutter Medical Center Castro Valley

The \$320 million project involves construction of a new, state-of-the-art hospital on the Eden Medical Center campus in Castro Valley, as well as campus improvements including additional parking and the demolition of the old hospital when the new hospital is completed. The project is fully funded by the owner, Sutter Health. The contracting firms along with all ten of the other key participants were on board early on in the project and signed an integrated form of agreement (IFOA). Additionally, five other parties were involved early but were not parties to the IFOA. The main parties released each other from liability with a “no sue clause” agreement, except in the event of gross negligence.⁷ The main parties worked collaboratively to develop the estimated maximum price (EMP), established after a 6-month validation effort, approximately 10-12 months before the project broke ground. Currently, the project is in the construction phase. Project participants are compensated on a cost-plus-fee basis and there is a shared risk and reward scheme, where the parties to the IFOA would share the savings and the overruns, with a possibility of increased savings by meeting quality criteria specified by the owner.

Case 4 - Autodesk One Market

The Autodesk One Market project involved a commercial interior renovation of about 40,000 sq ft with a roughly \$10 million budget and an aggressive 9.5-month design and construction schedule. The project’s main team included an owner, a general contractor, and two architects. These participants signed a relational four-party integrated project delivery agreement (IPDA), and all parties were on board early on when design started. The main parties released each other from liability and were compensated on a cost basis

⁷ The IFOA contract does not have broad waiver forms, as this would potentially nullify the ability to obtain insurance coverage for the project. Instead, the contract calls for “Indemnity Clauses,” which are essentially an agreement among project members not to sue each other and to take care of each other as if they were one team.

without a maximum all the way through the life of the project. The project's risks and rewards were shared by all parties through the incentive compensation layer (ICL), in which the direct costs of construction and project overhead are guaranteed to each party. The profits are placed in a common pool and are distributed based on the project's success. The success of this project was determined by the following criteria: functionality, aesthetics, materials, workmanship, and sustainability. The ICL could increase or decrease based on the project outcome. 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 scopes and purposes. The project achieved the design goals, and the ICL was increased by twenty percent. This award was then divided among the team members proportionally based on each party's profit and the overhead percentage placed in the pool.

Case 5 - Brigham Young University (BYU)

This project involves design and construction of a \$15 million university building located on the BYU campus. The owner's organization is set up in a way that enables them to provide planning, design, construction, space management, and maintenance services. For this project, the pre-planning groups and the third-party contractor were in charge of the estimate. Pre-planning groups were also in charge of establishing project goals and aligning them with the project mission as well as approving the scope, budget, and programming. Upon the approval of the scope and budget, the rest of the IPD team was then invited onto the project. The IPD team was comprised of the architect, contractors, and the owner representatives. The core team (executive group) was comprised of representatives from planning, design, and space management organizations within BYU. This core team was present and met weekly as the project progressed. Moreover, other project team members (architects, contractors, subcontractors) were encouraged to attend the core group meetings. The project adopted traditional AIA documents, which it modified into its own IPD contract. Currently, the project is in its design schedule phase.

Case 6 - Grant Joint Union High School

The Grant Joint Union High School project involved construction of a new \$150 million high school campus to meet the needs of the growing population in the suburbs of Sacramento. The construction of the project was completed in 2005. Project participants were selected in accordance with a California code which involves a two-step process. First, the teams submitted a request for qualification (RFQ), after which the pre-qualified teams were required to submit a request for proposal (RFP). There were three criteria for selection of the team: past performance based on previous California school experience, previous design-build experience, and finally previous projects, where contractors and architects had worked together. The project adopted a DBIA (Design-Build Institute of America) contract in an integrated fashion. As the design progressed, the owner maintained close involvement and attended weekly meetings with the design-build entity. In addition, key subcontractors were included as part of the RFP and were involved once the design started. The project participants were compensated via a lump-sum agreement.

Case 7 - West Los Angeles College

The project involves design and construction of two 38,000 sq ft buildings: the performing arts center and the learning center for the LA college district in West Los Angeles.

Angeles College. Both of the projects were projected to be LEED Gold-certified and were design-build projects, which the owner (the college district) required to be executed through IPD. The design firm developed the contract documents. The project was under extreme time pressure from the start. The design firm needed to complete two-design development sets in 5 weeks. By employing IPD, they were able to finish the job by the specified deadline. The designers were compensated based on a fee, and the main incentive for the team was to finish the project on time. Another firm is completing the construction documents, and construction was set to begin in Fall 2010.

Case 8 - Cathedral Hill Hospital (CHH)

The CHH project involves design and construction of a 1.3 million sq ft medical facility located in an urban area of San Francisco. The owner, California Pacific Medical Center (CPMC), an affiliate of Sutter Health, selected the architect and general contractor based on their past experience and familiarity with lean principles. The construction value is estimated at about \$1 billion. The project began in 2007; construction is expected to be completed by 2015. The project has adopted an IFOA three-party agreement. The main subcontractor also signed what is called a joining agreement by acknowledging their commitment to and understanding of IFOA and IPD method. The major parties were compensated via cost-plus-fee and were reimbursed for their time and materials. The shared risk/reward pool involved pooling of 25% of everyone's fee, including the owner, into a risk pool. The risk pool will be used to cover cost overruns if the final cost is above the estimated maximum price (EMP). If the final cost is below the EMP, the risk pool will be distributed among the members.

Case 9 - Sutter Medical Center Sacramento (SMCS)

The SMCS project involves the renovation of the Sutter General Hospital in Sacramento and construction of a new power plant, medical office building, and women and children's center. The decision to employ IPD was driven by Sutter Health. The project is about \$724 million, of which \$450 million is for construction. The current contracting firm took over from another contracting firm, which had been working on the project since 2003. The SMCS project is scheduled to end in 2011. The main teams are part of an IFOA multi-party agreement. Participants are compensated based on cost plus fee. The "pain-gain" mechanism is employed to give the participants the incentive to drive down the overall cost of the project. At the end of the project, project savings along with added bonuses are shared among the participants, including the owner.

Table 2: Detailed information of the industry cases

Case no.	budget (\$m)	Contract	Risk/reward	Compensation structure	Bonding required?	duration (years)
1	\$29	Modified DBIA	N/A	GMP	Yes	1
2	\$33	AIA 195-295	Sharing saving/overruns	GMP	Yes	5
3	\$320	IFOA	Sharing saving/overruns	EMP	No	5
4	\$10	IPDA	Profit pooling	GMP	No	<1
5	\$15	Modified AIA	N/A	GMP	Yes	2
6	\$150	DBIA	N/A	Lump sum	Yes	2
7	N/A	DBIA	N/A	Fixed fee	N/A	<1
8	\$1700	IFOA	Profit pooling	EMP	No	8
9	\$724	IFOA	Sharing saving/overruns	EMP	No	8

Ways to overcome barriers in implementing ipd

As a new delivery method, IPD presents novel challenges for the owner, designer, and the contracting team, including legal, financial, cultural, and technological barriers. The following sections report how each of the cases was able to overcome these major four barriers.

Cultural barriers

Cultural barriers refer to the unwillingness of the industry to vary from its traditional methods, as many AEC firms are accustomed to their own narrow leadership. The challenge is overcoming the inertia and changing the mindset built on the traditional hierarchy (AIA California Council 2008; Lichtig 2006).

Integrating Project Personnel

In traditional projects, a team member might be brought into the project late in the design process or during construction. This causes inefficiencies as the newcomers are usually not well coordinated with the rest of the team. Even though collaboration between the owner, architect, and the contractor takes place for all projects investigated, reaping the benefits of IPD was found only to be possible when the subcontractors were brought into the design and construction process as early as possible.

Involving subcontractors in the design process helped case 2 to reduce the cost of structural steel as the subcontractor designed a new detail in the design of slip joints that would work with moment frames. In case 6, the design-build code required the mechanical and electrical subcontractors to be identified by the design-build firm as part of the RFP. The contractor brought their subcontractors on board as the design progressed.

A trend across the cases indicates that most teams are prone to choosing integrated subcontractors that have both engineering and trade services in-house. Subcontractors in cases 1, 2, and 4 all had the design and installation in-house.

Cases 3, 8, and 9 called their subcontractors “trade partners”, treating them as partners on their projects. Contrasting strategies emerged for involving subcontractors on the IPD teams. In cases 3 and 9, all main subcontractors were the parties to the IFOA agreement as they signed a multi-party agreement along with the owner, general contractor, and the architect. In case 8, subcontractors signed a separate “Joining Agreement” promising their collaboration and commitment to IPD in addition to the three-party contracts signed by the owner, architect, and general contractor.

Cases 2, 3, 4, 7, 8, and 9 took a more proactive integrated approach as the whole project team was located in the same building and the design was integrated into a singular BIM model, allowing for stronger collaboration and sharing of information.

IPD Training

IPD training played an important role on most of the projects investigated and proved to be a crucial element in overcoming cultural barriers. The training was achieved at two levels, at the organizational and at the project level. Training at the organizational level involved general training regarding IPD and was done as part of a company’s voluntary transition toward IPD. Four out of nine cases had a program, in which they trained their employees in IPD.

Eighty percent of the employees of the design-build firm in cases 1 and 2 were enrolled in a one-day course about IPD methodology. The architectural firm in case 4 also took the initiative to train their employees in IPD methodology before entering into any projects; the organization has taken an initiative to have certain people trained and certified in IPD.

In case 5, the owner asked volunteers to be involved with their integrated project, which helped them identify those who needed training. This type of exercise allowed the firms to recognize those who could not fit into the IPD environment. These firms placed project participants on projects accordingly. Training at an organizational level was an important factor for overcoming cultural barriers as it helped firms to identify individuals that fit to the collaborative nature of IPD.

Project-level training refers to a series of activities completed early on or as the project progressed. These activities were completed at the discretion of the owner and after teams were put together.

In cases 1, 2, and 9, by using internal and external resources, the owner established a continuous learning plan throughout the course of the project. In cases 1 and 2, continuous training was carried out in three stages:

- project teams attended a meeting before they were awarded the project and before the start of design. In these meetings, a consultant was hired to train the team and encourage project participants to set goals and expectations for the project.
- the project participants also met throughout the design process and halfway through construction to ensure all expectations were met.
- there was a meeting at the end of the job to discuss the lessons learned from the project.

In cases 3, 4, 7, 8, and 9, all project participants, including the subcontractors, were present early on and were instructed concerning the project’s goal and set-up. Training of

those members ensured that all members were comfortable with the methodology and definitively committed to the project.

Case 8 reported a series of Study-Action Team™ activities designated for familiarizing the teams' understanding of fundamental concepts of integrated design and construction. Case 8 also took training the project members a step further by contractually requiring project members to read books about IPD methodology.

In addition, there were seminar-type events in cases 3, 4, 8, and 9. In these events, organizations supporting IPD, individuals experienced with IPD, and companies pursuing IPD gathered together to share educational materials and their learning experiences in the form of workshops.

Trust-building Activities and Tools

This theme emerged across several cases and allowed project teams to overcome cultural barriers by building confidence toward each other. The following factors helped project teams develop mutual respect and trust:

- collaboration at the inception of the project;
- coordination of communication between team members, including open conversations between and within groups;
- shared team confidence based on the capabilities of individual team members; and
- openness, honesty, and transparency between all team members.

All of these items together develop trust among the teams. The cases studied demonstrate that trust comes in two ways: preexisting trust and forced trust.

Preexisting trust was observed across cases where the participants had long and successful past working relationships. In both public and private projects, having a good past working relationship between the owner and other stakeholders was one of the factors taken into account during the owner's selection of the team. In case 2, the owner selected the design-build team based on their past 10-year working relationship. Similarly, in cases 3 and 4, the owner and the contracting firm had collaborated on other projects in the past. In case 6, a past relationship between the architect and the contractor was one of the three criteria specified by the California code and was taken in consideration in the RFP.

Where preexisting trust did not exist, a set of general tools and activities facilitated collaboration and allowed the project team members to acquire trust intentionally. Having team members collaborate and spend time together was mentioned by many of the cases as a requirement to achieve mutual respect and trust.

In case 1, trust was achieved through forced communication. The design-build project required the team members to meet face-to-face rather than communicating via email. In case 7, strong communication helped the team develop confidence as they became aware of each other's capabilities. In addition, the use of the lean construction concepts "Target Value Design" (TVD) and Last Planner® System (LPS) proved to facilitate collaboration, communication, and trust among the project participants.

In case 3, IPD teams collaborated extensively and underwent a 6-month validation effort to develop the TVD. Likewise, in cases 2, 8, and 9, the contractors, subcontractors, and architects underwent a similar validation study to produce a mutually agreeable

project costs. Validation study allowed contractors, architects, engineers, and subcontractors to get together in a *Big Room*.

The Big Room (or co-locating) concept allowed the teams in cases 3, 6, 8, and 9 to constantly interact, communicate, and give each other feedback. Project teams were able to test their ideas and get the real-time estimates on the same day, which not only facilitated collaboration but also helped with the decision-making process.

Financial barriers

Financial barriers refer to the challenge of selecting compensation and incentive structures commensurate to the unique characteristics of the project and its participants (Cohen 2010).

IPD Compensation Structure

Traditional contract structures tend to inhibit collaboration by only providing incentives for each individual firm. The review of industry cases (table 2) revealed that most IPD projects follow guaranteed maximum price (GMP) or estimated maximum price (EMP) for the compensation on their projects. EMP is similar to GMP in the sense that parties involved are paid based on a cost plus a fee with a difference that in EMP the owner will share the costs in excess of the estimated amount (Darrington & Lichtig 2010). Although the use of EMP allows the owner to take on the risk, otherwise assumed by the general contractor, and helps designers and contractors to focus on the project's overall goals (Darrington et al. 2009), there seem to be limitations to its use.

In case 2, the project team had to establish GMP after six months of design development as the owner needed financing on their project in order to obtain funding and bond the project. In addition, two different approaches emerged concerning sharing risk and reward: sharing cost savings and overruns, and profit pooling.

Sharing cost savings and overruns

Sharing cost saving and overruns refers to when project team members collaboratively agree upon a target budget and share the savings realized on the project. The cost sharing/overrun scheme was more prevalent when the majority of the subcontractors participated in the risk/reward and bonus program.

In case 2, the design-build firm provided a target cost and established the GMP after an extensive validation period. The contingency funds were held by the core team and were accounted for in the target cost of the project. At the end of the project, the savings realized from the project along with the remaining contingency funds were added to the savings and distributed among the members based on the risk each party has taken on in the project. There is a discretionary fund from anything that is left over, which is set aside to award additional bonuses to the teams who met the quality criteria set by the project.

Likewise, in case 3, eleven parties to the IFOA contract along with a few other key subcontractors worked collaboratively to establish the TVD. TVD requires project value, cost, schedule, and constructability to be the basic components of design criteria (Darrington and Lichtig 2010). As part of the contract, the IFOA calls for the team to develop a TVD in which the project members provide the best possible design that can be constructed for the target cost. The EMP was established after the validation study. There are two types of contingency funds, one under the discretion of the owner set aside in the

event of force majeure, and the other one being the project team contingency. The allocation of risks and rewards is based on the percentage of the project each participant has at risk. If the project is completed under the established EMP, 50% of the savings realized go back to the owner and the remaining 50% is distributed to other project members according to the amount of risk each party took on.

Case 9 uses a similar savings model, where project participants share savings if the project finishes below the target price and bonuses are distributed to the teams if they meet the quality, schedule, and cost criteria of the project. Similar to cases 2 and 3, in case 9, the contingency fund is also held by the project and not by the individual project participants.

Profit pooling

Profit pooling involves project teams to place a percentage of their fee or profit in a pool and withdrawing it at the project conclusion, with a possibility of increased bonuses if the specified targets are met.

In case 4, the IPDA contract called for the creation of incentive compensation layers (ICL) for the sharing of risks and rewards as well as additional bonuses to the project. The parties to the contract estimated their cost for the given project duration and placed 100% of their added profit in the ICL pool. Additional design bonuses were awarded to project teams as the ICL pool was expanded, based on the meeting of the target design. At the end, the ICL pool was distributed according to the profit each participant had placed in the pool.

Similar to case 3 and 9, case 8 involved the participation of main project participants in developing the TVD. However, in case 8, project members along with the owner put 25% of their fee in a risk pool, which is used to cover cost overruns during the project. The shared risk pool in case 8 is to be paid to the IPD team members, if the project is less than or equal to the EMP. Moreover, a system has been devised for awarding bonuses to the teams who are able to meet the quality, schedule, and cost of their project.

Legal barriers

Legal barriers refer to issues of liability and insurance. To allow for increased collaboration, some IPD contracts eliminate or reduce the abilities of parties to sue one another. Current insurance products are designed to assign liability to each participant and the liability issue makes the insurance and bonding requirement more complicated (Cohen 2010; Sive 2009; Pelberg 2009).

Insurance, Bonding, and Legal Limitations

While the biggest fear for industry professionals concerning adopting IPD is the issue of insurance and risk allocation (Kent and Becerik-Gerber 2010), all multi-party agreement projects investigated were able to overcome the legal barriers by selecting contracts that fit within traditional insurance products, or were able purchase an insurance product that satisfied their project needs.

Contrasting strategies emerged concerning managing risk and selecting proper insurance products on IPD projects. As an already integrated supplier, the design-build firm involved in cases 1 and 2 had an agreement with an insurance company and used comprehensive general liability (CGL) insurance on most of their IPD project. This type of insurance covers their professional liability during both design and construction stages.

In case 2, since the firm is in charge of both design and construction, an additional professional “project-specific professional liability” was purchased at the project’s expense to cover all project participants.

In case 3, the general contractor firm purchased a contractor-controlled insurance program (CCIP), which covers all parties involved including the owner, contractor, and subcontractors for builder’s risk, worker’s compensation, general liability, excess liability, pollution, auto, etc. However, this type of insurance does not provide any professional liability insurance for errors and omissions, for which insurance had to be purchased separately.

Case 4 was the only project in which all four of the parties waived all claims against each other except those arising from fraud and gross negligence and all project participants used their own traditional insurance. Similarly, in case 9, the contract allowed the team to maintain their own traditional insurance; moreover, fully wrapped general liability coverage was placed to cover third party bodily injury and property insurance. To cope with the third-party claims, all Sutter Health projects using the IFOA contract reported placing an *indemnification clause*, in which project members all agree not to sue each other except in the event of gross negligence.

In cases 1, 2, 5, and 6, bonding was required as part of the owner’s request and was included as part of the contract. None of the cases that required bonding were able to have any sort of liability indemnification or waivers on their project. Although surety bonding was not seen as a legal impediment preventing IPD’s initiation in the context of the cases studied, sureties have yet to learn how to distinguish between design and construction responsibility. As for IPD project in case 2, in which the owner required bonding (table 2), the best possible solution was for the design-build firm to bond the project as a whole. The rationale for not requiring bonding was that in projects, where project teams were selected based upon qualification and were part of a multi-party agreement, the owner saw no need to bond the entire project. All of the public project cases in this study required bonding as part of their contract.

IPD in the Public Sector

In the public sector, state and local laws governing procurement inhibit early collaboration between the owner, architect, and contractors. Laws in California do not allow an owner to enter into a multi-party agreement with the architect and contractor as signatory parties in public projects. In addition, there is no law allowing for the best value selection of an IPD team in California; IPD’s value selection criteria can only be achieved through a public law designated for design-build delivery.

In cases 1, 6, and 7, the participants delivered their projects using design-build contracts while still using the two most important features of an IPD project: early involvement of key participants and collaborative decision-making and control.

In case 1, the architect, contractor, and the owner were present and collaborated from the early stages until the end of the project. This enabled the team to finish the project two months ahead of schedule.

In case 7, the project chose design-build but was required by the owner to be IPD.

In case 6, the owner’s involvement began after the procurement period ended. Therefore, the owner was involved in the design process onward.

Negotiating relational contracts in a public entity is much harder because a system of check and balances for the taxpayers' money is needed; the perception remains strong that competitive bidding is needed to ensure fairness in selection. Hence, the role of state and local law governing procurement deserves more attention to achieve successful IPD implementations.

Technological barriers

Technological barriers refer to the legal challenges of ownership, liability and interoperability concerns in the integrated use of technology to achieve collaboration on IPD (Kent and Becerik-Gerber 2010 ; Hess 2009; Ashcraft 2008).

Integration

Although technology was not an issue for successful execution of IPD in the cases investigated, a few concerns regarding collaborative use of building information modeling (BIM) was expressed. In this study, the authors defined the use of BIM model as a mean to integrate different discipline models during each phase of a project. In all cases except 6, which was completed in 2005, projects used BIM as part of their integrated practice.

Concerns were expressed by the design-build firm in case 2 and the owner in case 5 regarding the level of BIM use by the subcontractors; the concerns were regarding the availability of BIM software to subcontractors and the capability of subcontractors (beyond the MEP, fire protection, and structural steel) to work in 3-D and use BIM collaboratively with other project teams. Nevertheless, the use of collaborative BIM was seen as a great tool for enhancing communication, transparency, collaboration, building relationships, reducing costs, and accelerating processes in all projects investigated.

Visualization and simulation capabilities of BIM gave the project teams in cases 7 and 8 more confidence.

The BIM collaboration between the MEP and fire protection subcontractors in case 4 saved time and money in fabrication and redesign. For example, an electronic scan of the ceiling and integration of the models with the contractor's BIM model allowed the teams to identify the location of the concrete columns that were thought to be missing from the drawings without tearing the ceiling apart.

In case 5, the use of BIM saved time in project planning and enabled the project teams to provide a more accurate estimate.

Other issues addressed by the literature are translation, interoperability concerns, model ownership, and liability when BIM becomes a platform for data sharing and collaboration among the project teams (Hess 2009; Ashcraft 2008).

In cases 2, 3, 4, and 7 the MEP and fire protection subcontractors along with a few other subcontractors merged their models into a single, information-rich model, which allowed the team to translate and integrate their design into a single model for collaboration purposes.

In cases where each project team used different platforms to create their models, the general contractors took on the ownership of integrating and controlling the model. The general trend regarding the accuracy of the model showed that the degree of accuracy depended on the accuracy of specific information provided by individuals and fed to the model by each party. In addition, other approaches were taken in order to avoid any translation and liability issues.

In cases 5 and 7, where the owners required their project teams to use and assemble their models on the platform specified in the contract, the owner took on the liability and ownership of the model.

Lessons learned

A cross-case comparison revealed that none of the IPD projects suffered from the issues commonly observed in the AEC industry. This supports the assertion by the literature that the delivery method is adequate and successful (Cohen 2010; Becerik-Gerber and Kent 2010; Matthews and Howell 2005). Extracting best practices from the cases reveals a range of principles that act as lessons learned for achieving successful IPD projects as well as overcoming major barriers when implementing IPD. These are discussed below.

Selecting the right team early and based on quality

IPD demands more diligence from the owner in selecting project teams. Unlike traditional projects where teams are selected based on the lowest bid, IPD calls for a best-value selection, meaning that teams are selected for the best design for the proposed budget. Two methods of team selection were observed in the cases investigated:

- sole selection by the owner and
- request for qualification (RFQ) followed by request for proposal (RFP).

In cases 1, 2, and 4, the owner selected the firms solely based on their long-standing previous relationship. In cases 5, 7, 8, and 9, the teams were qualified through an RFQ process. The qualified teams were then eligible to compete in the RFP and propose a design.

A common pattern emerged suggesting that all firms selected by the owners exhibited an ability to participate extensively in the planning and design phase of the project. Being an integrated supplier allowed cases 1 and 2 to participate in the early phases of planning, design, and as the construction process moved along. The construction firms in cases 3, 8, and 9 had long histories of embracing collaborative design and construction and had been practicing informal versions of IPD and lean construction in the past. Some of the qualities and characteristics that owners look for in IPD teams include:

- Team's ability to participate extensively in planning and design
- Subcontractors who are already integrated: who have the engineering and trade teams in-house
- Team's ability to use information technology
- Companies and individuals, who are open-minded, familiar with IPD, and able to work collaboratively with other teams
- Teams that are able to work on an open-book basis in the sense that the amount of profit they make is transparent to all project team members
- Previous working relationships with other teams and previous IPD performance

With the exception of the last point, all of the nine cases embodied the above characteristics.

Reconciling project goals

The analysis showed that it is necessary for the owner to provide the IPD team with a set of project goals in terms of scope, quality expectations, budget, schedule, and possibly

programming the project well ahead of the start of design in order to approve it when meeting with the IPD team for the first time. Two trends were observed in the establishing and reconciling of project goals: some owners selected their IPD project teams and then reconciled their goals, while others established their goals and then selected their IPD project teams.

The owner in cases 2, 3, 8, and 9 invited the key project teams to set the scope and goal, and engaged in a goal-setting session that set the budget, described their expectations, and laid out specific project roles. As a result, the teams were able to design the project so that it fit the quality and budget set by the owner.

Alternatively, in cases 1, 5, and 6, the owner set the project goals as well as approved the budget, scope, and planning *before* inviting and meeting with the IPD team. These cases reported more change orders.

In case 4, the owner provided the teams with set target schedule, target cost, and target quality but could not reconcile it with the IPD team due to time pressure. As a result, the IPD team rejected these set targets after the design started. This was problematic, as the owner had to issue a change order and increase the budget, which affected the target price and project schedule.

Setting procedures for problem solving and resolution

The cases presented an established mechanism and atmosphere for dealing effectively with problems, which is an essential factor for avoiding legal disputes. None of the four cases completed went through a legal process to reach resolution for their projects, and the remaining five cases that currently under design or construction have not seen any legal disputes that reached a legal resolution. All integrated projects placed a procedure in their contracts calling for the formation of an IPD core team. At a minimum, the IPD core team was comprised of representatives from the owner, contractor, and architect teams. They scheduled meetings to monitor progress and handle issues concerning the project.

In case 1, the dispute resolution board reported a couple of issues, but these issues were solved at the project level and never were acknowledged by the board. In case 3, the core group was comprised of executives forming a main ten-party core group that were part of the IFOA agreement. Forming a core group in case 5 allowed the team to meet and discuss any disputes that arose during the week and forced them to solve these issues.

Cases 4, 8, and 9 reported two IPD core teams, one comprised of technical experts such as representatives from contractors, architects, and general managers. This allowed them to make the necessary day-to-day decisions on the spot. The other team was comprised of executives including lead architects, lead contractors, and owner representatives in addition to having a core team handling day-to-day issues. The senior executive team was responsible for making important decisions on issues that could not be resolved at the project level.

Having an IPD core team also provides an environment that reduces the adversarial nature of the interaction between the project members by promoting openness and honest discussions. It also provides collaboration for problem solving and helps build relationships. In all projects, IPD helped project teams promote a level of openness by encouraging them to speak honestly about how they felt about project decisions. Interviewees of case 9

reported that conversations still can get heated, as they can in traditional projects, but that IPD allowed these heated discussions to come to reasonable conclusions.

In case 2, all project members gathered to promote participants from different disciplines to engage in discussions. This not only helped the project, but also built strong relationships between the participants even outside of the project by discovering commonalities.

Interviewees of case 7 believe that having collaborative projects helped their team look out for each other's responsibilities, and left no room for hiding from responsibilities.

Providing continuous organizational and project-level support

IPD involves a change in cultural paradigms and demands more collaboration among project participants. The participants were asked how they were able to overcome the changes that came with IPD. The answer stated by most participants was support from their organization and strong support from their organization's leadership. All cases were able to overcome problems by staying committed to their decision to employ IPD. The second widely offered answer was that firms' structures and past practices made the transition easier.

Lastly, participants stated that an organization's ability to function in an IPD environment was important to overcome communication issues between the team members.

Therefore, the first step for transitioning to IPD requires training at the organizational level. Educating teams on the organizational level has the potential to cut down on training costs during each phase of the project. This is not to devalue the importance of project level training, but case 2 reported that the amount of time spent on training teams during projects reduced their productivity rate at the beginning. Training individuals proved to be an effective way of overcoming cultural barriers.

Providing collaborative and fully integrated project environments

The analysis provides evidence that the early collaboration of the main players (owner, architect, contractor, engineers, and subcontractors) allowed for extra savings and early completion of five projects investigated. Early collaboration of contractors and subcontractors in cases 1, 2, 4, 6, and 7 allowed for early completions and extra savings. Most case participants agreed that true integration happens only when all the key project teams are able to unite their discipline-specific BIM models into a single model and participate on all aspects of the project from early design to construction completion. According to Cohen (2010), AIA's most recent definition describes IPD as "*a project delivery method distinguished by a contractual agreement between a minimum of the owner, design professional, and builder, where risk and reward are shared and project team's success is dependent on project success.*" The industry cases studied reveal that achieving full integration was possible without having a multi-party agreement or shared risk and reward. Three of the cases in this study were delivered by using the design-build delivery method and were able to assemble their teams in a way that enabled them to achieve true integration. This confirms the AIA's assertion that using design-build in its best practices aligns with the IPD definition (AIA California Council 2008). In addition, one factor that helped these three cases to achieve true integration was an environment of preexisting trust between the owner and the design-build entity. However, in cases 5, 6

and 9, where there was no specific prior relationship among the owner, architect, and contractor, having a relational element helped project teams build trust and achieve collaboration intentionally. Having a relational contract with specific clauses that encourage collaboration was considered crucially important to the execution of successful IPD projects. These relational contracts forced parties to communicate openly and provided the necessary environment and tools for project participants to build relationships.

Limitations and future research

While this study provides an overview of successful IPD practices, several IPD and non-IPD projects are worth exploring. There is a need to explore why there are so few IPD project examples, what differentiates the design-build practices from IPD, and what are the common barriers to widespread IPD adoption. This study draws conclusions from nine industry cases. Five of the cases are either under construction or design. The authors plan to have a follow up investigation when all projects are completed to determine if the projects were kept on the same course as they are described in this paper.

There is a need for broader IPD case projects with more diversified contract models such as the AIA C195, AIA C191 and ConsensusDocs 300, and other contract types with relational elements. A cross comparison of the practical benefits of each contract model will help to shed light on legal concerns surrounding IPD.

The role of state and local procurement also deserves more attention, as this is a major impediment to wider adoption of IPD in public projects. The discussion of technology in this study was limited to collaborative use of different discipline models; there is a need for more detailed exploration and use of different modes of BIM use.

Although the authors didn't intentionally focus on projects in California, eight out of nine cases are from the state of California. This may suggest that the State of California is the pioneer in implementing this new delivery method. Nevertheless, a broader investigation of IPD cases outside of California is needed, as it will allow discovering differences in practice of this delivery method.

Conclusion

This study focuses on investigating how successful IPD projects overcame common barriers, which have impeded IPD's widespread acceptance. Successful transitions to IPD require projects to overcome some of the prevalent barriers when implementing IPD. The study explored nine different integrated practices within the AEC industry. A cross case analysis revealed that each case, depending on their circumstances, had different ways of implementing IPD. From this, it is clear that the degree of integration varies from case-to-case. The extent to which each case embodied IPD characteristics varied by public laws, duration of projects, and the budget for each project. This suggests that each project is unique, and the potential to employ IPD principles should be analyzed and considered case by case for each project.

The research has highlighted a number of criteria that must be implemented to achieve a fully integrated project. In all of the cases investigated, the adoption of IPD was proportional to

- organizational anticipation,

- training of individuals, and
- establishing a collaborative framework within IPD teams.

These were found to be crucial for achieving a successful transition to IPD. A successful transition to IPD required companies to have the procurement ability and to be inherently structured in a way to support IPD. Also, widespread adoption of IPD will depend on the amount of legal support in both public and private sectors. Nevertheless, several new findings extracted from the best IPD practices reveal lessons learned that could be used by industry professionals interested in IPD.

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Assessing design process performance of construction projects

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Abstract

Construction projects are complex at every stage; however, the design phase requires primary attention since it is at this phase that the full project can be influenced to a greater extent and at lower cost. In the design phase of construction projects, several specialists from different disciplines participate, particularly in complex projects such as hospitals, airports, etc., where all the stakeholders form a temporary organization that must accomplish the multiple objectives set by the client. Although in construction projects there is a worldwide practice of measuring performance, through different indicators of schedule, cost, quality, productivity, etc., in the design phase, there is little practice of measuring performance except for the fulfilment of delivery milestones. This is not good given how fundamental this phase is in the rest of the project life cycle. The objective of this study is to propose a way to assess performance of the project during the design phase considering processes and results indicators, i.e.; indicators that can be obtained during design and others that can be obtained after design, particularly in the construction phase. To achieve this objective, it was necessary to do an exhaustive literature review to develop a first proposal of indicators and then carry out measurements in pilot projects. The pilot projects were nine airport projects in Chile at different stages of design, where process indicators were assessed for five weeks along with some result indexes. From this research experience, it can be concluded that there are great difficulties in evaluating performance during design since there is no culture for it. On the other hand, these indicators would be useful for preventing problems at the construction phase.

Keywords: construction projects, design phase, indicators, measurement, performance,

1. Introduction

The construction industry is complex in all of its phases and stages. This is because during the whole project life cycle different stakeholders with different interests participate to create a dynamic, diverse and complex organization (Bertelsen and Koskela, 2005; Zayed, Elwakil and Ammar, 2012). However, the design phase requires special consideration because it is in this phase that the overall project can be best driven towards lower costs (Nasrun *et al.*, 2016). Therefore, the design phase is fundamental in the project life cycle because the decisions made at this phase can significantly affect the subsequent phases. In addition, the cost of changes during design are negligible compared to the cost of further changes (American Institute of Architects California Council, 2007).

In the design phase of construction projects, several specialists from different disciplines participate (Kärnä and Junnonen, 2017). This is particularly true for complex projects such as hospitals, airports, etc. where all the stakeholders form a temporary organization that must accomplish the multiple objectives set by the internal and external clients (Mesa, Molenaar and Alarcón, 2016). In a design organization, the level of information flow regarding work is moderate to high, and the level of centralization is generally low since the owners are the managers and their management style influence completely the organization structure of the company (Oluwatayo and Amole, 2014; Segarra *et al.*, 2017).

Workflow at the design stage can be defined as the flow of information between the right people at the right time (Al Hattab and Hamzeh, 2015). Traditional planning and management methods applied during the design stage do not consider workflows or the problem of variability in workflows. The variability in flows in the Architecture, Engineering and Construction (AEC) industry generates suboptimal cycle times, higher costs and rework and affects design and construction performance (Arashpour and Arashpour, 2015).

Lean philosophy was suggested two decades ago as a solution to improve the design process by applying each of the principles of this philosophy in the design of a construction project (Koskela, Ballard and Tanhuanpää, 1997; Formoso *et al.*, 1998). These studies described the main causes of non-compliance with activities in the design process. The following causes were highlighted: insufficient input information, limited time, optimistic estimation of the duration of activities and delays in decision-making. Later, Freire and Alarcón, (2002) presented the greatest wastes in the design stages: clarification of needs, rework, internal control of activities, interdisciplinary reviews, waiting times and interruptions.

Although, in the construction phase, there is a global practice of performance assessment through different indicators like schedule, cost, quality, productivity, etc., in the design phase there is no extensive practice of performance assessment except compliance with delivery milestones. There are several performance indicators associated with the results of construction execution (Chan, Scott and Chan, 2004). However, when the indicators of the design phase are revised, the list decreases. Some metrics used to measure design productivity include hours per drawing and hours per number of elements designed (Ebrahimy and Rokni, 2010). Others indicators of productivity include the percentage of activities that do not add value (Freire and Alarcón, 2002), hours spent per project, cost efficiency, incomes per capita and development speed (Coates *et al.*, 2010). Some metrics are associated with the quality of the design and are calculated from the number of occurrences of design errors (Al Hattab and Hamzeh, 2015).

Therefore, there are no indicators that can assess performance during the design process of construction projects and that are capable of tracking productivity in order to comply with planning and minimizing main waste during this stage. In addition, there are no standardized assessment practices throughout the life cycle of a construction project that can be used to provide feedback and improve management at the design phase. The objective of this study is to propose a way to assess performance of the project in the design phase considering processes and results indicators, i.e., indicators that can be obtained during

the design and others that can be obtained after the design, particularly in the construction phase. To achieve this objective, it was necessary to conduct an exhaustive literature review to develop a first proposal of indicators and then carry out measurements in pilot projects.

2. Research Method

To achieve the objective of this work, the research methodology in Figure 1 was carried out. The process was divided into two stages. The first stage consisted of the proposal of performance indicators for use during, at the end of, and after the design process. Then, stage 2 was the assessment of the process indicators for five weeks in nine Chilean airport projects during the design phase.

Stage 1 started with a literature review including journals that specialize in engineering and construction project management as well as proceedings of the main conferences that occurred in the last 10 years. The search was done in the following libraries: Engineering Village, Web of Science and Scopus. The topics searched were: design management, design performance, indicators and design indexes. With this information, the indicators were classified into three groups: indicators during the design process, indicators at the end of the design process, and indicators after the design phase (construction and operation phases). In addition, for each indicator, it was noted whether or not the reference contained how to calculate the indicator and the frequency of measurement. Afterwards, a panel discussion was held with 15 experts in the practice who had an average of more than 10 years of experience in complex projects. This panel created a list of indicators for use during, at the end of and after design process. To elaborate on this list, the importance and feasibility of measuring each indicator was evaluated. We selected those that were considered the most important, being also feasible to evaluate.

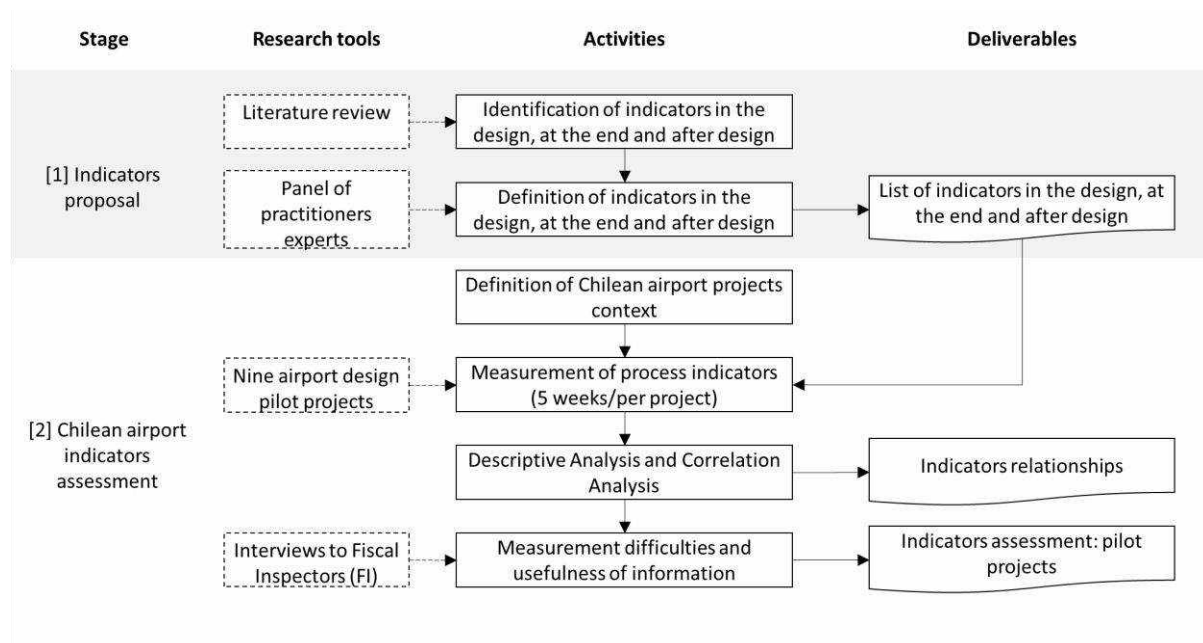


Figure 1: Research method process

Stage 2 consists of the assessment of process indicators in nine Chilean airport projects. To do this, it is first necessary to contextualize how this type of project is organized during the design phase; identifying key actors, phases and number of participants. Then, a measurement of the process indicators was carried out during five weeks in which the official inspectors had to collect the information from each designer and reviewer and process the data in a MS Excel spreadsheet. With the information from the nine projects, a descriptive statistical analysis and an analysis of the correlation between the indicators were performed. Afterwards, an interview was conducted with each project's

official inspector where qualitative information about measurement difficulties and usefulness of the information was identified.

3. Results and Discussion

This section presents and analyses the results of the main deliverables of this work: the list of indicators for use during, at the end of and after the design process, and the assessment of these indicators in the pilot projects. The section is divided into three sub-sections: the proposal of indicators, the context of airport projects in Chile and the assessment of indicators in the pilot projects.

3.1 Indicators proposal

In the AEC industry, there are different types of performance indicators that have different objectives: the key performance indicators (KPI), the key result indicators (KPO) and the indicators associated with a perception measure (PerM) (Radujković, Vukomanović and Dunović, 2010). Table 1 presents the objective of each of the categories and some examples to enhance understanding.

Table 1: Type of indicators. Source: Adapted from Radujković, Vukomanović and Dunović, (2010)

Acronym	Definition	Examples
<i>KPI</i>	<i>Leading performance measures. KPIs are indicative of assigned processes and can predict future trends. KPIs provide opportunity for change.</i>	<i>N° of investor interferences; changes in owners; project support; absence from work; motivation; ...</i>
<i>KPO</i>	<i>Lagging performance measures. KPOs, are lagging measures and do not enable ability for change. A KPO can also be assigned to sub-processes to become a leading indicator of its successor (Sub-process KPI).</i>	<i>Cost predictability; time increase; rework; profitability; ...</i>
<i>PerM</i>	<i>Perceptive performance measures. PerM can be either lagging or leading with regard to the time when they were measured. Often, they are measured through surveys and interviews.</i>	<i>Client satisfaction; employee satisfaction...</i>

The literature review found performance indicators of the three types explained in Table 1. However, in the reviewed papers, all the proposed indicators were referred to as KPIs, as mentioned by Radujković, Vukomanović and Dunović (2010). A classification of indicators was made according to the proposal in Table 1 separating the KPOs into two subcategories: (1) KPOs associated with an outcome of the design process, and (2) KPOs that are associated with a sub-process (KPO's) providing the opportunity to introduce changes in another sub-process or phase.

Table 2 shows a summary of the design phase indicators collected in the literature review. These indicators were classified according to Table 1. In addition, it is mentioned whether or not the document presents a proposal for calculating the indicator and how frequently to measure the indicator. The indicators that are most often mentioned in the papers are schedule and cost deviation, while indicators associated with the quality of the design process are divided into indicators of the design process (e.g., mistakes, rework, or communication) and indicators of the quality of the product developed (e.g., functionality, comfort, or customer satisfaction). In most of the works, there is a proposed method for obtaining each indicator; however, they do not provide a precise formula for how to calculate the

indicator, and even less often, the frequency of measurement. Many of the indicators are associated with a PerM of different stakeholders. Some studies even divide these indicators into several sub-questions for each of the project stakeholders (Haponava and Al-Jibouri, 2009; Kärnä and Junnonen, 2017). It is also unclear when these indicators should be measured, although it is assumed that KPOs and PerMs are measured at the end or after the design process and that KPIs and KPO's should be measured at the beginning and during the design process.

Table 2: Literature review indicators.

<i>Type</i>	<i>Indicator</i>	<i>Sources</i>	<i>Formula</i>	<i>Frequency</i>
<i>KPI</i>	<i>Time definition of scope</i>	<i>1;6</i>	<i>Yes</i>	<i>No</i>
	<i>Safety</i>	<i>1</i>	<i>No</i>	<i>No</i>
	<i>Latency</i>	<i>1;7</i>	<i>Yes</i>	<i>No</i>
	<i>Time investor approval</i>	<i>1</i>	<i>Yes</i>	<i>No</i>
	<i>Plan development</i>	<i>6</i>	<i>No</i>	<i>No</i>
	<i>Risk and value management</i>	<i>6</i>	<i>No</i>	<i>No</i>
<i>KPO' (sub-process KPI)</i>	<i>Energy efficiency</i>	<i>1</i>	<i>Yes</i>	<i>Yes</i>
	<i>Water efficiency</i>	<i>1</i>	<i>Yes</i>	<i>Yes</i>
	<i>Environmental pollution</i>	<i>1</i>	<i>Yes</i>	<i>Yes</i>
	<i>Rework</i>	<i>4;7</i>	<i>Yes</i>	<i>Yes</i>
	<i>Hours per project</i>	<i>5</i>	<i>Yes</i>	<i>No</i>
	<i>Speed of development</i>	<i>5</i>	<i>Yes</i>	<i>No</i>
	<i>Mistakes</i>	<i>2;5;7</i>	<i>Yes</i>	<i>Yes</i>
	<i>Planning accomplishment</i>	<i>7</i>	<i>Yes</i>	<i>Yes</i>
<i>KPO</i>	<i>Schedule deviation</i>	<i>1;3;4;8</i>	<i>Yes</i>	<i>Yes</i>
	<i>Cost deviation</i>	<i>1;3;4;8</i>	<i>Yes</i>	<i>Yes</i>
	<i>Environmental impact</i>	<i>1</i>	<i>Yes</i>	<i>Yes</i>
	<i>Request for information</i>	<i>8</i>	<i>Yes</i>	<i>Yes</i>
<i>PerM</i>	<i>Customer satisfaction</i>	<i>1;2</i>	<i>Yes</i>	<i>No</i>
	<i>Social impact</i>	<i>1</i>	<i>No</i>	<i>No</i>
	<i>Investor approval</i>	<i>1</i>	<i>No</i>	<i>No</i>
	<i>Functionality and Aesthetic</i>	<i>1</i>	<i>No</i>	<i>No</i>
	<i>Comfort</i>	<i>1;5</i>	<i>No</i>	<i>No</i>
	<i>Team satisfaction</i>	<i>2;5</i>	<i>Yes</i>	<i>No</i>
	<i>Quality</i>	<i>2;5</i>	<i>No</i>	<i>No</i>
	<i>Client requirement</i>	<i>6</i>	<i>No</i>	<i>No</i>
	<i>Communication</i>	<i>6</i>	<i>No</i>	<i>No</i>
<i>Sources: 1. Orihuela, Pacheco and Orihuela (2017); 2. Kärnä and Junnonen (2017); 3. Mesa, Molenaar and Alarcón (2016); 4. Hwang and Yang (2014); 5. Coates et al. (2010); 6. Haponava and Al-Jibouri (2009); 7. Herrera, Mourgues and Alarcón, (2018); 8. Salvatierra et al. (2019)</i>				

Then, with the information collected in Table 2, a discussion panel was conducted with 15 experts to define the useful indicators that can be evaluated at three moments: during the design, at the end of the design and after the design (Table 3). The indicators during the design are the KPI and the KPO's and the indicators at the end and after the design are the KPOs. Perception type indicators were not considered, and no indicators related to environmental and social issues were considered as this area

has already been included in several standards. Table 3 presents a description of the indicators in these three stages. Indicators during the design stage have a weekly measurement frequency, indicators at the end of the design are measured only once, and indicators after the design have a monthly frequency.

Table 3: Indicators proposal

<i>Stage</i>	<i>Indicator</i>	<i>Description</i>	<i>Goal</i>
<i>During the design</i>	<i>Designers' cost (DC)</i>	<i>The sum of the hours dedicated by each professional to the project multiplied by the cost per hour of each designer.</i>	
	<i>Rework (RW)</i>	<i>Percentage of hours that the design team spends working on a task that had already been done (rework) in proportion to the total time spent working on the project during that week.</i>	<i>0</i>
	<i>Latency (LA)</i>	<i>Average waiting time that exists between the request and delivery of information between two or more project members.</i>	<i>0</i>
	<i>Quality defects (QD)</i>	<i>Number of failures, errors or nonconformities detected in the design process per week.</i>	<i>0</i>
	<i>Commitment achievement (CA)</i>	<i>Percentage of plan completed within the week.</i>	<i>100%</i>
<i>At the end of the design</i>	<i>Schedule deviation (SD)</i>	<i>The rate between the number of actual days at the design stage and the number of days planned.</i>	<i>1</i>
	<i>Cost deviation (CD)</i>	<i>The ratio between the actual cost of the design stage and the planned cost.</i>	<i>1</i>
	<i>Request for information (RFI)</i>	<i>The number of requests for information at the end of the design before construction starts. Includes interference problems.</i>	<i>0</i>
<i>After the design</i>	<i>Change requirements (CR)</i>	<i>Number of change requirements at the construction stage.</i>	<i>0</i>
	<i>Cost of changes (CC)</i>	<i>Costs associated with the requirements of changes at the construction stage (design cost + construction cost)</i>	<i>0</i>
	<i>Request for information (RFI')</i>	<i>The number of requests for information after design during construction. Includes interference problems.</i>	<i>0</i>

3.2 Context of Chilean airports projects

Airport projects in Chile are supervised at the design and construction phase by the Airports Department (AD) of the Ministry of Public Works, while the Directorate General of Civil Aeronautics (DGCA) is responsible for the operation of the airports. First, the AD makes a pre-project and some specifications of the project; then the AD hires a consulting company to carry out the design of the project in two stages: the preliminary design and the final design. The preliminary design progresses through three reviews by the AD and the DGCA, and at this stage, 6 to 10 people participate (designers and reviewers). In the meantime, the final design is divided into basic engineering and detailed engineering, each of

them having three instances of revision by the AD and the DGCA, and at this stage, 9 to 22 people participate (designers and reviewers).

The AD, as an organization, has a group of professionals, mostly engineers and architects, who have two main functions. The first is to review the designs and documents delivered by the consultant in each of the projects, and the second function is that of an official inspector (FI). The FI is a professional that is responsible for leading the team of reviewers of a preliminary or a final design and that has a team of professionals from different specialties, including some from the AD, and other departments from the Ministry of Public Works. In addition, the FI is the main information channel between the consultant's design team and the AD's review team. Therefore, the same AD professional can, at the same time, be the FI of a project and part of the team of professionals that reviews other projects. For airport projects, the AD plays the role of client.

The DGCA is the institution in Chile responsible for the operation of airport facilities, and therefore, within the development of project design, plays the role of user. This organization has a group of professionals in charge of reviewing the projects and creating observations in its three instances.

The consultant is usually a highly complex engineering company that has several specialists who apply for a public tender to develop the design of an airport project whether the runway, terminal building or other operational facilities. The consultant must appoint a project manager who supervises his team of designers and specialists. This project manager is also the counterpart of the FI throughout the development of the project.

3.3 Assessment of design indicators in pilot projects

During five-weeks of design, four of the five process indicators were assessed in nine airport projects. The only indicator that was not evaluated was the designers' cost because the consultant did not agree to deliver the cost per hour of each of its designers. Additionally, indicators were not assessed at the end of the design and after the design due to the scope of the study. The projects were classified into two groups: preliminary design (PD) and final design (FD). Table 4 shows the average of the five weeks for each of the projects.

Table 4: Assessment of indicators during the design

<i>Project</i>	<i>Rework (%)</i>	<i>Latency (hours/request)</i>	<i>Quality defects (#/week)</i>	<i>Commitment achievement (%)</i>
<i>PD1</i>	4.33	15.47	0.00	80.00
<i>PD2</i>	9.19	18.40	0.20	80.00
<i>PD3</i>	30.00	5.15	3.20	82.80
<i>PD4</i>	50.13	3.07	1.40	76.66
<i>PD5</i>	36.74	20.14	5.40	59.80
<i>FD1</i>	40.36	4.90	6.00	58.40
<i>FD2</i>	11.88	9.34	6.00	54.80
<i>FD3</i>	5.80	11.54	0.60	81.12
<i>FD4</i>	0.00	0.00	3.00	100.00

The average weekly rework of the nine projects is 20.94% of all hours dedicated, i.e., on average one of five days is dedicated solely to rework. It is important to mention that the airport projects in Chile define instances of revision and correction; therefore, there are weeks in which the projects have a high level of rework. This observation explains the high variability in the percentage of rework among the nine projects. In PD stages, the average rework percentage is approximately 26%, while in the FD stages,

it reaches 14%. This is mainly because during the PD stages there is a high level of uncertainty in the design, which does not occur in the FD stage.

The average latency or time spent waiting for information is 9.78 hours; i.e., approximately to a day of work. Again, there is a significant difference between the projects in the PD stage and in the FD stage with the longest duration in the first stage (12.55 average hours), while in the FD stage, the average time is 6.44 hours. This difference is mainly because FD times are shorter, which forces the consultant and the client to have a faster information flow. Even so, these latencies appear to be reasonably short compared to the typical latencies in the construction phase of international projects.

The average number of quality errors detected per week fluctuates between 0 and 6. This fluctuation is mainly due to the revision and correction times that exist in the planning of the project. In this case, the projects in the FD stage have a higher number of quality errors than the PD projects because in the FD stage, the number of designers and other interested parties increases significantly causing an increase in the probability of finding errors and incompatibilities between the different specialties. Finally, the fulfilment of the weekly commitments in each project, which averages approximately 75%, was without significant differences between the different stages of the projects.

The measurement of the four indicators over five weeks in nine projects provides 45 data per indicator. Table 5 shows the Pearson correlations between the four indicators. The correlations between indicators can be highlighted as follows: the indicators of rework, latency, and quality defects are inversely correlated with the fulfilment of the planning being that the detection of errors is what most affects the achievement of weekly objectives. In addition, a moderate correlation can be seen between the number of mistakes detected per week and rework in that same week. It should be considered that not all errors are solved in the same week, and thus there are some that are resolved in later weeks.

Table 5: Pearson Correlation of indicators

	<i>Rework</i>	<i>Latency</i>	<i>Quality defects</i>	<i>Commitment achievement</i>
<i>Rework</i>	1.0000	-0.1743	0.3926	-0.4749
<i>Latency</i>	-0.1743	1.0000	-0.1904	-0.3352
<i>Quality defects</i>	0.3926	-0.1904	1.0000	-0.6684
<i>Commitment achievement</i>	-0.4749	-0.3352	-0.6684	1.00000

4. Conclusions

There are not many indicators in the design stage of construction projects. However, most of the existing indicators are associated with a final stage of the design stage or are a measure of the perception of the product developed during this stage. From a literature review and a panel of professional experts, it was possible to propose a set of indicators in three temporary instances of the design process, i.e., during, at the end and after the design stage. The objective of indicators used during the design process is to act early for the project in future stages. According to the panel of experts, these indicators are useful and feasible to measure. However, from the panel, there are measurement difficulties associated with a non-existent culture of assessment during the design phase. In addition, they advise that indicators related to costs may not always be evaluated due to professional jealousy between the different companies participating in this process.

From the pilot projects, it can be concluded that rework is on average one fifth of the working time. This element, together with the latencies for information and quality defects, affect the fulfilment of the planning. The pilot assessment demonstrated the cultural difficulties in conducting this type of assessment. For example, four projects that started the assessment process did not complete it, and the consultants did not agree to provide information about the costs per hour of their designers. This

validated the concerns of the panel of experts who proposed the indicators.

Some limitations of this study are related to the measurement of the other proposed indicators because of the temporal scope of this research. In addition, the results for the pilot projects cannot be extrapolated to all Chilean airport projects due to the limited amount of data available. Some recommendations for future work would include the evaluation of all the indicators in all their stages to analyse relationships between the indicators during the design process and those at the end and after the design process. In this way, it would be possible to form improvement plans at early stages that to reduce the number of errors in future stages. Concurrently, this strategy would reduce over-budget and overtime for the project in its life cycle.

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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 ConsensusDOCS 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 constraints 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,

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

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-fourth 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 midsize 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

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 Coun-

cil’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. Close-out 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 liquidated 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 (ConsensusDOCS, 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.

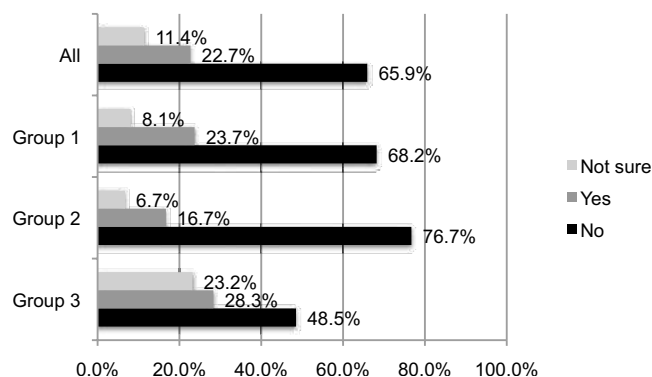


Fig. 1. Opinions of groups and all respondents regarding whether or not projects in the construction industry are delivered in an efficient manner

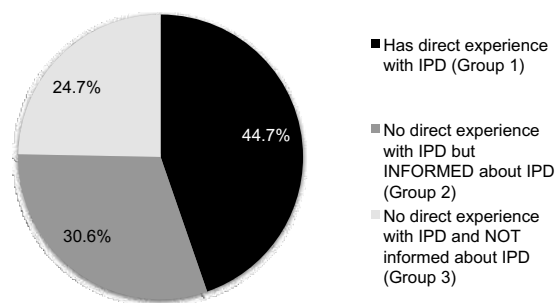


Fig. 2. IPD experience and awareness level of respondents

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 conclusions.

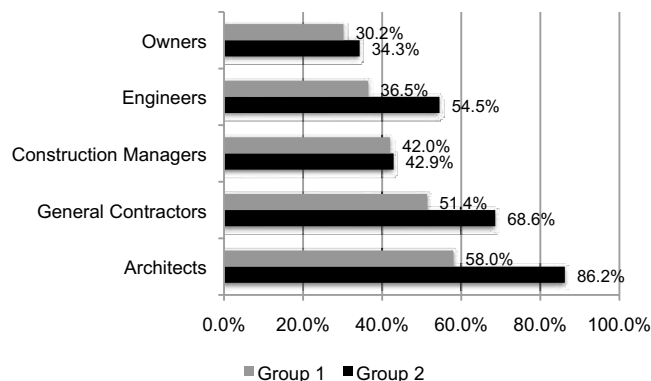


Fig. 3. IPD experience and awareness of respondents by discipline

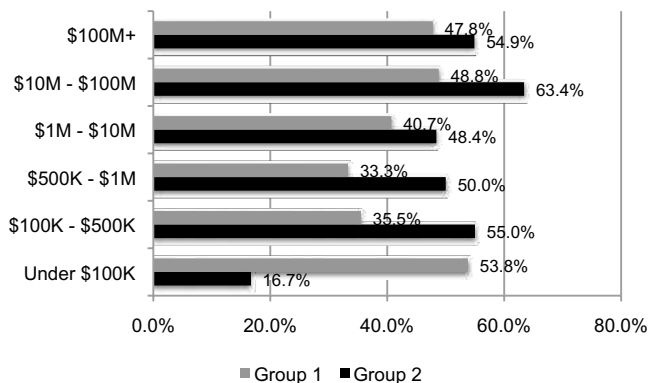


Fig. 4. Comparison of respondents that are experienced with IPD and that are informed about IPD to their firms' last year annual gross revenue

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%.

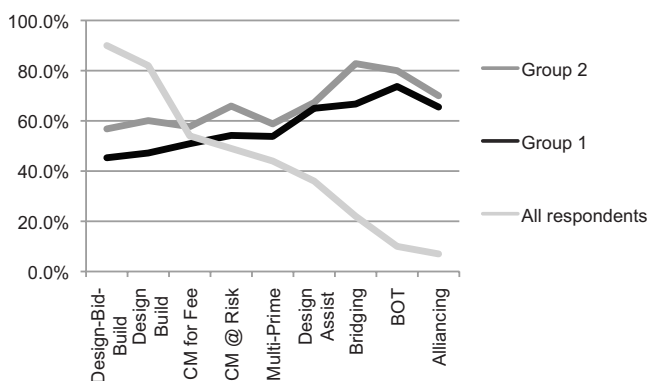


Fig. 5. Comparison of respondents that are experienced with IPD and that are informed about IPD and other project delivery methods

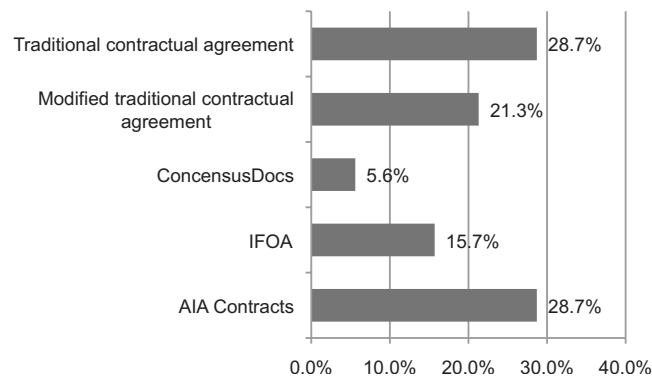


Fig. 6. Utilization of IPD contracts within the respondents who are experience with IPD

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%

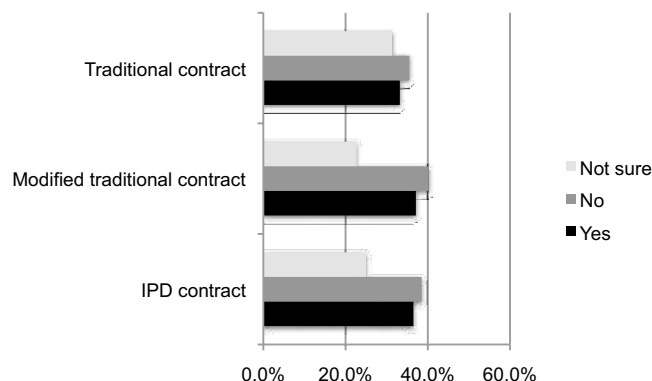


Fig. 7. If any unforeseen contractual issues or problems arose during the course of the project—by contract type



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

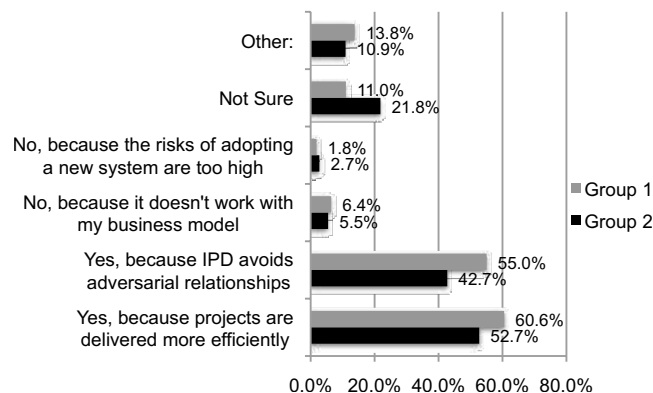


Fig. 9. Preference of IPD over traditional contractual agreements

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.

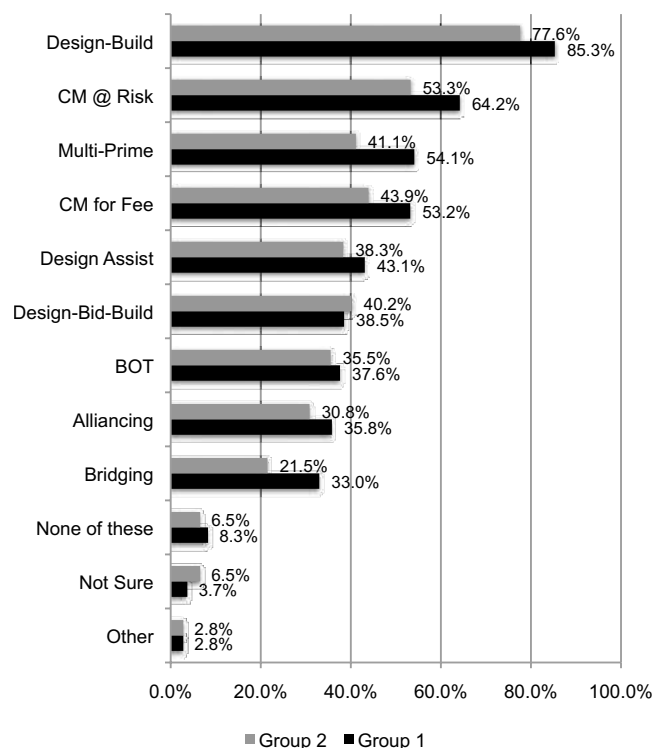


Fig. 10. Contractual agreements to which respondents believe IPD could be applied

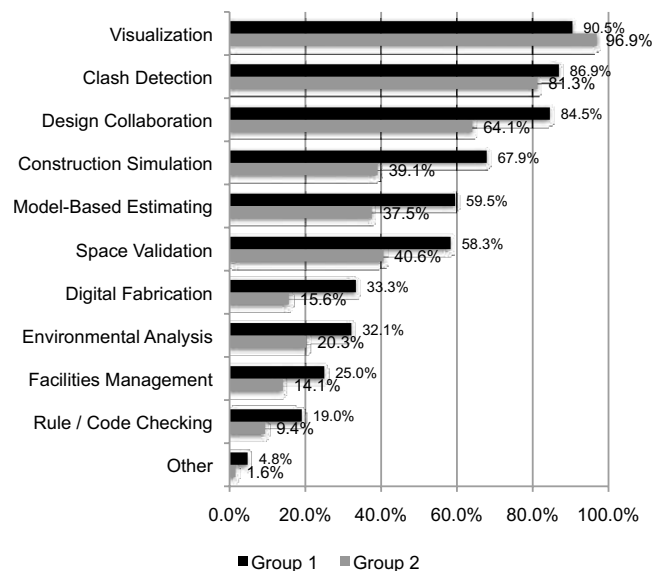


Fig. 11. BIM capabilities used on a project

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

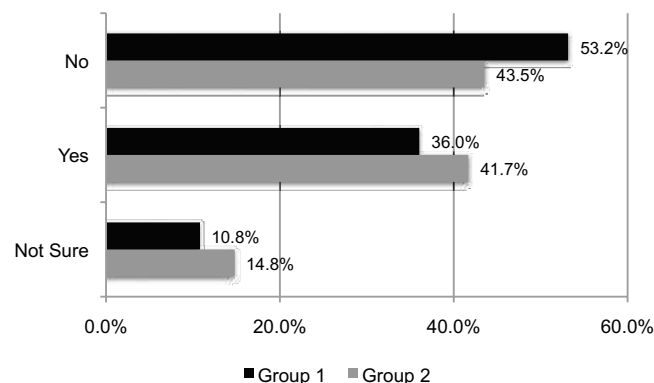


Fig. 12. If BIM is a prerequisite for IPD

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 com-

ments 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

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.

Acknowledgments

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The Dilemma of Innovation in the Construction Company: A Decade of Lessons Learned

Eugenio Pellicer, Víctor Yepes, Christian Luis Correa
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Abstract Innovation can be defined as the integration of non-trivial ideas capable of generating positive changes that increase a company's competitiveness. For construction companies, innovation is not an easy task, since their production is based on single projects built in different locations. This article summarizes the exploratory research conducted by the authors over the last decade, focused on the implementation, development and monitoring of a standardized innovation management system in a mid-size Spanish construction company. Collected evidence, also contrasted with other companies as well as with the sector as a whole, provide lessons learned, not only for the analyzed company, but also for construction companies in general. Innovation, in this kind of businesses, may not be a spontaneous act that appears on solving a specific problem, becoming a managerial process that can be systematized and homogenized. It allows faster identification of the involved tasks in creating new processes, products and services for companies and, therefore, their market competitiveness is improved.

Keywords Construction company • Innovation • Management • Standardization • Systematization

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1 Introduction

Innovation is an open concept that can have different meanings. Many authors historically have contributed their own definition of innovation, depending essentially on the context or scope in which they undertake their activity. Nevertheless, to avoid confusion, in this study, innovation is defined as the application of new ideas for the organization, regardless of whether these ideas are focused on products, processes, services or organizational, administrative or commercial systems, capable of generating positive changes that increase a company's competitiveness (definition adapted from Gibbons et al. 1994). Innovation management, on the other hand, can be considered as the creation of suitable conditions in an organization to make technological, organizational or commercial changes in an environment of uncertainty (Tidd et al. 1997). Having defined these two basic concepts, the problem detected must now be posited, serving as a starting point for the research reflected in this article.

The innovative capacity of a country depends on several key factors including, in particular, public policies that facilitate the advancement of innovation, the existence of regulations and laws that guarantee intellectual property, and a continuous collaboration between research centers and companies and institutions (Gann 1997; Mitropoulos and Tatum 2000; Seaden and Manseau 2001). Consequently, applying the commitments made in 2000 by the European Union in Lisbon, the Spanish government implemented various initiatives in the first decade of the new millennium, which in chronological order are the following:

- Law 4/2004 of Modification of Tax Rates and Benefits (Government of Spain 2004), which invites companies that invest in innovation activities to take advantage of tax incentives.
- The Ingenio Program (www.ingenio2010.es) launched in 2005, which seeks to reduce the innovation gap with the other Western economies through investment in public and private innovation.
- Set of standards UNE 166000, published in 2006 by AENOR, the aim of which is to systematize innovation management (AENOR 2006a, b, c).
- Inclusion of incentives in tendering for government contracts (up to 25% of the final score) for companies who show the implementation of innovative activities, preferably based on the set of standards UNE 166000 (Pellicer et al. 2008).

It is for this reason that, as the situation stood in 2006, many construction companies discussed whether innovation could be managed like any another additional company system (similar to quality, the environment or safety), so that it could be systematized and evaluated externally by a certifying agency according to the set of standards UNE 166000, for example (Pellicer et al. 2008). This is the point of departure of the research synthesized in this article, which yields the following main research question: Can innovation be systematized in a construction company? From this main question two more specific research questions arise:

Is the systematization of innovation beneficial for a company? What barriers exist to systematizing innovation?

This article summarizes the research conducted by the authors over the last nine years (2006–2014) focused on the implementation, development, evolution and follow-up of a standardized innovation management system in a mid-size Spanish construction company. The findings, also contrasted with other similar companies as well as the sector, provide lessons learned, not just for the company analyzed, but also for construction companies in general.

The article is organized as follows: First, the authors' research method is described. Next, the innovation management processes, implemented in the pilot company according to UNE 166002 standard, are explained. The following section justifies the in-company innovation management model developed by the authors. Then, the main results of the in-company implementation are presented. In the following section the most significant lessons learned are summarized. Finally, the conclusions, limitations and ongoing work are presented.

2 Research Method

As previously mentioned, in 2006, large and mid-size Spanish construction companies understood the systematization of innovation (according to the set of standards UNE 166000) as an opportunity to increase their company's competitiveness (Correa et al. 2007; Pellicer et al. 2008). At that time only one Spanish construction company was certified by the UNE 166002 standard (Pellicer et al. 2008, 2012). This is why the authors launched an exploratory investigation using analytical induction in the form of a single case study (Pellicer et al. 2010, 2012), based on the following research question: Can innovation be systematized in a construction company?

To select the company to study, the construction sector was researched in terms of its structure, considering two variables that define the size, revenues and employees (European Commission 2004), as well as the number of branch offices. Sixty five mid-size construction companies belonging to the associations FECOVAL, ANCI and SEOPAN were examined (Pellicer et al. 2012). Three companies very close to the average were identified, and were invited to participate; one accepted and became the focus of the case study. This construction company has been active in building and civil engineering projects since the 1960s, with revenues of approximately 400 million euros in 2006 (Pellicer et al. 2010, 2012).

The unit of analysis was the construction company as a whole: the headquarters, branch offices and construction sites. An in-depth analysis was carried out for three years that made it possible to implement the different processes required by the UNE 166002 standard and to verify their fulfillment and evolution. During that time all the branch offices were visited at least once, as were the ongoing construction

projects (more than a hundred), essentially those where potential innovative ideas arose. During the first year the company was analyzed in-depth (Pellicer et al. 2010), as well as the implementation of the innovation system according to the UNE 166002 standard (Yepes et al. 2016). In the two following years the success factors, benefits of and barriers to innovation were identified (Pellicer et al. 2012). In the first quarter of the fourth year, the results (success factors, benefits and barriers) were contrasted with other companies that had also implemented their innovation management system according to UNE 166002 (Pellicer et al. 2014). From 2009, a follow-up was done of the evolution of the innovation management system as well as of the company itself (Pellicer et al. 2012; Yepes et al. 2016).

The case study conformed to the guidelines proposed by Yin (2003), including the following six steps (Pellicer et al. 2012): (a) literature review; (b) theoretical model design; (c) data collection; (d) data analysis; (e) results of the study; and (f) generalization of results. With the first five steps, a comparison was made between theory and reality using multiple sources of evidence and logically linking the facts in order to explain this scenario. To fulfill this objective, the following sources of information were used (Pellicer et al. 2012, 2014): (1) participant observation for short periods of time (normally days); (2) monthly meetings with company management; (3) analysis of documents issued by the company or related to it (including websites); (4) external survey applied to 148 Spanish construction companies regarding their perception of innovation in construction; (5) annual survey (in the first three years) of the company management; (6) survey administered to company employees (in the second year of the study); (7) survey of suppliers and subcontractors (also during the second year); and (8) workshops for management and clients held annual or biannually from the third year on.

To ensure the quality of the research using a single case study, the indications of Yin (2003) were followed: (a) use of multiple data sources (as mentioned previously) to triangulate the facts; (b) generation of chains of evidence; (c) contrast of the theory with the observed reality (or pattern matching); and (d) explanation of the phenomenon in a logical manner (or explanation building). The first two aspects ensured the construct validity of the case study, whereas the last two guaranteed the internal validity of the research (Pellicer et al. 2012).

The external validity was accomplished using semi-structured interviews with the management of seven Spanish construction companies (of the eight possible ones) that had an innovation management system certified by UNE 166002 at the beginning of 2009 (Pellicer et al. 2014). The heads of each one of the company's innovation department were interviewed, all of whom had more than 15 years of experience in the sector. Additionally, eight managers from the company under study were interviewed as well as nine experts from the construction sector not linked to contractors.

3 Innovation Management Processes Based on UNE 166002

UNE 166002:2006 “R&D&i management: requirements for R&D&i management systems” defines the innovation management system (AENOR 2006c). This system comprises the company’s global management system that includes the organizational structure, planning, responsibilities, processes, procedures, records and resources. UNE 166002 defines the manner of developing, implementing, executing, reviewing and maintaining the company’s innovation policy (AENOR 2006c). The innovation system is divided into five basic processes (Yepes et al. 2016): (a) technological watch (according to UNE 166006); (b) creativity; (c) planning and development of innovation projects (according to UNE 166001); (d) technology transfer; and (e) protection of results.

Next, the five basic processes that include the innovation management system implemented in the pilot company are described (Yepes et al. 2016):

- Technological watch is a constant and organized effort to observe, obtain, analyze, disseminate and recover accurate information pertinent to the business context. It endeavors to detect opportunities and threats, as well as to anticipate changes that minimize decision making. The process of technological monitoring is regulated by UNE 166006:2011 “R&D&i management: technological watch and competitive intelligence system” (AENOR 2011).
- Creativity is the generation of ideas on the part of the employees that can stem from the analysis of the weaknesses, threats, strengths and opportunities of innovation, or from issues that arise in the construction works. The ideas are stored in a database. These ideas are valued according to their technical and economic feasibility and their affinity with the strategic lines previously established by the company.
- The planning and development of the innovation project not only considers its detailed design, but also its implementation in the construction project. On many occasions, both aspects can be almost parallel when the cause is to solve a problem that has arisen on the site. Normally, the person in charge of the project is the construction site manager. A detailed report including the project planning is needed prior to implementation; then follow-up reports are necessary, finalizing the process with the preparation and delivery of a closing report. The process is regulated by UNE 166001:2006; “Management of R+D+i: Requirements of a R+D+i project” (AENOR 2006b); each project can be certified externally by an agency recognized by the Government of Spain (Pellicer et al. 2008).
- Technology transfer is the process of acquisition, transfer, exchange, granting of licenses and permissions, and positioning in the market. It is oriented toward securing a competitive advantage in the market from the outcomes of the innovation activities. It can end up with signing a contract. In any case, it is advisable to evaluate the technology transfer.

- The company also seeks to protect sensitive information through confidentiality clauses when new employees are hired or cooperation agreements are signed with other organizations. As in the previous case, it is also advisable to evaluate the protection of results.

This set of processes involves feedback from the system. It is therefore important to have indicators, as well as results of the previous implementations, even if they are partial results or recommendations by those in charge of the innovation projects or construction site managers (Yepes et al. 2016). These results can be stored in a database to which all members of the organization have access. They can include usual sources of information, technological monitoring records, ideas, certified projects, partners, etc.

4 Innovation Model in Construction Companies

The proposed innovation management model is based on the open systems theory (Bertalanffy 1968), which comprises a set of interrelated elements to achieve specific objectives. It begins with the proposal by Seaden and Manseau (2001) focused on the company as a knowledge system, interlinked with suppliers, clients, resources, and even competitors. The innovation management model developed (Pellicer et al. 2012, 2014) considers that construction companies obtain novel ideas (input) from the company itself (normally at organizational or commercial level), as well as from construction sites. These ideas are transformed into innovation projects (output). All this is developed in the construction industry where the company is active (environment). To design a suitable innovation strategy, the company's business environment and organizational abilities are taken into consideration. These are reflected in the goals and policies that facilitate communications within the organization. Consequently, the results of the innovation projects have an impact on the company and its construction projects.

The results of the study generated 18 propositions, which are shown in Fig. 1 (Pellicer et al. 2012, 2014) and detailed in Table 1 (Pellicer et al. 2012, 2014). These propositions are organized around the following aspects of the innovation management process (Correa et al. 2007; Pellicer et al. 2012): innovation drivers, results from innovation, innovation system, business environment, and organizational capabilities. Table 1 also includes the scientific contributions that support each of the propositions in the model.

These 18 propositions were subjected to validation as explained in the research method. The results of the validation revealed a broad consensus among the three groups interviewed, which confirmed 15 of the 18 formulated propositions beyond doubt. Three of the propositions were only weakly supported: P4, P15 and P16. The proposition with the least support states that when adopting an innovation management system in a construction company, innovation can be achieved using a

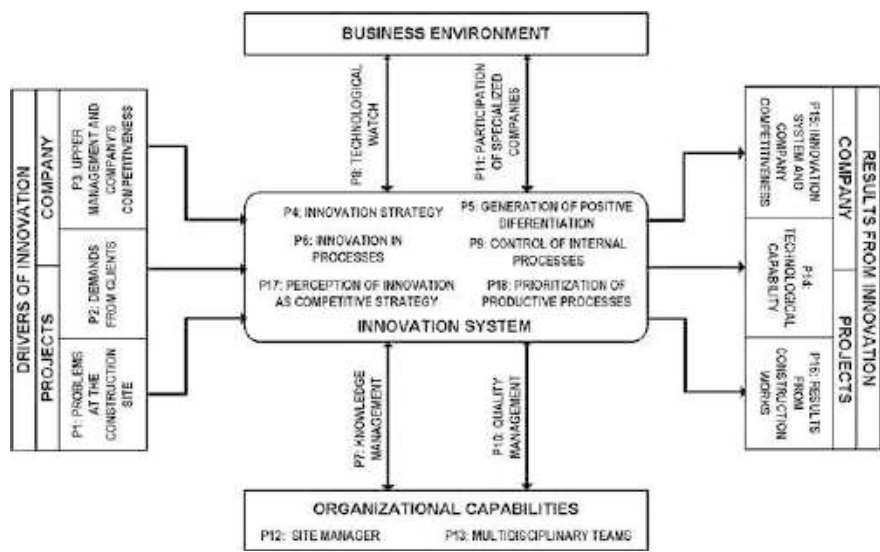


Fig. 1 Innovation management model and its propositions (Pellicer et al. 2012, 2014), with permission from ASEM and ASCE respectively

previously defined strategy. It is possible that, when innovation management is not sufficiently mature, informal strategies do not allow perceiving the advantages of innovation.

5 Results of the Implementation

Once the main phase of the research had been carried out (2006–2009), which included the implementation of the processes and formulation of the propositions that define the innovation management model, a follow-up was done of the company’s performance. Table 2 shows the company’s evolution during the nine years of observation (from 2006 to 2014, although in this last year only partially). The data include revenues, profits before taxes, employees with university degrees and employees working in the innovation department, and innovation projects that have been certified by an external agency. The company implemented the innovation management system in 2007 and it was certified by AENOR (external agency) in 2008 (Pellicer et al. 2012). The data in Table 2 must be interpreted in the context of the crisis in the Spanish construction sector starting in 2008 (Torres-Machí et al. 2013; Oviedo-Haito et al. 2014). To facilitate comparison with the sector in general, the production indexes in building and civil engineering in Spain for that period are also included (SEOPAN 2014).

Table 1 Propositions and main references that support them (Pellicer et al. 2012, 2014)

Code	Proposition	References
P1	Innovation comes from technical problems that arise in project execution at the construction site	Slaughter (1993), Nam and Tatum (1997), Winch (1998)
P2	Construction companies innovate to meet client requirements	Nam and Tatum (1997), Mitropoulos and Tatum (2000), Blayse and Manley (2004)
P3	Senior management propels innovation projects to improve the competitiveness of the company	Tatum (1987), Winch (1998), Slaughter (2000)
P4	By adopting an innovation management system, innovation follows a previously defined strategy	Gann and Salter (2000), Seaden et al. (2003), Stewart and Fenn (2006)
P5	By implementing an innovation management system, the company responds to the need to generate positive differentiation that is valued by clients	Slaughter (2000), Sexton and Barrett (2003), Van den Ven and Poole (2005)
P6	Construction companies generally innovate in processes	Gann and Salter (2000), Sexton and Barrett (2003)
P7	The implementation of an innovation management system improves knowledge management	Winch (1998), Parikh (2001), Hardie et al. (2005)
P8	Construction companies that adopt an innovation management system understand their environment better	Tatum (1987), Pries and Janszen (1995), Seaden et al. (2003)
P9	The control of internal processes (mainly production and management) constitutes a basic source for generating innovative ideas	Dulaimi (1995), Stewart and Fenn (2006), Kornish and Ulrich (2011)
P10	The existence of a quality system certified by the ISO 9001 standard facilitates the implementation of an innovation management system	Prajodo and Sohal (2006), Santos-Vijande and Alvarez-Gonzalez (2007), Casadesus et al. (2011)
P11	The existence of an innovation management system stimulates subcontracting to specialized companies and adds value to the innovation process	Blayse and Manley (2004), Wagner (2006)
P12	The active involvement of the site manager in the innovation process has a significant impact on the results of innovation	Park et al. (2004), Dulaimi et al. (2005)
P13	Innovation in construction requires the participation of multidisciplinary teams	Gann and Salter (2000), Bossink (2004)
P14	The adoption of an innovation management system improves the company's technological capabilities	Tatum (1987), Nam and Tatum (1992), Slaughter (2000)
P15	The adoption of an innovation management system improves the company's competitiveness	Tatum (1987), Nam and Tatum (1992), Mitropoulos and Tatum (2000)
P16	The certification of an innovation project improves the results of construction projects	Marimon and Cristobal (2005), Veal et al. (2010)
P17	Innovation in construction is delayed when senior management does not perceive it as a competitive strategy	Nam and Tatum (1997), Slaughter (2000), Blayse and Manley (2004)
P18	The prioritization of production processes hinders the identification of innovation opportunities	Tatum (1986), Pries and Janszen (1995), Gann and Salter (2000)

Table 2 Evolution of the company and the Spanish construction industry for the period 2006–2014 (Yepes et al. 2016)

Indicators (data from 12/31/2014)	2006	2007	2008	2009	2010	2011	2012	2013	2014
Revenues (in millions of Euros)	451.3	488.1	567.6	591.2	475.6	396.8	279.9	238.6	NA
Profit before taxes (in millions of Euros)	6.7	8.2	15.4	17.9	12.2	3.1	−7.8	0.5	NA
Employees with university degree	37	42	53	56	48	45	40	38	39
Employees working at the innov. dept.	1	3	4	4	4	4	4	3	4
Annual innovation projects certified	0	1	1	6	11	9	8	5	11
Production index for building	183	174	146	121	100	81	78	80	NA
Production index for civil engineering	150	147	123	145	100	79	67	63	NA

Analyzing the data in Table 2, it is observed that company profits tripled from 2006 to 2009, while the revenues increased only a third and the construction sector remained stable, at least in civil engineering. In that period, there was a spectacular increase in certified projects, as well as in qualified personnel and technicians working in the innovation department. These results show the benefits of implementing an innovation management system in a mid-size company, at least from the point of view of the innovation projects; obviously, this does not necessarily mean that there is a direct relation between profits and innovation, this being a question for future research.

For 2010–2014, company revenues and profits decreased, just as it did in the Spanish construction industry as a whole. However, the innovation department stayed stable for three years (2010–2012) despite the crisis, maintaining the same personnel and with an acceptable production in innovation projects.

Additionally, the company's innovation department garnered great prestige among company employees, given that even in times of crisis it worked at a good pace. For example, some innovation projects increased productivity, such as optimization of manufacturing, transportation and application of asphalt mixtures, or the improvement in the process of shoring and removal of formwork in underground parking lots. Other projects improved the flow of information: between the offices and construction sites using mobile devices, with suppliers and subcontractors through a computerized system, or with workers on site using an intelligent planning and control procedure. For these reasons, the directors and managers of the company sensed that, over time, clients, suppliers and subcontractors came to see the company as an innovator. For company management, implementation of the innovation management system was a success.

6 Lessons Learned

The systematization of innovation helps to assimilate new ideas and, therefore, to disseminate new knowledge in the company. Initially, the main sources of creativity in the construction company were solving problems at construction sites and meeting client demands, always with the support of company management. Once the system was implemented, however, the following processes were followed: technology watch, creativity, project planning and development, technology transfer and protection of results. In any case, problem solving continues to be the main innovation source, fulfilling several objectives: (1) those inherent to each construction site; (2) improvement of the productive processes that can be replicated on future projects; and (3) increased scoring (in the innovation section) for upcoming public tenders.

During the nine years of this investigation, the lessons learned regarding the implementation, development and evolution of the systematic management of innovation in construction companies have been many, especially the following:

- The establishment of an innovation management system modifies the company's organizational structure, even if this is only by the creation of a specific innovation department.
- The previous existence of a quality management system facilitates and benefits the implementation of an innovation management system.
- The construction company mainly innovates through processes and their related products.
- Innovation opportunities are identified as a result of the evaluation of the company's internal processes, as well as construction projects and the environment.
- The identification, development and transfer of innovative solutions require the integration of several disciplines: (1) observation of the environment, including technological watch, to identify opportunities to innovate, feasible solutions and technology partners who add value to the innovation process; (2) knowledge management in the organization so that findings are transferred to other projects, either innovation or production projects; and (3) the ability to discern the specific demands of clients.
- Collaboration with technology partners and the management of multidisciplinary equipment are necessary conditions to generate innovation in construction companies.
- The main benefit of innovation management is an increase in technical capacity.
- The two main barriers to innovation are the prioritization of production over everything else and the underestimation of innovation as a competitive strategy on the part of the company's senior management.
- Standardizing innovation different benefits are obtained for the company: improvement of the organization, increased technical capacities, profit, and client satisfaction.

- The implementation of an innovation management system is an opportunity to implement a knowledge management system in the company (Pellicer et al. 2008; Yepes et al. 2016).

7 Conclusions

This article presents the implementation, development and evolution of an innovation management system in construction companies. It is based on the case study of a mid-size construction company, the results of which were contrasted through interviews with other companies also certified by the UNE 166002 standard. Moreover, the study also includes an analysis of the evolution of the company once the system has been implemented.

Most companies generate innovative products and processes; however, the main difficulty lies in carrying out continuous and methodical innovation, far from occasional efforts and happy ideas. Innovation must be planned, organized, directed and controlled, like any other business activity.

Innovation in companies in the construction sector may cease to be a spontaneous act that only arises when solving a specific problem, and become a systematized and homogenized management process. The standardization of innovation, therefore, makes it possible to accelerate the identification of the activities involved in the creation of new processes, products and services in companies in the industry, and thus to improve their competitiveness in the market. The systematization of innovation not only facilitates the incorporation of new ideas, but also increases the capacity to acquire, develop and use new knowledge.

The main limitation of the present investigation is the generalization of the results obtained. This model cannot yet be generalized, despite contrasting the results of the implementation using semi-structured interviews with managers responsible for innovation in other certified companies. To this end, a validation could be carried out, for example, by means of a survey administered to a sufficient number of companies with an adequate degree of maturity in the systematic management of innovation. The implementation in other countries is another line of enquiry initiated by the authors; they aim to conduct case studies in countries like Chile, Portugal or Mexico.

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Integrated Project Delivery An Example Of Relational Contracting

Owen Matthews¹ and Gregory A. Howell²

Abstract

Maximizing value and minimizing waste at the project level is difficult when the contractual structure inhibits coordination, stifles cooperation and innovation, and rewards individual contractors for both reserving good ideas, and optimizing their performance at the expense of others. This paper describes an innovative contractual structure that aligns the interests of all contractors with the objectives of the lean delivery system. The approach, requirements for implementation, and results obtained will be described and a brief reflection on theory offered.

Key Words

Contract, Lean Delivery, Project Organization, Primary Team Member, Pact, Relational Contracting, formula, Integrated Project Delivery™

Introduction

Westbrook is a 55-year-old mechanical contractor located in Orlando Florida. Chilled water systems have been the heart of Westbrook's construction business over the years. Westbrook also offers air-conditioning, plumbing and electrical services to residential and commercial Clients.

Westbrook has participated in a number of design build projects, sometimes as a subcontractor and sometimes as a prime contractor. They could not help but notice that when they worked as a subcontractor, promises of cooperation and teamwork never seemed to reach their potential, and the results often fell short of the team member's expectations. This happened even when they worked with high-caliber and well-intentioned General Contractors (GCs) and for clients who had bought into, and expected to receive the benefits of a design/build cooperative effort. Even as the prime contractor they were unable to sustain a spirit of teamwork through the end of the project. The instinct among all parties for self interest was too keen especially in instances where individual profit potential might have eroded somewhat throughout the project.

Maximizing value and minimizing waste at the project level is difficult when the contractual structure inhibits coordination, stifles cooperation and innovation, and rewards individual contractors for both reserving good ideas, and optimizing their performance at the expense of others. What was wrong? What was standing in the way of their being able to work as a true team; one able to work together to maximize value while minimizing waste throughout the process?

In pursuit of answers to these questions, they have been working over the past five years with a consortium of design professionals and construction practitioners to determine if there might not be a better way to organize themselves to deliver a project than the models that are common today. For four years now they have been

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meeting for breakfast twice a month to further this pursuit and in the process have built relationships that form the basis for Relational Contracting.

Four major systemic problems with the traditional contractual approach

Problem 1: Good ideas are held back

The Mechanical, Electrical and Plumbing (MEP) contractors and other major trades were generally brought into the process by the GC once the drawings were at the Design Development (DD) stage in order to establish a competitive price. Even though the trades were frequently consulted through the design process, there was no real commitment to or from them because a number of different companies representing the same trades were involved. As a result, each of the trade contractors saved their best ideas in hopes of gaining a competitive edge during the “bidding process.” Many times these ideas were very good. Time and the opportunity for innovation among the trades were lost as the design team attempted to revamp their designs to accommodate the best of these late arriving ideas.

Problem 2: Contracting limits cooperation and innovation

A systemic, but less obvious problem was the system of subcontracts that link the trades and form the framework for the relationships on the project. The prime contractor held the contract for every consultant and subcontractor. Long and tedious subcontract agreements attempted to spell out in great detail exactly what each subcontractor was to provide (and by deduction exactly what he was not to provide), rules for compensation, and sometimes useful, if unrealistic, information about when work was to be performed.

The 20 to 30 page subcontracts mostly dealt with remedies and penalties for noncompliance. These contracts made it difficult to innovate across trade boundaries even though the work itself was frequently interdependent. (*It is hard to have a wholesome relationship with another when you have a charge of dynamite around your neck and the other holds the detonator.*) Of course, horse trading always takes place anyway, but for “equal” horses. Trading a small increase in effort by one contractor for a big reduction for another, a horse for a pony was almost impossible.

Problem 3: Inability to coordinate

While some projects held “partnering” sessions, there was no formal effort to link the planning systems of the various subcontractors, or to form any mutual commitments or expectations amongst them. Project organizations looked like 20 or more rubber balls, representing subcontractors, all tethered to a single point by long elastic bands. When the connection point jiggled, the balls jiggled in all random directions colliding with each other in unusual and unexpected ways.

Problem 4: The Pressure for local optimization

Each subcontractor fights to optimize his performance because no one else will take care of him. The subcontract agreement and the inability to coordinate drive subcontractors to defend their turf at the expense of both the client and other subcontractors. Remember that everyone on the project other than the prime contractor is a subcontractor. These subcontractors frequently, in their life outside of the subcontract, may be generous, caring and professional. However, since right or wrong is defined by the subcontract, they, more often than not, take on a very legalistic and litigious stance becoming an army where the rules of engagement are “Every man for himself.”

Approaching the solution

Could they organize themselves to function as a single company with unified goals and objectives? Could independent design firms and construction companies actually find a way to integrate project delivery?" To use the earlier analogy, was there a way to take all of these rubber balls and connect each to the other so that they could all move in the same direction. A new set of questions suggested the new approach:

What if every member of the design build team shared completely the responsibility for the entire project and set about correcting deficiencies or problems wherever they popped up without regard to who caused the problem or who is going to pay for it? What if all of the construction members were friends looking out for the interest of the Client and each other, applauding the successes of each other and sharing the pain of each others failures? What if all of the design and construction entities on a project could be organized in such a way that they all functioned as if they truly were a single company with a single goal and with no competition amongst themselves for profit or recognition?

They were not naïve. They knew that aligning interests, objectives and practices, even in a single business, is not easy or automatic; however, the advantages looked real, and they had powerful ties and long standing relationships with the companies that could make it happen. A new process which they called Integrated Project Delivery³ (IPD) was taking shape. Primary Team Members would include the Architect, key technical consultants as well as a general contractor and key subcontractors.

There are two types of contracts, transactional and relational.

- transactional where exchanges are made for goods and services,
- relational contracts where the relationship "takes on the properties of 'a mini-society with a vast array of norms beyond those centered on the exchange and its immediate processes.

Without benefit of these definitions in the beginning, the Team was never the less creating a network of commitment built around relational contracts.

Two Principles Govern Their Team Relationship

With the IPD process, two principles define the relationships between the Team Member that holds the prime contract with the client and between that Team Member and the other Primary Team Members (PTM).

- With IPD, all PTMs are responsible for all provisions of the prime contract with the Client.
- Primary Team Members share the risk and profit for total project performance.

The Prime Contract

A single contract binds the IPD Team to the client. The prime contract may be any one of a number of standard forms that are available. It spells out the commercial terms and defines the scope, schedule and cost of the project. One entity signs the prime contract.

³ Integrated Project Delivery (IPD) is a registered business mark with the US PTO

The Team Member Agreement

Each Primary Team Member (PTM), including the one who holds the prime contract, then enters into a single “pact” with the other PTMs. They each jointly and severally bind themselves to each other and to the fulfillment of all of the terms, conditions and requirements of the prime contract. Further, PTMs agree in this “pact” to share the cost on the project and to distribute profit based upon a formula that rewards the PTMs in accordance with their participation on the project. The entity that signed the Prime Contract is simply a PTM and receives profit based on the same formula and in the same manner as the other PTMs.

Key Pact provisions:

- The PTMs each agree to be bound together accepting full responsibility for all of the terms and conditions of the prime contract, sharing together in the cost and profit in accordance with a pre-established formula. Each member is reimbursed for all verifiable direct costs that he incurs. Profit is calculated at the project level at the end of the project and divided based on the formula.
- Each of the PTMs provides a certificate of insurance in the form and amounts as indicated in the prime contract.
- Each PTM agrees to open their books pertaining to this project to the other PTMs and to the Client.

Team members are united together under the prime contract. The Team has one price, and that is the price to the Client. The Team has one scope, and that is the project scope as defined in the prime contract. There is no accounting among PTMs for who is over or who is under budget. *Holding everyone solely accountable for their own scope and price would drive the project back down the road to local optimization and inhibit innovation. IPD was formed to avoid these problems.*

Through their association with the Lean Construction Institute, they have learned that their intuitive and practical approach rests on a principle of production system design; *local optimization leads to sub-optimal project performance*. Prior to forming IPD, they were working in a system that guaranteed that each participant would vigorously work to optimize his own part of the project without regard to the effect on the other parties or the over all project. Typical subcontracts confer upon the subcontractors an autonomy that always works to the detriment of the project. Instead of becoming a team working in harmony toward a common goal, they often became separate warring factions. The structure of IPD also supports innovation and improvement within each craft and between them. As a result, they may shift work and cost across traditional boundaries to reduce total expenditures and to improve total project performance.

To support this IPD process each PTM agrees to immediately disclose any condition (internal or external) that might threaten their ability to fully perform on the project. The pact automatically expires with the final fulfillment of the terms and conditions of the prime contract and the final distribution of profits to the pact members after fulfillment of all warranty obligations.

“One for all and all for the project” sounds great but there is an unavoidable implication: If one PTM makes a mistake, each PTM will pay for it. Some find this hard to accept. Cost reductions anywhere are shared among those in the Pact and with the Client. An overrun on the project will reduce the gross profit available for distribution. Under this pact, they came to think of themselves as mountain climbers roped together. If one falters the others pick up the slack; they don’t cut him loose. They are not involved in a search for the guilty. They are involved in applying all of their talents to getting the job done. They recognize that everyone makes mistakes and are willing to

jointly absorb the cost for those honest mistakes. They are comfortable in this because they have chosen team members with integrity, character and competency; Team Members who are trustworthy.

The Impact of IPD on Project Delivery

On the design process

There is no incentive for team members to hold back ideas. This effect is very powerful in reducing project costs and enhancing the “value engineering” process. Value engineering takes place at the beginning of the project and throughout the project. It is “built in” as it should be and not “tacked on” at the last minute as a cost saving or profit enhancement tactic. It is amazing how quickly effective solutions can be devised when there is no concern over which entity will pay for them. This creativity always benefits the client, however, when the GMP is set too late in the process the IPD Team Members are limited in their participation in the savings brought about through this creativity.

Cooperation, Innovation and Coordination

All of the primary team members wear the same hardhats on the job with the same logo. They all work under one general superintendent who has total authority from the Primary Team Members to direct the project to achieve the most efficient and lowest overall cost delivery. Field problems are quickly resolved based on the lowest perceived overall cost and least impact principle.

The Team decides what positions such as Project Executive, Director of Design Services, Director of Construction Services, Project Manager, Project Superintendent, Project Accountant, Manager of Information Technology, and Systems Manager need to be filled for the particular project at hand. These positions are filled with the best available person from any of the Primary Team Members. They become direct job cost and the company from which they came is reimbursed for the time they spend on the project.

Each person assigned a project leadership position works for the Team, is paid by the Team, and is responsible to the Team. In this way, their allegiance is to the Team and the project and not to their own sponsoring company. All have the traditional authority and responsibilities of the positions that they are filling.

The principals of the companies developing the IPD process meet two mornings a month for breakfast and fellowship. They discuss the IPD concept in order to refine and further develop it. Attendance at these meetings, and the involvement and “buy in” of the top stakeholders is crucial to success of the process. These meetings underpin the broader network of relationships that hold the projects together.

Each month the PTMs are reimbursed based upon their actual verifiable direct job cost. At the end of the project, gross profits are distributed to each PTM in accordance with their incurred direct cost on the project. A mutually agreed upon formula is used for determining the actual amount of gross to be distributed to each team member. The formula is weighted more highly toward direct labor than subcontracts and more highly toward material purchases than major equipment purchases. The intent is to recognize the varying overhead associated with each type of job cost.

Governing the relationship

The best governance is self-governance. With IPD self-governance among PTMs is facilitated and encouraged by the structure of the IPD process. From the Client’s viewpoint the IPD central accounting and monthly review of each of the PTMs billing

packages is a form of governance. Since the collective interest of the PTMs is aligned with that of the Client, he can have confidence in this review process. The open book, and shared savings features are both means of governance. Governance of the project execution is vested in the people who perform the traditional roles of Project Executive, Project Manager, Superintendent, Director of Design Services, etc. These people have traditional responsibilities and authority on the project. Dispute resolution would be handled by discussion and agreement between the PTMs. They have found that most project disputes typically are rooted in the financial interests of the disputing parties. Since they have a common financial interest, disputes of the typical type do not seem to be a problem. In any case through the first four projects, there have been no disputes.

Examples of success

They have completed four successful IPD projects and have been awarded a five-year continuing services contract for design build work for Orlando Utilities Commission, an enthusiastic Client from a prior IPD project. Rather than describe the projects that have been completed, it may be more helpful to offer some examples of the IPD process in action. Some of these examples may seem trivial in size but they are offered as best illustrating the effects IPD. A “Case Study” is also included for the OUC North Chiller Plant which is the most current IPD project.

The Last Planner™: An extensive dormitory renovation had to be done over the summer. The Team knew that an exhaustive approach to planning and organizing the work would be required because the renovation of an old building can be very complex, a large number of trades would be involved, and the completion time was short. They committed to an aggressive use of the Last Planner™. Their integrated approach to the project enabled us to optimize implementation of the Last Planner™ system. Instead of a GC having to herd a group of independent contractors and design professionals, each with their own agendas, toward a project completion date, they were able to develop a coherent approach and work as a unit. No one wanted to let the Team or themselves down. They each shared the full responsibility for the total project and this meant keeping on schedule. Occasionally, despite their best efforts, work fell behind. In other situations it cost more than expected to hold to the schedule. These situations did not present an insurmountable obstacle as they were sharing all cost and the burden of overtime, etc. The cost of keeping up did not fall on the party working to catch up, but was shared by the total Team through their shared cost arrangement. The project finished two weeks ahead of schedule while other similar projects on campus ran over their schedules.

Shared Manpower: Their electrical team member made use of workers from other trades as needed to assist in pulling wire and other chores. This availability of ready casual labor enabled him to complete the job with fewer workers assigned to the project than otherwise would have been required. This type of impromptu sharing of manpower occurred throughout the project and between all trades.

Problem Resolution: In the course of construction, a large conduit bank masked a portion of a new roof hatch. The IPD superintendent agreed with the Client’s representative to install a second hatch in another section of the plant. This solution gave the Client a full hatch and a second hatch with somewhat restricted access. There was no need to price anything or to get any kind of approval. All trades simply did what was necessary to quickly and efficiently make this change.

Handling Major Changes to the Work: The intention was to match new cooling towers to existing towers. After the towers were released the manufacturer notified them the model had been changed to one that was taller and had a different footprint. The

Client opted to go with a different manufacturer. The IPD Team was able to stop the order for the original towers without penalty, select the new towers that were suitable, redesign the support steel and modify the piping and electrical to accommodate the new towers. Because of the flexibility of the IPD process and integrated design team, they were able to make this change without requiring an increase to the GMP or any extension of the project schedule. They believe that the magnitude and timing of this major change would have scuttled the schedule and budget of a traditionally run project.

Work Across Traditional Boundaries: Their electrical Team Member received a favorable quote for variable frequency drives as a part of the equipment package. These drives were originally intended to be provided in the mechanical package. They simply agreed on the spot for the electrical to buy the drives as a part of his package as that made the best sense for the project. The project cost was reduced and the increased profit shared by all including the Owner.

Recovering From Oversights: When they discovered a missing elevation for an exterior light, the superintendent called the architect and explained the problem. Within 30 minutes a sketch was faxed showing the mounting elevation. No RFI was required and there was no impact on the project because of this omission. It was their integrated approach that made it possible for the field superintendent to call the project architect direct and effect this fast resolution.

Avoiding Redundant Effort and Expense: Multiple trades required core drilling, fire protection, electrical and pipe chases, and clean up. The trade that had the most in each category, or for whom the work was most convenient, provided this service for all trades. There was no need to record or charge back any cost. This resulted in efficiency and lowered overall project cost.

Enhancements to Job Site Safety: The IPD Team determined to run accident free projects. The superintendent has the authority to direct the activities of all workers on the projects. This ensures uniform compliance with safety procedures. The cost of safety compliance falls to the entire team and not just to the involved subcontractor, so there has been no resistance to following these sometimes costly safety procedures. There has not been a single accident on any of the four IPD projects completed to date. All shared the costs and the benefits of this achievement.

Spending More to Save More: Normally, the Design Engineer prepares design drawings from which the contractor prepares shop drawings for fabrication. Major changes in the layout can arise during this translation. In the case of the OUC South project, the engineer sent his designer to the mechanical contractor's office. The designer worked there with an experienced mechanical piping expert to lay out the equipment room in detail using object based 3-D. This increased engineering cost at first, but saved money downstream. The mechanical contractor did not have to produce shop drawings because the engineering drawings were sufficient for the fabrication shop. The pipe was fabricated and installed exactly as designed.

Sharing Rental Equipment: Rental equipment and other resources were shared by the Team. This resulted in optimum usage of the equipment. There was no need to track who used the equipment or for how long. The Team Members shared all cost.

OUC North Plant - A Case Study

Westbrook and the IPD Team was awarded a contract for the design and construction of a central chilled water plant in downtown Orlando that would have the utility infrastructure to support the ability to deliver 12,000 tons of chilled water to the chilled water customers of Orlando Utilities Commission in the downtown area. Initially

the plant would have an installed capacity of 3,000 tons that could be easily and quickly expanded as needed to the ultimate build out of 12,000 tons.

This contract was awarded to the Westbrook/IPD team pursuant to their having been selected as one of two design-build firms that would deliver chilled water plants such as this to OUC over a five year period.

The plant stands today as a testament to the benefits of Relational Contracting as employed by the Westbrook/IPD Team.

Schedule Performance

- Contract Date 12/30/03
- DD Complete 1/26/04
- Demolition Complete 1/7/04
- Permit Issued 4/14/04
- Work Begins on Site 5/4/04
- Plant Ready to Operate 7/28/04

This performance would not have been possible without the Team commitment and the heavy reliance on the relationships amongst the Team Members to ensure that commitments were kept. Once everyone got in the spirit of accelerating the project, it seemed that anything was possible.

Budget Performance

- GMP \$6,000,000
- Final Price \$5,400,000
- IPD savings against GMP \$600,000

The GMP was set after the DD documents were complete and reflected the Team's best value engineering which was applied from the first day. These savings of approximately 10% were realized in the construction phase of the project. No one ever dreamed such savings were possible in the actual construction phase. The IPD advantages mentioned above contributed to these savings. Beyond that, they have discussed below some of the job specific events that contributed to these extraordinary savings in both time and direct job cost.

Coordinate Design With Schedule: Many different column cross sections will satisfy a design requirement. By involving the steel erector, they were able to use the mill schedule to inform the selection of columns that would be available when needed. This type of coordination would have been next to impossible under traditional delivery systems.

Function Over Form in Design: The placement of the columns can be arbitrary to some degree. The mechanical contractor modeled the equipment room using the 3D objects for the actual equipment and suggested a column spacing that worked best even to the point of offsetting one of the columns 18" from its predicted location. From a structural viewpoint this worked as well as any other layout and it was adopted. The structural engineer verified the adequacy of the design to accommodate this change. Rarely, if ever, would a mechanical contractor be involved in the determination of the column grid and certainly no other system would afford the opportunity to offset a main column to accommodate the mechanical work.

Early Fundamental Design Decisions Support Construction Details: When the Team began to seriously consider placing all utilities under the slab the design of the column footers was the subject of a rigorous Team meeting which considered how high the tops of the pads could be and still allow utilities that had to pass over them to turn up

properly to the finished floor. Several vertical offsets were planned in the perimeter foundation wall to allow passage of utilities without sleeving or cutting that wall.



Figure 1. Column Footers ⁴



Figure 2. Step downs in the wall footer allowed for proper utilities crossing - Team decision

⁴ The top of the column footers was set 30" below top of grade to allow room for all utilities to turn up and penetrate the finished floor vertically. Setting the elevation for the top of the footers was a Team decision determined in a weekly Team design meeting.



Figure 3. Installing under-slab utilities⁵

GC Goes the Extra Mile: The general contractor backfilled and compacted to an elevation 30" below grade and the site was turned over to the Team Member responsible for the electrical construction who laid 1 mile of conduit without the need for any excavation. Seeing the entire grid laid out "above ground", as it was, afforded the opportunity for accurate layout and verification. The GC then came back in and backfilled to grade using fire hoses to wash fine aggregate in and around the conduits. This innovation saved more than three weeks off of the schedule and many thousands of dollars. Consider that the conduit was originally intended to be run overhead in galvanized pipe. This implied extensive hangers and considerably increased lengths as the pipe would have had to run parallel to column lines and would have required 20' drops at each end of each run.

⁵ An initial perceived obstacle to laying out all of the utilities exposed was how backfill could be done without crushing and moving the conduits. The Team solution was to begin backfill at one point using fine sand, washing it in with fire hoses, compacting and testing as they fanned the backfill operation over the entire building. It worked flawlessly. Here you can see the backfill process beginning at the top of the picture. An added benefit was that each run was totally visible and could be easily checked for correctness.



Figure 4. CADD drawing of hanger assembly.

Figure 4 illustrates a CADD drawing prepared by Westbrook, in which we can see each hanger assembly. The main headers are 30" and 24" pipe. Everything shown was prefabricated off site and delivered "just in time".

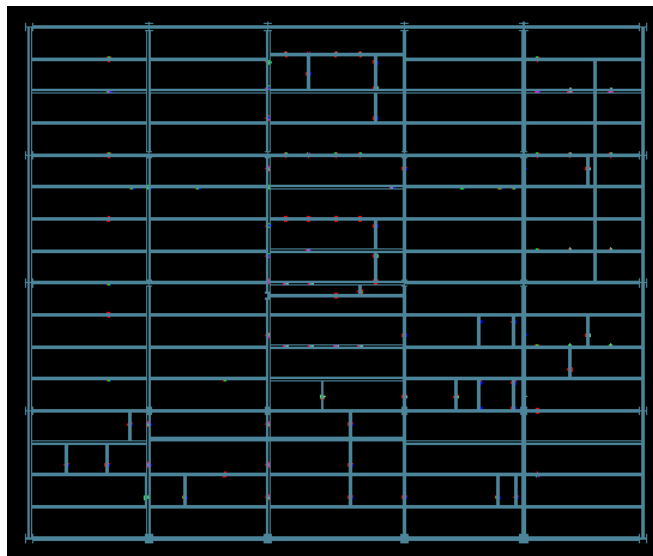


Figure 5. Column grid layout

Figure 5 shows a column grid layout as determined by the mechanical design and where the structural engineer designed to suit. Here we see that one column near the center was offset to accommodate connections to one chiller. The points represent pipe hanger locations placed by mechanical contractor/design team. Where no steel existed, the structural engineer added beams to carry the pipe hangers.



Figure 6. Structural steel beginning to take shape.

As Figure 6 shows, the steel has arrived and is being erected. Note the weldments to receive the pipe hanger assemblies. This steel with the weldments was prefabricated in another state. Note the date on the picture.



Figure 7. Hanger assemblies installed.

By the end of the next day, 5/19/04 (see Figure 7), every hanger assembly was installed and still no pipe had been delivered to the site. The hanger assemblies were prefabricated to exact lengths. No measuring or layout was required to install them. All that was required was putting assembly A on point A and installing a bolt.



Figure 8. Pipe hoisting and installation using special crane.

In Figure 8, we see pipe being hoisted into place using a crane rigged through the steel. The steel erector held off the decking to facilitate this time saving and safe operation; another example of a contractor spending a nickel to save the project a dollar. This worked because we never had to consider who was spending the nickel or who was saving the dollar. All pipe was installed, two 1,500 ton chillers set and connected in 10 calendar days. Everything fit perfectly. Finally, Figur 9 shows the final plant - a showplace of quality and efficiency of design and execution.



Figure 9. Completed plant.

PROBLEMS ENCOUNTERED

IPD has encountered and resolved a number of challenges concerning such issues as insurance, bonding, job costing, job accounting, the formula for distributing gross, the

form of the internal “pact”, project leadership, consolidated budgeting, warranty, communications, etc. These have all been, for the most part, expected issues that simply needed to be addressed and solved. Even so, over the past four years there have been other problems worth noting.

The Uncommitted Member: IPD team members were carefully selected and had significant history working together on design-build projects and design-bid-build projects. Nonetheless, they still had a team member who wasn’t suitable for the IPD process. The managing partner and majority shareholder of that member of the Team had very little personal involvement with IPD. As a result, the representative of that company experienced significant internal pressure to revert to the old self-preservation concepts. At the conclusion of the project, the member withdrew from the IPD Team through mutual consent.

Old Habits Die Hard: On an early IPD project the General Contractor assigned a skilled and respected project manager who had been working in the industry for more than 20 years. While the President and Executive Vice President of the GC partner were fully on board with IPD and attended the bi-monthly meetings, the assigned project manager just could not get his mind around the concept. He often seemed offended that he was not being asked or allowed to function in his typical role as PM. This was a man that the Team Members had enjoyed working with successfully on other more traditionally run projects, but he could not work effectively in the IPD environment.

These cases show that not everyone is suited to work in this environment. Those assigned to work on IPD projects must be carefully selected and prepared for the new rules.

Continuing Concerns - areas for development

Setting the price: With IPD, the value engineering process is so strong and effective that by the time they reach the design-development stage, everyone’s best ideas are incorporated. The budget produced at that time, therefore, reflects all of the Team’s creativity and experience. Value engineering, experienced as cost saving ideas submitted late in the design process, does not occur as the construction practitioners and design professionals work together from the start to ensure a cost efficient design. The Client receives the full benefit of this process and the likelihood of contractor initiated change orders is greatly reduced. It seems clear that this offers powerful benefits for the Client but the IPD Team is uncertain at this point how these benefits can be quantified and how they can be compensated for the true value that the IPD process adds to the project. As it stands today, IPD members benefit only from cost savings after the budget is developed. These result from the considerable field efficiencies inherent in the IPD process and the application of Lean Construction Principles.

Managing Risk: Depending on the size or complexity of the project, a joint risk assessment committee could review the project monthly focusing on such areas as the team’s performance, any indications of a team member problem, change orders and claims initiatives, payment history of the Client and any trends that may need correcting.

Working with Non IPD members, expanding the team

It is fairly easy to introduce a specialty contractor into a project as a member of the team either by bringing him in early and negotiating a price at the appropriate time or by actually inviting them to become a full member of the team for a particular project

sharing cost with the rest of the Team. Circumstances would determine which method might be employed.

They pursued a major project where their usual engineering partner was unable to participate. They agreed to invite another engineering firm to participate with them as a full Team Member for that particular project. The substitute firm readily understood the IPD process and was an eager and capable participant in the preliminary design and pricing. IPD was not the successful bidder for this design-build project, but the experience with the “plug in” Team Member was successful.

Reflection on theory (Greg Howell)

IPD developed as the participants applied common sense drawn from their experience; No particular theoretical consideration shaped the effort. Even so, reflection on organizational theory, particularly those rooted in transactional cost analysis, helps explain why the approach is so effective and may offer guidance for future development. This note proceeds by first considering two types of cost that arise in the course of doing work in an organization. This is followed by a discussion of the way managing these types of cost shape organizations and contracts. IPD is located in the resulting framework and suggestions offered.

Types of costs

The cost associated with doing work in organizations can be divided between the cost expended producing goods and services - the production cost, and transactional costs - the cost of “doing the deal”, associated with the movement of those goods and services across organizational or market boundaries (Williamson 1979). In construction, transaction costs include among others, the cost of preparing and negotiating contracts, insuring performance and settling disputes. Efforts such as partnering are aimed at reducing the transaction costs associated with disputes. Constructability and value engineering efforts are mostly aimed at reducing production costs. Examples of efforts that reduce both costs can be found in this paper under the heading “Examples of Success.” For example, IPD demonstrates how they reduced transaction costs in “Recovering from Oversights”. An example of reduced production costs is found in “Sharing Rental Equipment”. (Interested readers are advised to read closely the works of Williamson, Ouchi, Gunnarson & Levitt, and Macneil included in the references section of this paper.)

Types of contracts

Williamson and Macneil discuss two broad classes of contracts; transactional where exchanges are made for goods and services, and relational contracts where the relationship “takes on the properties of ‘a mini-society with a vast array of norms beyond those centered on the exchange and its immediate processes.’” (Williamson 1979, pg 238) Relational contracts arise as transactions become less discrete, and the transaction costs increase due to the duration, uncertainty and complexity of the matter at hand.

Transactional contracts foresee a single outcome; the value of a single future outcome is made present and both parties agree to the exchange - money for the project (Williamson 1979). The dispute record of the construction industry proves that drafting transactional contracts for the delivery of complex and uncertain construction that foresee all contingencies, allocate all risks, limit opportunistic behavior and still motivate highest global efficiency is impossible.

Macneil, cited extensively by Williamson, proposes relational contracts to manage in this situation (Macneil 1974). Relational contracts foresee many possible outcomes - for

richer, for poorer, in sickness and health, now and forever - and bind the parties to maintain their relationship even as they pursue other objectives^[3].

IPD Contract and Organization

IPD employs both transactional and relational contracts. Externally, they enter a classic transactional contract with the client and some suppliers. Internally, members are bound by a relational contract described in the “pact” they all sign. The “pact” minimizes transactional cost by binding the parties together in a partnership for the duration of the project. Records are not kept to allocate costs or determine blame. They have yet to have a dispute internally or with a client.

Production costs have been reduced by sharing resources and finding innovative ways to reduce project cost; trading ponies for horses. All this is accomplished because the contractual incentives and operating rules reward cooperation and still stimulate innovative approaches to managing work. (It could be argued that sub contractor transaction costs may be increased if they could have made more money pursuing their own short term interest or by the requirement for a larger insurance policy, but we hear no complaints from IPD participants.)

IPD is a clever solution to the tough organizational and contracting problems faced in today’s market. It relies on careful participant selection, transparency and continuing dialog. They have not set in place alternative dispute resolution methods or taken other steps to insure they can solve problems and retain their organizational structure. Perhaps they will never face such problems. In any case, it is hard to imagine a better internal contractual relationship for applying lean construction. Construction consumers might consider rethinking their contracting strategies to share more fully in the benefits.

Conclusion

IPD is a Relational Contracting approach that aligns project objectives with the interests of key participants. It creates an organization able to apply the principles and practices of the Lean Project Delivery System.

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INTEGRATED PROJECT DELIVERY: COLLABORATION THROUGH NEW CONTRACT FORMS

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I. INTRODUCTION

One of the worst-kept secrets in the construction industry is that the provision of design and construction services is egocentric and inefficient. Risk assessment is a dark art. Risk allocation is an exercise in economic Darwinism. Traditional contracts rigidly delineate responsibilities with much elaboration on the consequences of failure. These contracting approaches reinforce self-protective behavior and instill mistrust. Moreover, while many risks can be identified and evaluated such that the effort to do so is well spent, often the unknowable remains material to the success of the enterprise. Nevertheless, traditional construction contracting improperly presumes a high degree of clairvoyance when allocating risk. More often than not risk flows down the contracting tiers to those least able to bear or control the risk. Not surprisingly, classical contracts combined with traditional delivery methods often produce sub-optimal results.

The industry's problems are many and varied. There is too little investment in innovation, technology, training, and education.² This includes innovation in the form of collaborative delivery approaches fostered by more flexible and responsive contracts. These collaborative project delivery methods are often identified by the term "Integrated Project Delivery" (IPD). This rubric covers a spectrum of contracting – from the familiar (construction management infused with collaborative or team-based processes) to the arcane (alliance models with "no-dispute" clauses).³

In 2007 and 2008, two industry organizations published IPD contract forms for the domestic market. The American Institute of Architects (AIA) published two separate IPD families: the so-called transitional IPD family, built on a construction management at risk model, and the Single Purpose Entity (SPE) family, developed as the contract embodiment of the principles espoused in *Integrated Project Delivery: A Guide* (the *IPD Guide*).⁴ ConsensusDOCS was first to market with its Standard Form of Tri-Party Agreement for Collaborative Project Delivery, more commonly referred to as ConsensusDOCS 300, published in 2007.⁵ We first focus on the pre-requisites of collaborative contracting and then examine the

² See Patrick J. O'Connor, Jr., *Productivity and Innovation in the Construction Industry: The Case for Building Information Modeling*, 1 J. ACCL 135 (Winter 2007).

³ See Steve Rowlinson, et al., *Alliancing in Australia: No-Litigation Contracts; a Tautology?*, J. Prof. Issues in Engr. Ed. & Prac. (Jan. 2006); J.G.J. Koolwijk, *Alternative Dispute Resolution Methods Used in Alliance Contracts*, J. Prof. Issues in Engr. Educ. & Prac. (Jan. 2006); M. C. Jefferies, et al., *The Justification and Implementation of Project Alliances – Reflections from the Wandoo B Development*, J. Constr. Procure., 7 (2) (2001); M. Motiar Rahman and Mohan Kumaraswamy, *Contracting Relationship Trends and Transitions*, J. Manage. Eng. 147 (Oct. 2004); Allen Overcash, *Will the New Contract Forms for Integrated Project Delivery Make Conflict Obsolete? (Or Are We Still Lost in our Contract Obsession?)*, 3 J. ACCL 19, 32-33 (Winter 2009) (galley proof). See also, The Be Collaborative contract, <http://www.constructingexcellence.org.uk>.

⁴ AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 (2007), available for free download at the AIA's website: www.aia.org.

⁵ ConsensusDOCS consists of twenty-one member organizations, including the Associated General Contractors of America (AGC), the Construction Owners Association of America (COAA), the Construction Users Roundtable (CURT), Lean Construction Institute (LCI), and a large number of subcontractor organizations. See <http://www.consensusdocs.org>.

AIA and ConsensusDOCS IPD contracts with periodic detours through other integrated contracting approaches (e.g., alliancing, and the Lean Construction IPD agreement).⁶

II. CURRENT STATE OF CONSTRUCTION CONTRACTING: THE NEED FOR CHANGE

Numerous industry professionals have lamented the inefficient and adversarial nature of construction services procurement and delivery.⁷ The following assessment is gaining acceptance:

The construction industry is highly fragmented and has been deplored for being very adversarial. Construction owners are risk evasive, while contracting parties interpret contract clauses differently and for their own benefit. Productivity levels are low compared to other industries and have even dropped over time in some countries. The design/bid/build procurement culture had, until fairly recently, influenced public-sector construction project transactions and processes. Purely price-based selection strategies entice tenderers to lower their bids to win contracts, relying on subsequent claims to recover their costs. However, this scenario could well be different in enlightened private-sector negotiated contracts with selected project teams. The significance of using other selection criteria is not merely to redress the present mismatch between client and contractor perceptions, but also to reduce the gap between expected and actual performance. Contracting parties often work at arms length in disjointed relationships, usually motivated by divergent objectives and hidden agendas. Other consequences

⁶ See Matthew W. Sakal, *Project Alliancing: A Relational Contract Mechanism for Dynamic Projects*, *Lean Constr. J.*, Vol. 2, No. 1 at 67 (April 2005); William A. Lichtig, *Ten Key Decisions to a Successful Construction Project – Choosing Something New: The Integrated Agreement for Lean Project Delivery*, *Am. Bar Assn., Forum on the Construction Industry* (Sept. 29-30, 2005).

⁷ See M. Motiar Rahman and Mohan Kumaraswamy, *Contracting Relationship Trends and Transitions*, *J. Manage. Eng.* at 147 (Oct. 2004) (“Many reports worldwide, such as that of the Construction Industry Review Committee in Hong Kong (CIRC 2001) and other reports in Singapore (C2IC 1999), Australia (ISR 1999), the U.K. (Latham 1994), Egan (1998), and the United States (CII 1991, 1996) have identified the above self-destructive trends and suggested remedial measures to arrest and reverse them. For example, they have called for dramatic “cultural” changes and recommended cooperation and collaboration through different teamworking approaches such as partnering and alliancing. Application of these approaches, mainly between owner and contractors, have recently met with some success (Drexler and Larson 2000; Bayliss 2002).”) See also, J. Egan, *Rethinking Construction, Construction Task Force Rep.* Dep. of the Environment, Transportation and the Regions, London (1998); M. Latham, *Constructing the Team: Joint Review of Procurement and Contractual Arrangements in the U.K. Construction Industry*, Dep. of the Environment, London (1994); Construction Industry Institute (CII), *In Search of Partnering Excellence*, Pub. 17-1, Bureau of Engineering Research, the U. of Texas (1991); Construction Industry Institute (CII), *The Partnering Process – Its Benefits, Implementation, and Measurement*, Bureau of Engineering Resources, U. of Texas (1996); Construction Industry Review Committee (CIRC), *Construct for Excellence*, Rep. of the Construction Industry Review Committee (Hong Kong 2001); Construction 21 Committee (C21C), *Construction 21 – Reinventing Construction*, Ministry of Manpower and Ministry of National Development, Singapore (1999); Ministry of Land, Infrastructure and Transport (MLIT), *Japanese Procurement Procedures for Public Works*, Tokyo (Dec. 15, 2003); S.D. Anderson and S.S. Patil, *Improving Organizational Effectiveness of Asset Life Cycle Management*, Proc., *Construction Research Congress in Construction – Winds of Change: Integration and Innovation*, K.R. Molenaar and P.S. Chinowsky, eds., ASCE, Reston, Va. (2003).

including time and cost overruns, poor quality, customer dissatisfaction, lengthy and costly disputes, and disruption of relationships among the contracting parties.

...

Classical (i.e., traditional) contractual arrangements call for clear and definitive allocations of risks (and responsibilities and liabilities) among stakeholders. But all possible risks/uncertainties are not foreseeable and quantifiable at the outset. Even the foreseeable risks may change in importance and may influence some other risks, requiring considerable adjustments during project execution. Classically “complete” contractual arrangements are therefore not suitable for proper risk management. The objective of risk management should be to minimize the total cost of risks to a project, not the cost to any parties separately.⁸

The Construction Industry Institute, touting the benefits of partnering, noted:

The U.S. construction industry, contributing over \$847 billion annually to the U.S. Gross National Product, is experiencing competitive pressures which have squeezed margins to historic lows. The construction industry now ranks as the second worst performing industry in terms of return on investment – only the airline industry rates poorer. Intense competition has forced companies to seek any avenue to preserve profits, and when such is threatened, to aggressively seek to recover losses through litigation. This business climate has led to adversarial relations which greatly hinder the construction process.⁹

The U.S. Department of Commerce, Bureau of Labor Statistics, reports that, of all major industries, construction is the only one to have actually experienced decreased productivity since 1964. Whereas average productivity has more than doubled since 1964, in the construction industry it has actually declined.¹⁰ There are a number of forces at work contributing to the low

⁸ M. Motiar Rahman and Mohan Kumaraswamy, *Contracting Relationship Trends and Transitions*, J. Manage. Eng. at 147-148 (Oct. 2004). See also, P. Mitropoulos and C. Taum, *Management-Driven Integration*, J. Manage. Eng. 16(1), 48-58 (2000); S.M. Ahmed, et al., *Risk Management Trends in Hong Kong Construction Industry: A Comparison of Contractors' and Owners' Perceptions*, Eng. Constr. Archit. Manage., 6(3), 256-266 (1999); F. Hartman, et al., *Effective Wording to Improve Risk Allocation in Lump Sum Contracts*, J. Constr. Eng. Manage., 123(4), 379-387 (1997); S.R. Clegg, *Contracts Cause Conflicts*, Construction Contract Management and Resolution, P. Fenn and R. Gameso, eds., 128-144 (1992); B.R. Schwegler, et al., *Near-, Medium- and Long-term Benefits of Information Technology in Construction*, Proc. Int. Conf. on Constr., Vol. 1 (2001).

⁹ Construction Industry Institute (CII), *The Partnering Process – Its Benefits, Implementation and Measurement*, Clemson Univ., Research Report 102-11 (Sept. 1996).

¹⁰ See C.C. Sullivan, *Best Practices in Integrated Project Delivery for Overall Improved Service Delivery Management*, McGraw-Hill Construction: Continuing Education (May 2008) (This publication contains a well-publicized graph depicting the U.S. Department of Commerce statistics, regarding which the author notes: “Of all industries, construction is the only one to show decreased productivity since 1964, as seen in this U.S. Department of Commerce chart. Total waste is estimated at as much as 30%, according to *The Economist* magazine.”). See also, Bernstein, *Measuring Productivity: An Industry Challenge*, Civil Engr. 47 (Dec. 2003); *Key Trends in the Construction Industry – 2006*, SmartMarket Report 18 (McGraw-Hill, July 2006); E. Allmon, et al., *U.S. Construction Labor Productivity Trends, 1970-1998*, J. of Const. Eng. and Mgt. ASCE 126 (2) 97-104 (2000). See

productivity in the construction industry.¹¹ Certainly poor contracting practices, inequitable risk allocation and inappropriate delivery approaches play a role.¹² A recent study out of Canada evaluated the premium added by contractors to cover against the five most common exculpatory/disclaimer clauses in current contracts. The result? An estimated eight to twenty percent impact due to a perception of high risk associated with “uncertainty of work conditions” or “sufficiency of contract documents.”¹³

The Construction Industry Institute expressed the same concern:

Every risk has an associated price – visible or hidden. Visible costs appear in project bids as contingency or insurance costs and can be compared. Onerous contract conditions promote hidden costs. Hidden costs (in terms of time and money) derived from this study include: (a) the cost of restricted bid competition; (b) the cost of increased claims/disputes; (c) the cost of replacing a lesser quality contractor who is more likely to unknowingly accept a grossly inequitable risk allocation; and (d) the cost of harboring an adversarial-contractor relationship in terms of final product quality, expeditious change order processing, reputation, and ultimate project outcome.¹⁴

also, www.bls.gov.

¹¹ See Patrick J. O’Connor, Jr., *Productivity and Innovation in the Construction Industry: The Case for Building Information Modeling*, 1 J. ACCL 135 (Winter 2007).

¹² A recent article in the ASHRAE Journal makes this point:

Most insurance companies and legal professionals will tell you disastrous projects are typically the result of poor communication and unmet expectations on the part of one or more of the team members or third parties. These projects are fraught with multiple changes orders, hundreds of requests for interpretation (RFIs), identification of building component clashes during construction, and additional time and additional financial claims due to errors, omissions, unforeseen and unanticipated conditions, and delays as a result of poor and untimely communication during the design or construction phases. Even projects that are perceived as successes often experience many similar problems. Many in the industry blame our current forms of agreement, contracting and project delivery methods as the reason conflicts of interest and adversarial relationships between stakeholders seem to occur so often.

M. Dennis Knight, *Teams, Contracts & BIM*, ASHRAE J. at 72, 75-76 (Sept. 2008).

¹³ R. Zaghloul and F. Hartman, *Construction Contracts: The Cost of Mistrust*, Int. J. Proj. Manage., 21 (6), 419-424 (2003). See also, Mohan Kumaraswamy, *Constructing Relationally Integrated Teams*, J. Constr. Eng. and Manage. (Oct. 2005). Much legal commentary in the United States devoted to construction contracting focuses upon the ways various participants can shift or avoid liability. These are often very fine articles that provide useful advice given the current contracting environment. Yet, most of these articles presume a win-lose contracting situation where the protection of one party inevitably results in exposure to another. A recent example providing valuable advice to an owner regarding shielding itself from liability for implied obligations is Steven Lesser and Daniel Wallach, “The Twelve Deadly Sins: An Owner’s Guide to Avoiding Liability for Implied Obligations During the Construction of a Project,” *The Construction Lawyer*, Vol. 28, No. 1 at 15 (Winter 2008).

¹⁴ Construction Industry Institute (CII), *Impact of Risk Allocation and Equity in Construction Contracts*, Source Document 44 at ii-iii (March 1989). As early as 1989, CII viewed teamwork as a method of improving project outcomes:

The Owner or its representative has an essential role in improving working relationships, contract execution and overall project performance, by the decisions made regarding risk allocation. This

Advocates of Lean construction techniques have identified at least four major systemic problems with the traditional contractual approach: (1) good ideas are held back; (2) contracting limits cooperation and innovation; (3) an inability to coordinate; and (4) pressure for local optimization at the expense of the project as a whole.¹⁵ The authors note that while mechanical, electrical and plumbing (MEP) contractors and other major trades are generally brought into the process by the general contractor once the drawings are at the design development stage in order to establish a competitive price, they often save their best ideas in hopes of gaining a competitive edge during the “bidding process.” Many times these ideas are very good. Time and the opportunity for innovation is often lost, however, as the design team struggles to accommodate these late-arriving ideas. Cooperation, innovation, and coordination are stultified by the use of long and tedious subcontract agreements that spell out in great detail what will happen in the event of failure:

Each subcontractor fights to optimize his performance because no one else will take care of him. The subcontract agreement and the inability to coordinate drive subcontractors to defend their turf at the expense of both the client and other subcontractors. Remember that everyone on the project other than the prime contractor is a subcontractor. The subcontractors frequently, in their life outside of the subcontract, may be generous, caring and professional. However, since right or wrong is defined by the subcontract, they, more often than not, take on a very legalistic and litigious stance becoming an army where the rules of engagement are “Every man for himself.”¹⁶

The personal observations of an executive with many years experience with a construction management firm set out at the end of his informative work entitled *Managing Integrated Project Delivery: Concepts and Contract Strategies*, is particularly poignant:

In the 1980s, our company added CM-at-Risk to our CM and Design Service.

research documents the general conclusion that use of onerous contract provisions that cause the contractor to assume inequitable, unbearable and uncontrollable risks will directly and negatively impact the owner-contractor working relationship.

Beyond equitable allocation of risk there are additional steps an owner can take to improve working relationships. Several firms interviewed in this study suggested development of project problem-solving teams with owner and contractor personnel to anticipate potential project problems and provide workable solutions in advance.

Construction Industry Institute, *Impact of Risk Allocation and Equity in Construction Contracts*, Source Document 44 at v-vi (March 1989).

¹⁵ Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, *Lean Constr. J.*, 2(1) (2005).

¹⁶ Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, *Lean Constr. J.*, 2(1) (2005) at 2. See also American Arbitration Association, *The Dispute Avoidance and Resolution Task Force Newsletter* (February 1994), cited in D. J. Yates, *Conflict and Disputes in the Development Process: A Transaction Cost Economics Perspective* (“During the past 50 years much of the United States construction environment has been degraded from one of positive relationship between all members of the project team to a contest consumed in fault finding and defensiveness which results in litigation. The industry has become extremely adversarial. . . . A positive alliance of parties (involved in the construction process) constitutes an indispensable link to a successful project. . . . Disputes will continue as long as people fail to trust one another.”)

While we usually provided CM and design services separately, we occasionally combined them (often with the addition of other companies to the team). We found great advantages in doing so. We called the package “Integrated Services.” In the 1990s we met with Ellerbe Beckett to compare and benchmark our firms. We found that we were doing the same thing with the same name and were equally pleased with the result.

Clients were less enthusiastic. Perhaps it was an idea whose time had not quite come. But now, with a larger chorus of voices, Integrated Services appears to be gaining acceptance. . . .

Out of boredom with tradition, love of innovation and enthusiasm for experimentation, I typically embraced new ideas with more conviction than they deserved. Carl Sapers, my long-time friend and legal guru to the construction industry, once stated that I never saw a future I didn’t like. He was right. And I like this future best of all.

However, as a septuagenarian, I have become more circumspect about breakthrough ideas that will fix our complicated industry. There is no doubt that good people have made all the other processes work – and no doubt that inept people will cause IPD projects to fail.

However, the IPD process provides owners with the ability to choose good people (if they know how to do it). Moreover, no capable designer or builder is going to join an IPD team if it has incompetent Members, so there is an element of self-correction in the system. Most of all, the process broadens the avenues for multiple talents to collaborate.

Typically, contracts have focused on defining processes and products. They have described services and the desired result. IPD contracts also describe culture. That’s a refreshing addition.¹⁷

¹⁷ Charles Thomsen, *Managing Integrated Project Delivery: Concepts and Contract Strategies* at 51-52 (A Working Draft – November 2008). See also, Matthew Sakal, *Project Alliancing: A Relational Contracting Mechanism for Dynamic Projects*, *Lean Constr. J.*, Vol. 2, #1 at 67-68 (April 2005) (“In order to achieve truly outstanding project outcomes, dynamic projects require contracts that are designed specifically to embrace and manage change. Unfortunately, most traditional contracts do not embrace change, but instead treat change as if it is an anomaly. This is illustrated by the fact that traditional contracts attempt to predict and specify all possible eventualities by drafting contracts to prepare for the worst-case scenario. Unfortunately, the goal of trying to achieve ‘100% planning is never achieved in life.’ Therefore, when changes do occur, the focus of traditional contracts is on ‘the bump at the bottom of the cliff’ which leads to difficulty and not on the cooperation that is necessary to embrace change and diffuse problems before they get out of control. . . . ‘The success of the contractual relationship depends less upon what has been agreed than upon how the parties will agree to handle events in the future.’ This is one of the fundamental issues that separates relational contracts from traditional, more discrete, transactional, types of contracts. Another problematic issue with using traditional contracts with dynamic projects is that instead of focusing on maximizing project outcomes and creating a good framework for developing a collaborative environment between the parties involved, they are generally legal shields written in a biased manner

If real improvement is to be achieved, it must be through owners demanding more innovation and collaboration from their design and construction professionals. Only owners can drive the industry toward IPD.

III. WHY COLLABORATE?

Why collaborate? Because it works, and because we can – more now than ever, given advancements in digital technology. Why the industry has been slow to adopt new collaborative delivery approaches is deeply rooted in the fragmented and frugal nature of its membership. To foster true collaborative behavior – collaboration that can withstand the inevitable challenges presented by complex construction projects – requires the right people performing the right tasks within an environment that promotes trust and mutuality of expectation over shared project outcomes. Teamwork produces optimal results in nearly all fields of human endeavor.¹⁸ Military engagements, marketing campaigns, and sporting contests all depend on closely coordinated team effort. The failure to work as a team often results in failure or worse.¹⁹

to protect the drafter. For the most part this is due to an overall lack of trust of one another. Owners often use contracts in an attempt to shed unbearable risk to contractors through the form of harsh exculpatory contract clauses. This subsequently leads to large contractors passing the same risk onto the shoulders of smaller subcontractors who are least able to financially bear the risk. Often owners feel that the shedding of risk to the contractor through clear documentation in the contract will reduce the number of claims and disputes. This is not correct. Not only does it not prevent disputes, it actually causes increased antagonistic relations between the owner and contractor that are clearly not in the best interests of the project.”) See also, Arthur McInnis, *Relational Contracting Under the New Engineering Contract: A Model, Framework, and Analysis*, Soc. of Constr. Law, U.K. (2003); David Campbell, Ian Macneil, *The Relational Theory of Contract*, Center for Legal Dynamics of Advanced Market Societies (CDAMS), Discussion Paper, Kobe University (2004); Richard Steen, *Five Steps to Resolving Construction Disputes – Without Litigation*, J. of Manage. Eng. (July/Aug. 1994).

¹⁸ Teamwork has long been recognized as important to the improvement of the construction industry. See Construction Industry Institute, *Potential for Construction Industry Improvement*, Vol. I at 29 (Nov. 1990) (“An early [1979] and very comprehensive project management study . . . examined over 190 proposed determinants of project success. Their sample of approximately 650 individuals involved in projects covered a variety of project types with construction as the end product representing 43% of the respondents. . . . Their measure of success was project satisfaction. . . . Their determinants of success included many project situational or context factors such as extent of public enthusiasm, project larger in scale than most, and parent experience with similar projects. The strongest determinant of success, however, were factors relevant to coordination and relations. Included in this category were variables like project team capability, the project manager’s human relation and administration skill, adequacy of change procedures, and project team participation in decision-making.”)

¹⁹ Comparisons between construction projects and military engagements are best avoided, as the differences outweigh similarities. Yet on the issue of teamwork, military history provides some valuable lessons. Until meeting Wellington at Waterloo, Napoleon and his armies subdued most of continental Europe with an army that many claimed was zealous but untrained. Why such success? To answer this, one first has to understand what war-making looked like before Napoleon:

Drill, discipline, mechanical tactics, scientific gunnery all worked to make eighteenth-century war-making quite different in character from the chaotically experimental style of the sixteenth and seventeenth centuries. By 1700 the weapons with which battles were fought had assumed a form that did not alter for 150 years. The infantry was armed with a musket which, though almost harmless to combatants at ranges much above a hundred yards, could be used in mass volley-firing to create a deadly killing-zone immediately to the front of the battle line. Increasingly mobile and quick-firing field artillery offered the only certain means of shaking the solidity of drilled infantry

Technology changes everything. It always has. Some changes are immediate. Others take time. Take the case of refrigeration. Some of the benefits of this technology were quickly recognized and timely implemented, including its introduction into the produce and perishable goods distribution business. In the matter of a few years, the diets of millions of people significantly improved as fresh produce was able to be shipped thousands of miles to urban areas in northern climates unaccustomed to fresh fruits and vegetables during the winter. As this technology moved into the home it significantly altered the rhythm of daily life, as food

formations; its safe deployment, however, could be threatened by the timely unleashing of cavalry which was increasingly committed to that subordinate activity, and to charging against infantry disorganized by artillery fire or harrying fugitives driven to fight. . . . Time and again, the liveried musketeers arrayed themselves in dense formation, fired their volleys, reeled under artillery fire, repelled or more infrequently ran from cavalry, but at the end of the day parted from each other on the battlefield with their power to fight again still intact. The “great battles” of the heyday of dynastic warfare – Bleheim (1704), Fontenoy (1745), Leuthen (1757) – were notable rather for the number of casualties suffered among the docile ranks of the participants than for any permanency of outcome achieved. It was an exhaustion of reserves of money and manpower that brought eighteenth century wars to an end rather than a decision by clash of arms.

John Keegan, *A History of Warfare*, at 344-345 (1994).

Napoleon changed these tactics. His armies were comprised of men caught up in the spirit of revolution – willing soldiers fighting for cause and comradeship:

Most of all, success stemmed from the superior quality of the Revolutionary armies themselves. At least at the outset, they were composed of men who were genuinely willing soldiers, devotees of a “rational” state (even if its nature greatly alarmed many of the surviving rationalists of the Age of Reason), and led by officers with outstanding personal qualities. . . . When led into battle, the “amalgamated” units simply outfought their enemies, who remained trapped in the habits of doltish obedience and stereotyped tactics from which the French had escaped.

John Keegan, *A History of Warfare*, at 332-353 (1994).

A little cooperative spirit and team effort can go a long way. Witness the extraordinary efficiency with which Ground Zero was cleaned up after 9/11 due to the patriotic zeal of the men and women charged with the task (given the current health problems some of them are now experiencing, one might question whether a bit more caution may have been in order). While collaboration can produce amazing results, its absence can be disastrous. The British military’s failure to properly coordinate between army and naval forces in the attack on the Dardanelles during the opening months of World War I led to a disastrous stalemate in which Britain and her allies suffered more than 200,000 casualties (the Turks a like number). Failure in the Dardanelles extinguished the prospect of a thrust through the Balkans to Germany, thereby dooming the combatants to four long years of debilitating trench warfare along the Western Front. Some have made the case that Britain’s failure in the Dardanelles eventually led to the conditions causing so much conflict in the Middle East today:

It was a decisive battle, in that the allies could have won it and, with it, the Middle Eastern war – but did not. It foreshadowed things to come: a supposedly backward Asian army had defeated a modern European one.

It had the effect of drawing Europe into Middle Eastern affairs on a long-term basis. The military involvement which Kitchener had feared but failed to prevent was suspended temporarily by the allied evacuation, but would resume a year later. More important, the setback to allied fortunes drove Britain both in a specific and general sense to involve herself more deeply in Middle Eastern affairs. In a specific sense, it would be seen presently, it drove Kitchener’s lieutenants to ally themselves with a Middle Eastern ruler they believed could help to save Sir Ian Hamilton’s armies at Gallipoli from perishing. In a general sense, the sheer magnitude of Britain’s commitment and loss at Gallipoli made it seem vital years later that she should play a major role in the post-war Middle East to give some sort of meaning to so great a sacrifice.

David Fromkin, *A Peace to End All Peace*, at 166 (1989).

shopping no longer had to be a daily affair. As refrigeration technology evolved into air-conditioning, change once again followed a familiar pattern. First utilized by business such as textile manufacturing where it kept down dust and cloth fibers, greatly improving working conditions and worker health and safety. The golden age of cinema was due in no small measure to air-conditioned theaters which offered a cool respite to the hot and tired on a warm summer's evening. (The movie theater business has always trafficked in economic misdirection. Whereas, in the 1930s it sold a cool environment as much as what was on the screen; today it is popcorn, candy and soda that benefit the bottom line more than ticket sales.) Eventually, air-conditioning (coupled with elevator technology and advancements in the use of steel in tall structures) transformed the skyline of every major urban city from America to Europe and beyond. Cooling tall structures was impractical without air-conditioning.

The twin technologies of steam power and the precursor to modern digital telecommunications, the telegraph, permitted 19th century Britain to rule over an empire upon which the sun never set:

At first, it is true, the Admiralty had been appalled by the advent of steam, believing it would 'strike a fatal blow at the naval supremacy of the Empire.' But quickly it became apparent that the new technology had to be adopted, if only to keep up with the French. . . . Far from weakening the Empire, steam power tended to knit it together. In the days of sail it had taken between four and six weeks to cross the Atlantic; steam reduced that to two weeks in the mid-1830s and just ten days in the 1880s. Between the 1850s and the 1890s, the journey time from England to Cape Town was cut from forty-two to nineteen days. Steamships got bigger as well as faster: In the same period, average gross tonnage roughly doubled.

The telegraph was another invention the Admiralty had tried to ignore. Its original inventor, Francis Reynolds, had been rebuffed when he offered the navy his brainchild in 1816. It was not the military but the private sector that developed the nineteenth century's information highway, initially piggybacking on the infrastructure of the early railways. By the late 1840s it was clear that the telegraph would revolutionize overland communications. . . . However, the crucial development from the point of view of imperial rule was the construction of durable undersea cables. Significantly, it was an imperial product – a rubber-like substance from Malaya called gutta-percha – that solved the problem, allowing the first cross-Channel cable to be laid in 1851 and the first Trans-Atlantic cable to follow 15 years later. . . . By 1880 there were altogether 97,568 miles of cable across the world's oceans, linking Britain to India, Canada, Africa and Australia. Now a message could be relayed from Bombay to London at the cost of four schillings a word with the reasonable expectation that it would be seen the next day. In the words of Charles Bright, one of the apostles of the new

technology, the telegraph was ‘the world’s system of electrical nerves.’²⁰

The computer (digital technology) is the telegraph of the late 20th century. This technology has revolutionized the finance, communications, and manufacturing industries. Like the major technologies of the past, it has changed the way we live and interact with one another. Surprisingly, with some limited exceptions such as scheduling software and computer-aided design (CAD), innovations in digital technology have not significantly changed the design and construction industry. This is beginning to change with the advent of very powerful computer databases permitting industry professionals to virtually “build” their projects before ever breaking ground. This technology, often referred to as “Building Information Modeling” (BIM), is a powerful collaboration tool.²¹ As the AIA California Council describes the technology:

A building information model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward. A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.²²

Building information modeling provides an excellent platform for collaboration within and across design and construction teams.²³ Indeed, BIM demands collaboration in order for the participants to obtain the benefits of this technology. The use of this technology has immediate and demonstrable benefits. Once relevant sections of a project are accurately modeled, it is possible to move through the digital structure and detect design conflicts. Clash detection alone often justifies the expense of modeling. But clash resolution is just scratching the surface, as modeling produces more riches in the form of enabling project participants to engage in meaningful and productive collaborative effort. While it is possible to deliver design and construction services in an integrated way without modeling, it is difficult to conceive why one would want to do so except in the case of the most simple and straightforward project. As a consequence, all of the current standard form IPD agreements anticipate the parties will employ BIM technology.²⁴

²⁰ Niall Ferguson, *Empire: The Rise and Demise of the British World Order and the Lessons for Global Power* at 139-141 (Basic Books, 2004).

²¹ See Patrick J. O’Connor, Jr., *Productivity and Innovation in the Construction Industry: The Case for Building Information Modeling*, 1 J. ACCL 135 (Winter 2007).

²² AIA California Council, *Integrated Project Delivery: A Working Definition, Version 1*, Updated May 15, 2007.

²³ See AIA National/AIA California Council, *Integrated Project Delivery: A Guide* at 10 (2007) (“Because BIM can combine, among other things, the design, fabrication information, erection instructions, and project management logistics in one data base, it provides as platform for collaboration throughout the project’s design and construction.”).

²⁴ As a consequence, both the AIA and ConsensusDOCS have published separate BIM documents. See AIA Document E-202 – 2008, Building Information Modeling Protocol Exhibit and ConsensusDOCS 301, BIM

IV. RISKS OF COLLABORATION

While collaboration makes sense, it is not without risk. Collaborative arrangements are built on trust. Participant selection is key. While strategic alliances present additional challenges beyond those presented by one-time project collaborations, there are lessons to be learned here. Businesses have engaged in strategic alliancing for many years. Since the 1980s, the number of alliances has increased by approximately twenty percent per year and by the 21st century they accounted for nearly twenty-five percent of firm revenue for many U.S. companies.²⁵ Yet, the majority, approximately sixty percent, of alliances fail.²⁶ Published surveys suggest that companies engaged in strategic alliances rely heavily on familiarity and trust with alliance partners as well as upon contract terms:

The high incidence of failure of collaborative arrangements – reportedly 60 percent of alliances fail – is typically linked to the *risks* associated with collaborative organizational forms; risks associated not only with the lack of cooperation among partner firms, but also with performance failure *despite full cooperation*. Indeed, collaborative arrangements are subject to severe “business process” and “information risks.” *Business process risks* include the risks associated with hold-up by a partner firm and risks associated with the inequitable allocation of collaboration returns in the absence of complete contracts. The measurement of partner performance and overall collaboration performance is difficult in many of the settings in which performance quality is not clearly defined (e.g., R&D alliances). This represents a significant *information risk* to individuals (e.g., internal auditors) attempting to monitor and control such collaborations.

...

[Firms seek to control these risks in four principal ways.] The first lever of control described in the framework is *belief systems*. These are the organizational standards that are used to reinforce the core values, purpose, and direction of the organization. Examples of belief systems include corporate credos and mission statements. *Boundary systems* comprise the second lever of control. Boundary systems indicate the minimum standards of a company and what partners are *not* to do. The third control level, *diagnostic control systems*, is defined as feedback systems and include the most traditional control practices used by management. Diagnostic control systems are designed to: (1) measure the outputs of a process, (2) identify the existence of a predetermined benchmark to which results can be compared, and (3) enable the manager to correct deviations from these

Addendum (2007). For a discussion of these documents, see Kimberly Hurtado and Patrick O’Connor, *Contract Issues in the Use of Building Information Modelling*, [2008] ICLR 262 (2008).

²⁵ D. Ernst, *Give Alliances Their Due*, McKinsey Quarterly No. 4 (2002).

²⁶ CMA Management, *Alliance Management: Five Destructive Myths*, CMA Management Vol. 73, 14-15 (2000); Shannon Anderson, et al., *Managing Strategic Alliance Risk: Survey Evidence of Control Practices in Collaborative Inter-Organizational Settings*, The Inst. of Internal Auditors (Jan. 2006).

benchmarks. Finally, the fourth lever, *interactive control systems*, is formal information systems that allow management to involve themselves regularly and personally in the partner's activities.

[The survey results] indicate equal reliance on each of the four types of control systems: belief systems, boundary systems, diagnostic control systems, and interactive control systems. Median responses indicate that firms rely upon each lever of control to a moderate extent. Therefore, firms seek a balance in their control practices to enhance the overall control environment. By utilizing all four levers, firms are able to reveal the core values of the business, empower strategic alliance partners to strive for goal achievement, and encourage long-term success.... In general firms place moderate reliance on written codes of conduct, regardless of the type of strategic alliance in which they are involved. More importantly, all firms indicate a relative high reliance on trust between partners.... This result is consistent with the widely held belief that strategic alliance management is dependent upon both control and trust.... All firms seem to rely significantly on various contract terms. Specifically, regardless of the partner type, respondents indicate greater than average reliance on contract terms detailing specific payment terms, delivery dates, etc.... Using the Levers of Control framework, we categorized and examined the control practices firms use to mitigate the risks raised by strategic partners. Consistent with the framework, firms appears to use control mechanisms from each control lever equally. This indicates that firms use a variety of complimentary control mechanisms to minimize strategic partner risks. The data also suggest that firms rely on high levels of trust between partners to preserve the alliance and minimize the fear of opportunistic behavior. Further, respondents indicate a reliance on contract terms to manage the partnership.²⁷

If partner selection and contract terms are important for managing collaborative risk in strategic alliances, there is every reason to believe they play an equally important role in integrated project delivery.

V. KEYS TO SUCCESSFUL IPD: PEOPLE, PROCESS, AND PROMISES

A. People: Selecting the Team

Because true and meaningful collaboration requires a high degree of trust, choosing the right people with whom to team is paramount. Not everyone can successfully perform within an IPD environment. As one commentator noted when discussing protect alliancing – a particular form of IPD:

The first step in setting up a Project Alliance is the selection of the preferred non-owner participants. Selection of the right participants is the most important

²⁷ Shannon Anderson, et al., *Managing Strategic Alliance Risk: Survey Evidence of Control Practices in Collaborative Inter-Organizational Settings*, The Inst. of Internal Auditors at 3, 7, 17 and 22 (Jan. 2006).

step.... It is absolutely critical to the overall success of the project. This is due to the fact that the Project Alliancing contract is a relational contract that requires absolute dedication to a step change in behavior between project participants in order to be successful. Therefore, besides typical technical skills, alliance proponents are chosen based on their willingness to buy-in completely to the ideas of sharing risk, open and honest communication, and creating a “no blame” culture that encourages collaboration and innovation. To this end, the selection process is very robust to ensure that it is virtually impossible to select the wrong proponents. . . . It is important to note that commercial discussions begin *after* the alliance team members are chosen and not during the selection process. The reason for this is that any conversation concerning project-related costs will increase the risk that selection process will become tainted and the wrong participant could potentially be chosen.²⁸

Because IPD agreements depend upon a higher than customary degree of trust between contracting parties, the screening and selection process must be rigorous and robust.²⁹

²⁸ Matthew W. Sakal, *Project Alliancing: A Relational Contract Mechanism for Dynamic Projects*, *Lean Constr. J.*, Vol. 2, No. 1 at 74 (April 2005). The importance of proper team member selection is a common theme found in many commentaries on collaborative contracting. The following is typical:

However, not every company will function well in such flexible contracting environments. Various ‘partners’ in RC (Relational Contracting) and JRM (Joint Risk Management) environments should be selected on the basis of their ‘relational qualities’ A balance between different ‘hard’/technical factors (e.g., price and performance on time and quality) and ‘soft’/relational factors (e.g., attitude towards teamworking, negotiation and workplace relations) should also be maintained.

M. Motiar Rahman and Mohan Kumaraswamy, *Assembling Integrated Project Teams for Joint Risk Management*, *Constr. Mgmt. & Econ.* At 366 (May 2005).

Successful IPD implementation requires new thinking and this can sometimes be difficult for project managers and superintendents steeped in traditional construction relationships:

On an early IPD project the General Contractor assigned a skilled and respected project manager who had been working in the industry for more than 20 years. While the President and Executive Vice President of the General Contractor partner were fully on board with IPD and attended the bi-monthly meetings, the assigned project manager just could not get his mind around the concept. He often seemed offended when he was not being asked or allowed to function in his typical role as PM. This was a man that the Team Members had enjoyed working with successfully on other more traditionally run projects, but he could not work effectively in the IPD environment.

Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, *Lean Constr. J.*, 2(1) (2005).

²⁹ Participant selection was an eight-step selection process: (1) invite proposals; (2) receive proposals; (3) assess capabilities and suitability & commitment to alliancing; (4) short list proponents (maximum five desirable); (5) conduct interviews to consider in detail: (a) capabilities, (b) suitability & commitment to alliancing; (6) reduce list of proponents (maximum two desirable); (7) two-day workshop with each proponent to establish: (a) alliance principles, (b) commitment to outstanding results, (c) alliance board, and (d) project management team; and (8) determine preferred alliance team of consultants and contractors.

The twelve characteristics upon which potential alliance members were judged were:

1. Demonstrated ability to complete the full scope of works including contributing to building, structural, mechanical and landscaping design.

A related theme is the need for top management to express its full commitment to the IPD concept down to the rank and file. A case study of an alliance project between public and private organizations in Queensland, Australia, highlights the importance of top management commitment:

The case study suggests that leadership has a strong influence on the alliance climate. Analysis of the questionnaire survey indicates that the overall mean of Work Unit Leadership is above 5 (the maximum score is 7), with little variation across the variables (vision, intellectual stimulation, and inspirational communication). Commitment and action by the PAB [Project Alliance Board] (and parent organizations) have a strong impact on the team and alliance culture, indicating alliancing has a high chance of failure where there is inadequate support from top management. Inter-organizational rivalries and barriers must be quickly knocked down, and open communication and trust developed and maintained. The questionnaire survey results also reveal relatively lower ratings on the group coordination measure suggesting work units can find it relatively difficult to work well together, particularly without the presence of leaders (managers). This again reinforces the important role of the leader in an alliance project. Leadership is especially important in construction projects to facilitate and encourage timely decisions and dispute resolution, as well as clarify issues. Leaders need to act as mentors of the AMT [Alliance Management Team] and nurture a team culture. They need to be visible, available, and attentive, showing respect to AMT processes which motivate employees. Another crucial role of leaders is constant communication with their subordinates on wider goals.³⁰

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2. Demonstrated ability to minimize project capital and operating costs without sacrificing quality (value analysis and life-cycle costing).
 3. Demonstrated ability to achieve outstanding quality results.
 4. Demonstrated ability to provide the necessary resources for the project and meet the project program (including resumes of key staff).
 5. Demonstrated ability to add value and bring innovation to the project.
 6. Demonstrated ability to achieve outstanding safety performance.
 7. Demonstrated ability to achieve outstanding workplace relations.
 8. Successful public relations and industry recognition.
 9. Demonstrated practical experience and philosophical approach in areas of developing sustainability and environmental management.
 10. Demonstrated understanding and affinity for operating as a member of an alliance. (Collaborative experience and views on risk/reward schemes.)
 11. Substantial acceptance of the draft alliance document for the project including the related codes of practice, proposals for support of local industry, and employment opportunities for Australian indigenous peoples.
 12. Demonstrated commitment to exceed project objectives.

Matthew W. Sakal, *Project Alliancing: A Relational Contract Mechanism for Dynamic Projects*, Lean Constr. J., Vol. 2, No. 1 at 75 (April 2005).

³⁰ Steve Rowlinson, et al., *Alliancing in Australia: No-Litigation Contracts; a Tautology?*, J. Prof. Issues in Engr. Ed. & Prac. at 79 (Jan. 2006). The problems posed by an uncommitted member were discussed in connection

Building the proper team is paramount. No contract, whether based on traditional or relational concepts, can save one after making the wrong choice with whom to collaborate. It's all just a matter of damage control then, and while a well-crafted contract can be useful here, this is not the way to start a successful IPD project. But if proper due diligence is performed and the right team assembled, the results can be remarkable.³¹

B. Process: Managing the Team

One of the reasons team selection is so crucial and challenging is because IPD team members interact with one another in ways different from traditional project delivery. For many, the IPD process is little more than early interaction between design and construction teams with an eye toward problem solving.³² While this is undoubtedly better than little or no early interaction, it is not, in and of itself, IPD. In many cases, early interaction takes the form of the construction team giving advice with respect to constructability and offering “value engineering” tips on a proffered design. Integration requires a deeper collaboration than simply one set of

with another case study:

IPD team members were carefully selected and had significant history working together on design-build and design-bid-build projects. Nonetheless, they still had a team member who wasn't suitable for the IPD process. The managing partner and majority shareholder of that member of the Team had very little personal involvement with IPD. As a result, the representative of that company experienced significant internal pressure to revert to the old self-preservation concepts. At the conclusion of the project, the member withdrew from the IPD Team through mutual consent.

Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, *Lean Constr. J.*, 2(1) (2005).

³¹ Of course, you need more than just the right team. The team needs to develop the right collaborative procedures and protocols and operate within an incentive framework that encourages superior performance. Where this occurs, the results can be spectacular:

The incredible results of the Andrew Field Project [one of the first project alliance arrangements involving North Sea oil exploration by British Petroleum (BP)] clearly illustrate the resounding success of BP's new relational contracting tool (Project Alliancing). Before instituting these new innovative contracting methods and after many attempts to re-engineer the project using the latest technology, estimates for the Andrew Field Project originally stood at £450 million – well above the necessary development cost to achieve profitability. In order to send a clear message and show prospective contractors BP's sincere desire to change the way it did business, BP initially set an astonishing target estimate of £270 million as part of the Project Alliance bid documents. After a rigorous contractor selection process and six months of intense collaboration with the partners, the project team agreed to a target cost of £373 million; almost £80 million lower than [sic] the previous low estimate! Then, due to unprecedented dedication to teamwork and growing trust, within 3 months after the project commenced, the alliance had already revised this estimate down to £320 million and the team felt the project could be finished 3 months earlier than originally scheduled. Ultimately, the final cost ended up at, amazingly, just under £290 million and the project began producing oil 6 months before originally scheduled!

Matthew W. Sakal, *Project Alliancing: A Relational Contract Mechanism for Dynamic Projects*, *Lean Constr. J.*, Vol. 2, No. 1 at 68 (April 2005).

³² Integration should be driven within disciplines as well as across them. See Busby, Perkins & Will and Stantec Consulting, *Roadmap for the Integrated Design Process*, at 9 (2007) (“Perhaps the most important principle for a successful IPD relates to inclusiveness and collaboration which should translate into the establishment of a broad collaborative team.”)

professionals commenting upon the work of another set of professionals. “Target Value Design,” as envisioned by the Sutter Health/Lean Project Delivery model reveals meaningful collaborative effort:

The goal of Target Value Design is to enable the design to proceed informed, on a real time basis, by the cost, quality, schedule and constructability implications of proceeding with a design concept. Traditionally, the construction team participated, if at all, only after designs have been committed to paper and thrown over the wall – performing “un-constructability analysis” and de-value engineering.” At best, this results in negative iteration and waste when designs have to be changed when they prove to be over budget or not constructible. Instead, the Integrated Agreement seeks to create the equivalent of “paired programming,” where individuals with different backgrounds and expertise simultaneously, side-by-side, attack the same problem, allowing each to benefit from the expertise of the other. The team is expected to engage in design reviews with an eye toward value – constantly exploring whether other construction options would better serve the owner’s value proposition.³³

Because IPD approaches stress relationships, collaboration and mutual goals rather than individual responsibilities and the consequences of failure commonly emphasized in more traditional contracts, IPD agreements often contain detailed provisions setting forth team structure and expectations with respect to team interaction. Article 4 of ConsensusDOCS 300 provides a representative format. There is a Management Group that serves as the decision-making body and consists of an authorized representative of the owner, designer and constructor. In addition to the Management Group, there is also a Collaborative Project Delivery team (CPD). Trade contractors and consultants participate with the owner, designer and constructor in the CPD by signing joining agreements accepting the principles and methods of collaboration set forth in the integrated agreement. The CPD is a more “hands-on” group responsible for facilitating the design, construction, and commissioning of the project. Article 4 contains an elaborate protocol of communications and meetings among and between the two teams. Article 23 sets forth the process by which teams resolve disputes.³⁴

³³ William A. Lichtig, *Ten Key Decisions to a Successful Construction Project – Choosing Something New: The Integrated Agreement for Lean Project Delivery*, at 16-17, Am. Bar Assn., Forum on the Construction Industry (Sept. 29-30, 2005).

³⁴ ConsensusDOCS 300, Standard Form of Tri-Party Agreement for Collaborative Project Delivery (2007). The AIA’s integrated agreement involving a Single Purpose entity (Document C195) also contains a rather elaborate team management structure. The Single Purpose Entity (SPE), a limited liability company, has a Governance Board which manages the business and affairs of the company. The company is responsible for furnishing the design and construction services necessary to complete the project. Article 8 sets forth the structure and decision-making process of the Governance Board. The project is managed on a day-to-day basis by a Project Management Team. Exhibit D sets forth the composition and responsibilities of the Project Management Team. Article 18 sets forth the dispute resolution process which includes the creation of a dispute resolution committee in the event conflict cannot be resolved at lower levels. See AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery (2008).

Alliance agreements often contain similar team structures. For example, the Acton Peninsula Alliance

Team structure is not optimized unless teams work together in ways materially different than the coordination efforts of traditional project delivery methods. Decision-making within IPD teams is not hierarchical but proceeds on a “best person” principle.³⁵ The most knowledgeable or capable person about a given matter takes responsibility and the rest of the team provides input and support. Changing traditional allegiances by co-locating team members and placing workers under the supervision of the team can be important steps to creating a collaborative atmosphere.³⁶ Traditional roles may be altered under an IPD arrangement:

For a regular DBB [Design-Bid-Build] or D-B [Design-Build] project, an architect usually leads the design phase and hires engineers and consultants to develop design documents. A GC [General Contractor] is in charge of the construction phase by hiring contractors and suppliers to perform construction jobs.

On an IPD project, however, the IPD Team establishes the lead position in a different way. The team determines early on who will lead the project delivery process based on the nature of the project. If a project is mechanically intensive, for example, and the architect needs only to “box” the facilities, it would make

Agreement, entered into for the development of a new National Museum in Australia, called for the creation of an Alliance Leadership Team (“ALT”) responsible for creating project vision, insuring corporate management support in resolving conflicts. The ALT, in turn, established the Project Management Team. The Project Management Team effectuated the day-to-day overall management of the work and administered the trade contracts. See Allan Hauck, et al., *Project Alliances at National Museum of Australia – Collaborative Process*, J. Constr. Eng. Manage., 130(1) at 143-152 (2004).

³⁵ See AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.3 (2008) (“Unless mutually agreed otherwise, risks will be managed on a “best person” principle depending upon the person’s ability to control the risk.”)

³⁶ As one practitioner described the process on a particular IPD project on which he was involved:

All of the primary team members wear the same hardhats on the job with the same logo. They all work under one general superintendent who has total authority from the Primary Team Members to direct the project to achieve the most efficient and lowest overall cost delivery. Field problems are quickly resolved based upon the lowest perceived overall cost and least impact principle.

The Team decides what positions such as Project Executive, Director Of Design Services, Director of Construction Services, Project Manager, Project Superintendent, Project Accountant, Manager of Information Technology and Systems Manager need to be filled for the particular project at hand. These positions are filled with the best available person from any of the Primary Team Members. They become direct job costs and the company from which they came is reimbursed for the time they spend on the project.

Each person assigned a project leadership position works for the Team, is paid by the Team, and is responsible to the Team. In this way, their allegiances to the Team and the Project and not to their own sponsoring company. All have the traditional authority and responsibilities of the positions that they are filling.

Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, Lean Constr. J., 2(1) (2005). See also, AIA National/AIA California Council, *Integrated Project Delivery: A Guide, Version 1* at 9 (2007) (“Once a team is formed, it’s important to create a team atmosphere where collaboration and open communication can flourish. Locating the team in a joint facility may facilitate open communication and cooperation, and regular meetings and video conferences may be useful when co-location is impractical.”)

sense for the mechanical contractor to take the lead.

The lead position within IPD has two key roles. First, it offers effective project management with the help of that PTM's [Project Team Members] professional expertise and experience. Second, it provides one entity to deal with external administrative issues (e.g., communication with client). For internal issues, the IPD management team makes unanimous decisions, handles and resolves all conflict. The management team consists of representatives from all the PTMs.³⁷

If IPD is to have a future, the processes by which teams provide their design and construction services must produce measurably better results than traditional methods. At present, there are few empirical studies providing this information. Anecdotally, there are reasons to be encouraged. One case study involving a 60,000-ton chiller plant in downtown Orlando, Florida, is a case in point. The IPD team worked through a number of design and construction challenges that brought real savings, including developing an efficient pipe fabrication and installation process:

The original pipe design and installation process exposed two major problems: (1) redundant work between Peninsula [mechanical engineer] and Westbrook [mechanical contractor], and (2) time-consuming and inefficient field installation. In contrast, the innovative process indicates how these problems could be addressed. First, Westbrook and Peninsula eliminated design waste by working together. This made a lot of sense 'as high as 50% of design time is spend on needless iteration that can be eliminated without value loss.' Second, Westbrook figured out an efficient way to resolve their limited manpower problem by implementing off-site prefabrication to lower cost, improve productivity and quality, and reduce safety risks. Third and last, the innovation also demonstrated how team members used all means to reduce cost and schedule. For example, the team improved efficiency of pipe and equipment installation by using the powerful cranes from the steel erector. The work flows of the innovative pipe design and installation process demonstrate considerable collaboration between the involved parties. Again, this should be attributed to relational relationships within IPD. On the one hand, relational relationships fostered full collaboration and insured the realization of the innovation. On the other hand, all the PTMs benefited from the outcomes of the innovation, which strengthened relational relationships.³⁸

³⁷ Jilei Wang, *Integrated Project Delivery – Achieving Relational Contracting Through Traditional Project Management Methods*, Graduate Thesis, University of Cincinnati at 32-33 (Aug. 2008).

³⁸ Jilei Wang, *Integrated Project Delivery – Achieving Relational Contracting Through Traditional Project Management Methods*, Graduate Thesis, University of Cincinnati at 67 (Aug. 2008). *See also*, Renaye Peters, et al., *Case Study of the Acton Peninsula Development: Research of the Case Study of the Construction of the National Museum of Australia and the Australian Institute of Aboriginal and Torres Strait Islander Studies*, Queensland University of Technology (July 2001); NAP/DACE, *Alliance Projects in the Petrochemical Industry, Clustering of Theory and Experience*, The NAP Red Management Guide, Pallas Offset, The Hague, The Netherlands (in Dutch); M. Bresnen and N. Marshall, *Building Partnerships: Case Studies of Client-Contractor Collaboration in the U.K.*

C. Promises: Motivating the Team

Collaborative behavior is more than just getting along. IPD is an approach that deeply instills collaborative behavior through the employment of intelligently-crafted incentives. The rationale behind most IPD incentives is to reinforce project-centric behavior and to diminish the natural tendency to protect oneself at the expense of the community. While teamwork is built on trust, the IPD community is not altruistic. Incentives must be crafted so as to provide the real prospect of economic benefit for high performance. As a consequence, most IPD contracts contain elaborate positive incentive provisions. Most traditional contracts which, if they contain any incentives at all, tend to focus on negative incentives.

Incentives work.³⁹ The wildly successful book, *Freakonomics*, was so popular in part because it revealed that seemingly disparate behavior (e.g., school teachers' role in test scores and sumo wrestlers' match results) was influenced by similar hidden incentives. In case after case, while the incentive underlying and motivating the behavior might be hidden, it was nevertheless quite powerful. While a bit of an exaggeration, from the author's point of view all of economics is at its core really a study of incentives; and, more to our point, that incentives, once they are understood, are very powerful agents of change:

Economics is, at root, the study of incentives: how people get what they want, or need, especially when other people want or need the same thing. Economists love incentives. They love to dream them up and enact them, study them and tinker with them. The typical economist believes the world has not yet invented a problem that he cannot fix if given a free hand to design the proper incentive scheme. His solution may not always be pretty – it may involve coercion or exorbitant penalties or the violation of civil liberties, but the original problem, rest assured, will be fixed. An incentive is a bullet, a lever, a key: an often tiny object with astonishing power to change a situation.⁴⁰

Construction Industry, Constr. Manage. Econom., 18(7), at 819-832 (2000); Construction Industry Institute (CII), *Costs of Quality Deviations in Design and Construction*, Pub. 10-1 (average re-work on industrial projects exceeds 12%, equating to waste of \$17 billion annually); E.A. Edkins and J.H. Smyth, *Contractual Management in PPP Projects: Evaluation of Legal versus Relational Contracting for Service Delivery*, J. Prof. Issues Eng. Ed. and Prac., 132(1), 82-93 (2006).

³⁹ See Construction Industry Institute, *Potential for Construction Industry Improvement*, Vol. I at 29 (Nov. 1990) (“Contract Incentives are rarely used as a mechanism to improve project performance (37% utilization). Positive incentives have been cited as being very successful. Appropriate use of positive incentives is needed.”)

⁴⁰ Steven D. Levitt and Stephen J. Dubner, *Freakonomics*, at 16 (William Morrow, 2005). The authors expound upon their theme that incentives “make the world go round”:

This book, then, has been written from a very specific worldview, based on a few fundamental ideas:

Incentives are the cornerstone of modern life. And understanding them – or often, ferreting them out – is the key to solving just about any riddle, from violent crime to sports cheating to online dating.

The conventional wisdom is often wrong. Crime didn't keep soaring in the 1990s, money alone doesn't win elections, and – surprise – drinking eight glasses of water a day has never actually been shown to do a thing for your health. Conventional wisdom

Incentives come in a number of different flavors. While economic incentives are readily understood, particularly by commercial entities, there are powerful social and moral incentives at work in society.⁴¹ A well-fashioned IPD contract does not rely on economic incentives alone. Collaborative behavior is encouraged through the creation of an environment that reinforces teamwork through moral and social incentives. This process can begin with an initial session between all major team members, such as a partnering workshop, wherein behavioral norms and expectations are explained to and instilled in the participants. A survey of industry professionals from seventeen different countries reveals a common recommendation in favor of implementing such initial collaborative workshops:

The common recommendation was to establish and maintain “good relationships” among the parties, on a project basis, for successful RC[relational contracting]-based teambuilding exercises. “Partnering workshop” is a means to establish and maintain good relationships. Contractor and engineer may share the same office to enable teamworking to develop faster and better. Offices of the engineer, contractor, designer and client can be electronically linked for faster and smoother

is often shoddily formed and devilishly difficult to see through, but it can be done.

Dramatic effects often have distant, even subtle, causes. The answer to a given riddle is not always right in front of you. Norma McCorvey [the “Roe” of *Roe v. Wade*] had a far greater impact on crime than did the combined forces of gun control, a strong economy, and innovative police strategies. . . .

“Experts” – from criminologists to real estate agents – use their informational advantage to serve their own agendas. However, they can be beat at their own game. And in the face of the Internet, their informational advantage is shrinking every day – as evidenced by, among other things, the falling price of coffins and life-insurance premiums.

Knowing what to measure and how to measure it makes a complicated world much less so. If you learn to look at data in the right way, you can explain riddles that otherwise might have seemed impossible. There is nothing like the sheer power of numbers to scrub away layers of confusion and contradiction.

Steven D. Levitt and Stephen J. Dubner, *Freakonomics*, at 11-12 (William Morrow, 2005).

Many of these “lessons” can be applied with equal force to the design and construction business. The key to understanding why so many projects underperform lies in an examination of the incentives underlying modern construction contracting. Conventional wisdom about the industry is often wrong. The way to secure the best price for your project is not necessarily to fully design it and have a number of contractors hard-bid the construction. Nor does the secret to successful contract performance always lie with harsh penalties for failure. Dramatic effects can have subtle causes such as British Petroleum’s success in the North Sea due to effective teamwork under a project alliance arrangement. Experts, including design and construction professionals will use their informational advantage to serve their own agendas unless sufficiently powerful incentives are provided to counteract this behavior. Finally, metrics are the measure of success and, in order for IPD to take off in the marketplace, the numbers must tell the story.

⁴¹ Steven D. Levitt and Stephen J. Dubner, *Freakonomics*, at 17 (William Morrow, 2005):

There are three basic flavors of incentive: economic, social, and moral. Very often a single incentive scheme will include all three varieties. Think about the anti-smoking campaign of recent years. The addition of a \$3-per-pack “sin tax” is a strong economic incentive against buying cigarettes. The banning of cigarettes in restaurants and bars is a powerful social incentive. And when the U.S. government asserts that terrorists raise money by selling black-market cigarettes, that acts as a rather jarring moral incentive.

communication. Some other suggested strategies include: public decision-making, generating enthusiasm in people, encouragement, recognition of good work, clear instructions to people, and explaining the reasons to people to whom instructions are made. Of course, some of these strategies may be the basic management strategies.⁴²

If incentives work, why does the construction industry largely shun them? As the Construction Industry Institute points out, neither owners nor contractors employ “incentives,” by which they mean positive incentives, on any uniform basis. In fact, of all the management practices employed by owners and general contractors to accomplish desired project outcomes, the use of positive incentives ranks at the bottom.⁴³

Perhaps the more accurately phrased question is not “Why are incentives so seldom employed?”; but rather, “Why are the wrong incentives so persuasive?” The answer lies in how industry participants perceive their roles in traditional project delivery. Take, for example, the role of the subcontractor:

Prior to forming IPD, they [subcontractors] were working in a system that guaranteed that each participant would vigorously work to optimize his own part of the project without regard to the effect on the other parties or the over all project. Typical subcontracts confer on the subcontractors an autonomy that always works to the detriment of the project. Instead of becoming a team working in harmony toward a goal, they often become separate warring factions. The structure of IPD also supports innovation and improvement within each craft and between them. As a result, they may shift work and cost across traditional boundaries to reduce total expenditures and to improve total project performance.⁴⁴

In other words, in traditional contracting incentives work at cross purposes to optimal project outcomes and are deeply embedded within the very framework of the process. It is difficult to “tinker” with this system and achieve desirable results. While process innovations, such as what one might expect to see with design/build, can improve performance, this is not equivalent to the

⁴² M. Motiar Rahman and Mohan Kumaraswamy, *Assembling Integrated Project Teams for Joint Risk Management*, Constr. Manage. & Econ. At 370-371 (May 2005). The AIA’s SPE integrated project delivery agreement takes a page out of this book by requiring the members to conduct a Collaboration Standards Workshop. This workshop is intended as a way for the members to “establish protocols, standards and tolerances required for the proper execution of the Work.” AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.2 (2008).

⁴³ See, Construction Industry Institute, *Potential for Construction Industry Improvement*, Vol. II at 273, Source Document 62 (Nov. 1990) (“Contract Incentives are rarely used [by owners] to improve project performance (37% utilization). Positive incentives have been cited as being very successful. Appropriate use of positive incentives is needed.”)/

⁴⁴ Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, Lean Constr. J., 2(1) (2005).

fundamental change offered by IPD.⁴⁵

While certain design/build approaches take on a number of IPD characteristics, particularly where a design/builder works closely and repeatedly with particular design professionals and trade contractors, the network of promises still evokes traditional contracting. While design/build is particularly well-suited for certain IPD processes, such as early introduction of construction expertise into the design process, the risk allocation and incentive structure is often quite traditional. Moreover, owner involvement in many design/build delivery approaches is quite minimal. As described in the *IPD Guide*:

Like many of the other traditional models, one of the more common characteristics of Design-Build serves as one of its largest challenges to IPD. Under traditional Design-Build, the owner usually participates through completion of the design and then seeks to minimize input and involvement to protect the clear silos of responsibility and risk. As a result, opportunities for project improvement and innovation are, unfortunately, also minimized. Accordingly, in order to achieve integration, the owner must adjust its traditional involvement in Design-Build. The increased owner involvement necessary for IPD is a significant shift from traditional Design-Build delivery and should be reflected in the owner/design-builder agreement.⁴⁶

A web of economic, social and moral incentives provides the fuel for innovation and collaboration. Structuring appropriate incentives can be a challenge.⁴⁷ Just as challenging,

⁴⁵ As one practitioner described the difference between IPD and design/build:

The Integrated Agreement is a single agreement that is signed both by the architect and the construction manager/general contractor. It is not a design/build agreement, where one entity takes total responsibility for all aspects of project delivery. Instead, the agreement describes the relationships that are established among each of the members of the Integrated Project Delivery (IPD) Team. Recognizing that different members of the team, whether traditionally a consultant or a subcontractor, may have design responsibility. From the outset, the agreement seeks to create coherence between the interests of the project and the participants and to align the interests of the project performers.

William A. Lichtig, *Ten Key Decisions to a Successful Construction Project – Choosing Something New: The Integrated Agreement for Lean Project Delivery*, at 13, Am. Bar Assn., Forum on the Construction Industry (Sept. 29-30, 2005). The role of subcontractors in most design/build arrangements is not much different than found in the design/bid/build method. Subcontractors still have a basic incentive to maximize their portion of the project, thereby increasing the chances they will personally benefit from the undertaking. Of course, in order for IPD to change this dynamic, it requires bringing many of the major subcontractors within the IPD-incentive plan. Current IPD contracting approaches do not emphasize this aspect, although the standard forms are flexible enough to permit subcontractor involvement.

⁴⁶ AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 48 (2007).

⁴⁷ The authors of *Freakonomics* begin their work with a cautionary tale of a day-care center penalizing tardy parents. An Israeli day-care was troubled by the fact that parents were often late picking up their children and sought to do something about it. With the help of a couple of economists, they decided to fine tardy parents. Any parent arriving more than ten minutes late would pay \$3 per child for each incident. The fine would be added the parents' monthly bill, which was roughly \$380. Before instituting the fine, the day-care incurred on average eight late pickups per week. After the fine was enacted, the number of late pickups promptly soared. Eventually there were more than twenty late pickups per week. What went wrong? You guessed it – the fine was simply too little.

however, is developing a rational framework for evaluating whether incentives have been successfully achieved and, if so, the measure of reward. In the final analysis, incentives must be clear, achievable, and appropriate. Because IPD, if it is to be successful, must engage the owner enough to want to “take the risk” of seeking better project outcomes through collaborative contracting. Incentives must present the owner with the prospect of value.⁴⁸

VI. BUILDING A COLLABORATIVE AGREEMENT

A. Are IPD Agreements a New Breed of Contract?

It is difficult to perform any amount of research on IPD without quickly running into articles discussing the concept of “relational contracting.”⁴⁹ The thrust of much of this

But why did pickups actually increase rather than remain steady? Because the day-care had inadvertently put a price on the moral stigma of being late. Many parents were willing to pay \$3 to absolve themselves of moral guilt for being late. Steven D. Levitt and Stephen J. Dubner, *Freakonomics*, at 15-16 (William Morrow, 2005).

As a construction lawyer, this story brings to mind the role of liquidated damages in construction contracting. It is difficult to find a construction law practitioner who has not encountered the situation of a tardy contractor who appeared to have little concern about finishing late because the contract stipulated an insufficient liquidated damage. Setting liquidated damages can be a tricky business. Set them too high and they may be judged a penalty and unenforceable. Set them too low and they may actually reinforce the behavior the owner seeks to avoid in the first place. The same can be said with respect to IPD incentives. They can be tricky, and careful thought must be given when fashioning them.

⁴⁸ This point was discussed in connection with public owners evaluating project alliance approaches:

One concern that clients may have with Project Alliancing is the value that is generated for the money spent. Since the project is not competitively bid, many clients (especially in the public sector) may be hesitant or unwilling to enter an arrangement where risk is shared and participants are selected before the target cost of the project is defined. Also there is the fear that, even once the target cost is developed, there is still a lack of certainty in the overall cost outcome. While there is obviously some uncertainty with project alliancing costs, competitively bid project costs are also far from certain. The lowest competitive bid is seen by many owners as the best value option, but when conflicts arise resulting in costly litigious claims, the real cost to the project is often much higher than the initial winning bid. The failure to understand that bid price does not equal final project costs is a major cause of the overall downward spiral of the construction industry. Also, when dealing with complex, uncertain projects that have tight budget and time constraints, it is very difficult to imagine that a collaborative, innovative project team would produce a more costly project than a traditional project team where individuals have far less incentive to share information and work together.

Matthew W. Sakal, *Project Alliancing: A Relational Contract Mechanism for Dynamic Projects*, *Lean Constr. J.*, Vol. 2, No. 1 at 76 (April 2005)

⁴⁹ See S. Rowlinson and F. Y. K. Cheung, “Relational Contracting, Culture, and Globalization,” Reprinted in *Proc., Int. Symp. of CIB*, W. 107/TG23; *Joint Symp. On Globalization and Construction*, Bangkok, Thailand (2004); M. Rahman, et al., *Transformed Culture and Enhanced Procurement: Through Relational Contracting and Enlightened Selection*, in *Proc. of the CIB*, W. 92, Int’l Symp. Procurement Systems and Technology Transfer, Trinidad & Tobago (2002); M. Motiar Rahman and Mohan Kumaraswamy, *Joint Risk Management Through Transactionally Efficient Relational Contracting*, *Constr. Manage. & Econ.*, 20(1) (2002); Barbara Colledge, *Relational Contracting – Creating Value Beyond the Project*, *Lean Constr. J.*, 2(1) (2005); I. Macneil, *Contracts: Adjustment of Long-Term Economic Relations Under Classical, Neo-Classical, and Relational Contract Law*, *Northwestern Univ. L. R.*, Vol. 72 at 854-905 (1978); M. Eisenberg, *Relational Contracts in Good Faith and Fault in Contract Law*, J. Beetsen and D. Friedmann, eds. (1995); Jilei Wang, *Integrated Project Delivery – Achieving Relational Contracting Through Traditional Project Management Methods*, Graduate Thesis, University of

commentary is to draw distinctions between traditional contracts and their relational brethren. Some proponents of relational contracting contend that it is premised on a different theory of contract law than either classical or neo-classical contracts. To some extent, this debate is a continuation of the tension in contract law doctrine, as envisioned first by Williston and later by Corbin. For Williston, contract interpretation and enforcement was largely dictated by rigid rules. For Corbin, contract theory necessitated a more contextual approach, where one needed to know about the facts underlying the dispute before making a determination about contract interpretation or enforcement. Relational contracting emphasizes the parties' underlying relationships more than classical and neo-classical contract theory. Whether this necessitates a different theory of contract is debatable. The general trend in American jurisprudence is that relational contracting is simply a species of traditional contract doctrine and the latter is equipped to handle questions of interpretation and enforcement.⁵⁰

ConsensusDOCS 300 directly incorporates the concept of relational contracting into the body of the agreement. Paragraph 3.2 states in relevant part: "The Parties agree that the Project objectives can be best achieved through a *relational contract* that promotes and facilitates strategic planning, design, construction and commissioning of the Project through the principles of collaboration and lean project delivery."⁵¹ The AIA IPD forms do not incorporate the concept into the agreements. The *IPD Guide*, however, discusses relational contracts in two separate ways. The *Guide's* glossary defines relational contracts in the manner most often found in the commentary, as: "Construction contracts that focus on communications and relationships between the parties as well as their specific rights, obligations and deliverables."⁵² Elsewhere, the *Guide* describes relational contracts as "similar to Project Alliances."⁵³ In this discussion, "relational contracts" are characterized as a particular contract type, where the parties create a virtual organization and agree to limited risk sharing with collective decision-making tempered by the owner's right to make a final decision in the absence of team consensus. Nevertheless,

Cincinnati (Aug. 2008); S. O. Cheung, et al., *How Relational are Construction Contracts?*, J. Prof. Issues Eng. Ed. & Prac., 132(1) (2006); A. J. Edkins and J. H. Smyth, *Contractual Management in PPP Projects: Evaluation of Legal versus Relational Contracting for Service Delivery*, J. Prof. Issues Eng. Ed. and Prac., 132(1) (2006); G. B. Baker, et al., *Relational Contracts and Strategic Alliances* (2002); Y. Ling, et al., *Incorporating Contractual Incentives to Facilitate Relational Contracting*, J. Prof. Issues. Eng. Ed. and Prac., 132(1) (2006); Owen Matthews and Gregory Howell, *Integrated Project Delivery: An Example of Relational Contracting*, Lean Constr. J., 2(1) (2005).

⁵⁰ Traditional contract law concepts, such as "course of dealing," "course of performance," and "usage of trade," have been emphasized by those claiming that traditional contract theory is encompassing enough to address interpretation and enforcement of "relational" contracts. See UCC §§ 2-208 and 2-314(3) ("course of dealing" sufficient to create implied warranties). See also, Jay Feinman, *The Reception of Ian Macneil's Work on Contract in the USA*, in *The Relational Theory of Contract: Selected Works of Ian Macneil*, David Campbell, ed. (Sweet & Maxwell 2001).

⁵¹ ConsensusDOCS 300, Standard Form of Tri-Party Agreement for Collaborative Project Delivery, ¶ 3.2 (*italics supplied*). The term surfaces again in ¶ 3.8.1 discussing the intent behind collaborative risk allocation:

The purpose of the Collaborative Project Delivery approach, established by this tri-party relational contract, is to minimize the risk of delay, conflict and increased cost typically experienced by Project participants in non-integrated project delivery.

⁵² AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 55 (2007).

⁵³ AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 33-34 (2007).

this discussion ends with the statement: “These combinations [relational contracts] are governed more by personal relationships than by the terms of any formal contract.”⁵⁴ This statement is typical of the legal commentary on relational contracting. It suggests that relational contracts are sufficiently unlike their traditional brethren to warrant different interpretation and enforcement approaches.

One has to be careful about making too much out of the characterization of IPD agreements as “relational.” Relationships, trust, and collaborative undertakings certainly play a heightened role in IPD contracts. This makes them unique and a bit more unpredictable than traditional contracts as they call upon parties to perform differently from what is expected under more traditional design and construction arrangements. Little benefit is gained, however, by treating IPD agreements as a different kind of contract for interpretation and enforcement purposes. While IPD agreements are founded upon different expectations with respect to the parties’ rights, responsibilities, and rewards than traditional design and construction contracts, they should be interpreted and enforced employing the same legal principles.

B. Prerequisites for Successful Collaborative Undertaking

A survey conducted out of Hong Kong sought answers from industry participants about the importance of different items for building a successful relational contract.⁵⁵ The respondents, from seventeen different countries, were asked to rank and weigh (measured on a scale of 1 to 10: 1 being least important and 10 being most important) twenty-five items. They placed “mutual trust” at the top of the list with an average weighted importance of 9.10. What follows are the rank and weight of all twenty-five items in descending order:

1. Mutual Trust (9.10); 2. Open Communication Among Parties (8.85); 3. Understanding Each Other’s Objectives (8.76); 4. Equitable and Clear Allocation of Foreseeable and Quantifiable Risks (8.69); 5. Attitude of the Project Participants (8.57); 6. Readiness to Compromise on Unclear Issues (8.28); 7. Awareness of Risks and Rewards (8.24); 8. Effective Co-ordination (7.94); 9. Collective Responsibility Instead of Personal Responsibility (7.87); 10. Alignment of Objectives (7.83).

11. Professional Ethics (7.79); 12. Agreed Process for Dispute Resolution (7.39); 13. Frequent Formal and Informal Meetings (7.55);⁵⁶ 14. Develop a Partnering Culture, First, Within the Organization (7.28); 15. Agreed Mechanism for Performance Appraisal (7.20); 16. Compatible Organizational Cultures (6.94); 17. Possibility of Future Work (6.91); 18. Pioneering Role of the Owner/Client (6.91); 19. Partnering Workshop (6.77); 20. Partnering Experience (6.75).

⁵⁴ AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 34 (2007).

⁵⁵ M. Motiar Rahman and Mohan Kumaraswamy, *Assembling Integrated Project Teams for Joint Risk Management*, *Constr. Manage. & Econ.* at 365 (May 2005).

⁵⁶ Given the higher average weight for number 13 compared to number 12, these items may be inadvertently transposed.

21. Role of Partnering Facilitator (6.52); 22. Legal Implications (6.29); 23. Cost of Implementing Partnering (5.69); 24. Jointly Organized Social/Cultural Activities (5.17); and 25. Traditional Owner, Contractor, Subcontractor Hierarchy (4.05).⁵⁷

There are a number of conclusions that one can draw from this information. First, with the possible exception of the last three items, all of these subjects are viewed with relative importance given an average weight of 6.29 or above. Second, quite a few of these items can be materially influenced by how parties negotiate and structure their agreements. Nevertheless, the most important item – mutual trust – is not something that can be created by contract but must exist independently of it. The issue of trust relies heavily upon the team selection process. The parties' contract, however, is not irrelevant to mutual trust. A well-crafted contract that creates appropriate incentives and calls for a reasonable sharing of risk will reinforce mutual trust; whereas, a poorly-crafted contract will do the opposite.

Many of the other items important to creating a successful collaborative relationship are directly influenced by the parties' contract: Open communication (2), understanding each other's objectives (3), and equitable and clear allocation of foreseeable and quantifiable risks (4) are items that should be directly addressed in an IPD agreement. The management/governance provisions common to these agreements are intended, among other things, to encourage open and frequent communication. Another common feature of IPD agreements is language directing the parties to collaborate upon developing project goals.⁵⁸ Clearly defining project goals goes a long way toward achieving a mutual understanding with respect to each other's objectives. IPD agreements commonly contain explicit provisions calling for risk sharing in an effort to achieve equitable and clear allocation of foreseeable and quantifiable risks.⁵⁹

Other items identified in the survey that are directly influenced by the IPD agreement are (7) awareness of risks and rewards; (9) collective responsibility, instead of personal responsibility; (10) alignment of objectives; (12) agreed process for dispute resolution; (13) frequent formal and informal meetings; (19) partnering workshop; and (22) legal implications. A well-crafted IPD agreement will address many of these issues. A review of the standard form IPD agreements currently in circulation reveals they address many of these items. Moreover, as you would expect from any thorough contractual agreement, the standard forms address many other issues including scope of work, payments, warranties, and the like.

⁵⁷ M. Motiar Rahman and Mohan Kumaraswamy, *Assembling Integrated Project Teams for Joint Risk Management*, Constr. Manage. & Econ. at 368 (May 2005).

⁵⁸ See AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.4 (2008). The C195 contains a detailed process by which the parties come to a mutual understanding with respect to project definition, which is based upon the owner's criteria. AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.1 (Developing a Project Definition) and Exhibit B (Owner's Criteria).

⁵⁹ While less common, provisions calling for the parties to engage in risk identification and quantification exercises have merit. See AIA Doc C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.3 (2008) (calling for the development of a risk matrix).

VII. REVIEW OF CURRENT STANDARD FORM IPD AGREEMENTS

A. Basic Features of AIA and ConsensusDOCS IPD Agreements

1. ConsensusDOCS 300

In 2007, ConsensusDOCS published its tri-party IPD agreement. ConsensusDOCS 300, Standard Form of Tri-Party Agreement for Collaborative Project Delivery weighs in at over fifty pages. It is a carefully crafted agreement that incorporates not only IPD principles, but also lean construction methodology. The economic model appears to be built on a Target Cost approach (Article 8) with a provision requiring the parties allocate responsibility for costs over the Target Cost where an adjustment to the Target Cost is unavailable (Article 11). Savings in the form of actual costs less than the Target Cost are shared according to agreed-upon percentages (§ 11.4).

The reason for the equivocation with respect to the economic model employed by ConsensusDOCS 300 is that others have interpreted it as a GMP contract and it contains language which, on first reading, might suggest a Guaranteed Maximum Price (GMP).⁶⁰ Articles 8 (Project Budget, Cost Modeling and Project Cost Estimate), 11 (Incentives and Risk Sharing), and 17 (Cost of Work) suggest a Target Cost approach. Moreover, the elaborate collaborative processes mandated under the agreement, particularly those geared toward establishing, monitoring and maintaining the Target Cost are consistent with a cost reimbursement platform. Why go to all the trouble creating such an elaborate structure if, at the end of the day, the constructor guarantees the construction price? Yet, the language of Article 10 (Constructor's Compensation) arguably suggests a GMP limitation on the constructor's right to recover for costs over the approved Target Cost.

Exploring this question in greater detail, it is appropriate to start with Article 8. Article 8 provides the process for reaching a Target Cost, known as the Project Target Cost Estimate (PTCE) in ConsensusDOCS 300 parlance. Upon acceptance by the Management Group of the Target Cost, the agreement is amended (Amendment No. 1) so as to set forth the Target Cost and its basis.⁶¹ Article 11 addresses what occurs in the event Actual Cost exceeds Target Cost (termed "losses"). The agreement sets forth two possibilities: (1) the excess costs are borne by the owner, or (2) the excess costs are shared by the parties as they specify in the agreement.⁶² If the parties share losses, the agreement calls for them to decide whether the designer's and constructor's fees are at risk and whether the total amount of each fee represents their respective limit of liability for costs in excess of the Target Cost.⁶³ Article 17 requires the owner to pay the

⁶⁰ Allen Overcash, *Will the New Contract Forms for Integrated Project Delivery Make Conflict Obsolete? (Or Are We Still Lost in our Contract Obsession?)*, 3 J. ACCL 19, 32 (Winter 2009) (galley proof) ("It would be easy to overstate the "collaborative" nature of the ConsensusDOCS 300 form of agreement. While the "collaborative principles" described in the agreement are well-stated, and theoretically govern the parties through the entire performance of the project, they are most important through stage one. However, once the price of the project is fixed, the contractor agrees to complete the project for no greater sum than that price.")

⁶¹ ConsensusDOCS 300 at § 8.3.6.

⁶² ConsensusDOCS 300 at § 11.5.

⁶³ ConsensusDOCS 300 at § 11.6.

constructor for the Cost of the Work as defined in the Article.⁶⁴

This structure, of course, suggests a Target Cost platform. Article 10, on the other hand, requires the owner to compensate the constructor for Work on the following basis: (1) preconstruction services on a lump sum, actual cost or other basis; (2) for the Cost of the Work pursuant to Article 17; and (3) the constructor's fee subject to adjustment for changes, delays, or managing the replacement of insured or uninsured loss.⁶⁵ Paragraph 10.2 places a limitation on the contractor's compensation:

The compensation to be paid shall be limited to the PTCE established in Amendment No. 1, as the PTCE may be adjusted and subject to the incentive and risk sharing provisions of Article 11.⁶⁶

What is the significance of this language? Does the constructor receive no additional compensation once the PTCE is exceeded? Because "compensation" is defined to include "Cost of the Work," such as interpretation would act as a guaranteed maximum price (GMP).⁶⁷

The ConsensusDOCS drafters, at least those participating in the preparation of the ConsensusDOCS Guidebook, do not understand the Target Cost under the ConsensusDOCS 300 to act as a GMP:

Project Target Cost Estimate: There is no lump sum or guaranteed maximum price established for the project that can create competing interests and counterproductive behavior among the Parties. Instead, the Parties establish a Project Target Cost Estimate under Article 8 that serves as a benchmark for measuring the Project's overall success, the performance of each Party and to what extent each will participate in any savings or losses.⁶⁸

The key language in Paragraph 10.2 appears to be "subject to the incentive and risk sharing provisions of Article 11." If the parties elect, under Paragraph 11.5, to have either the owner bear all costs in excess of the PTCE or share the losses, then the constructor's compensation is limited only to the extent of the parties' election under Paragraph 11.5.⁶⁹ Of

⁶⁴ ConsensusDOCS 300 at ¶ 17.1.

⁶⁵ ConsensusDOCS 300 at ¶ 10.1.

⁶⁶ ConsensusDOCS 300 at ¶ 10.2.

⁶⁷ Assuming the constructor had the obligation to complete the Project.

⁶⁸ ConsensusDOCS, *ConsensusDOCS Guidebook* at 7 (April 2, 2008).

⁶⁹ The "subject to," under this reading, modifies "limited" rather than "PTCE." This appears to be the correct reading as nearly identical language appears at ¶ 9.1.1 addressing the designer's compensation except in that instance there is a comma after the term "adjusted", which clarifies the intent behind the language. Moreover, the PTCE is not adjusted pursuant to Article 11. Rather, adjusting the Target Cost is addressed in Article 8 (pre-acceptance) and throughout the document (e.g., ¶ 13.14 – Concealed or Unknown Site Conditions). This might seem to be "much ado about nothing," but punctuation (or the lack thereof) can be critical. The case of *Potomac Constructors v. EFCO Corp.*, 530 F. Supp. 2d 731 (D. Md. 2008) comes to mind. As a well-placed comma in a supplier's purchase order saved it from a \$13 million delay claim. A contractor on a multi-billion dollar bridge project sued a steel supplier, alleging delay damages due to its failure to deliver formwork on time. The supplier's

course, this result places a premium on making an election as the failure to do so will create confusion as to the role of the PTCE.

Given the complexity of many IPD contract forms, it should not be terribly surprising that some confusion as to their meaning might arise. None of the IPD forms are immune from this problem. Moreover, because the IPD approach is substantially different from traditional delivery methods, and the contract forms contain language and features unlike anything found in other standard agreements, there are bound to be issues of interpretation. One has to be careful when interpreting IPD contracts by analogizing to their more traditional brethren.

2. AIA A295 Family (Transitional IPD)

In 2008, the AIA published two families of IPD documents. One built around the A295 (General Conditions for Integrated Project Delivery), and the other the C195 (Single Purpose Entity Agreement). The A295 IPD Family is considered a transitional IPD form. It is built on the AIA's Construction Management at Risk platform. Most of the changes institute IPD processes rather than alter risk allocation or create incentives. The A295 IPD Family will be quite familiar to most practitioners, although it adopts the IPD phasing first announced in the AIA California Council's *IPD: A Working Definition* and later adopted in the *IPD Guide*.⁷⁰

Article 1 of the IPD Owner-Contractor Agreement addresses preconstruction and construction phase services and insurance by reference to A295 General Conditions and enumerates the additional services the contractor may perform before the owner and contractor establish a Guaranteed Maximum Price (GMP).⁷¹ The additional services provisions are essentially the same as the additional services provisions of the AIA B-series agreements between owner and architect (including B195, §§ 1.5.2.1 through .7). This similarity between the architect and contractor agreements is attributable to the role IPD requires of the contractor in the design phases of the project.

purchase order stated that it was not responsible for loss from “delay, or no [sic] fulfillment of contract by reasons of fires, strikes, delays in transportation, regulations of the United States Government, or any cause which is unavoidable or beyond its control.” The supplier claimed that this language shielded it from all delay damages. The contractor claimed that it only limited the supplier's liability for delays due to the specific enumerated causes (*e.g.*, fires, strikes, etc.). The comma saved the supplier, as it created a separate and distinct clause after the word “delay” which did not modify the term:

Maryland courts recognize a rule of construction which dictates that a qualifying clause ordinarily is confined to the immediately preceding words or phrase – particularly in the absence of a comma before the qualifying clause. . . . Under [this] rule of construction . . ., the word “delay” is not modified by the phrase “by reasons of fires, strikes, delay in transportation, regulations of the United States Government, or any cause which is unavoidable or beyond its control.” Rather, a comma following the word “delay” creates a separate and distinct clause. Therefore, under both a plain reading of the text and the [above-stated] rule of construction, Plaintiff is contractually barred from seeking damages for delays.

Potomac Constructors, LLC v. EFCO Corp., 530 F. Supp. 2d 731, 735-36 (D. Md. 2008) (citations omitted).

⁷⁰ AIA California Council, *Integrated Project Delivery: A Working Definition*, Version 1 (Updated May 15, 2007); AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 (2007).

⁷¹ AIA Document A195 – 2008 Standard Form of Agreement Between Owner and Contractor for Integrated Project Delivery, Article 1 (2008).

The IPD owner-contractor agreement contemplates that the owner and contractor will execute the “GMP Amendment”⁷² after the owner, contractor, and architect have completed the “Detailed Design Phase” under A295. The GMP Amendment follows the format of AIA Document A102-2007 and A121-2003, (1) requiring an itemized statement of trade categories, allowances, contingencies, alternatives, and the contractor’s fee, (2) incorporating a definition of “Cost of the Work” and specific requirements about items that the contractor can and cannot include, and (3) establishing standards for accounting and recordkeeping. The GMP Amendment also establishes the Anticipated Date of Substantial Completion and the issuance dates for the Implementation Documents upon which the Anticipated Date of Substantial Completion relies.

The structure of the IPD owner-architect agreement⁷³ is almost identical to the IPD owner-contractor agreement. Its substance is essentially an abbreviated version of B101, with essential business terms (compensation), architect-specified matters (standard of care, insurance), and certain additional services set out in the document with detailed service descriptions, dispute resolution provisions, and other matters that apply to both the architect and the contractor, addressed by reference to A295.

The IPD general conditions are the foundation of the IPD “transitional approach.” The roles and responsibilities of owner, architect and contractor are similar to those assigned in A121CMc, A201 and B101, but, because of the desire for a higher degree of integration of services, these roles and responsibilities are all in one place (*i.e.*, the general conditions) rather than in the separate agreements between the owner and the architect and between the owner and the contractor.⁷⁴

Article 2 of the IPD general conditions is substantially the same as Article 2 of the A201 General Condition, to the extent both require the owner to provide information about the owner’s requirements for the project, the physical characteristics of the project site, and the financial arrangements the owner made for the project.⁷⁵

Article 4 describes the contractor’s general responsibility for consultation with the owner and the architect during the preconstruction phases “on proposed site use and improvements, selection of materials, and building systems and equipment . . . constructability; availability of materials and labor; time requirements for procurement, installation and construction; and factors related to construction cost including, but not limited to, costs of alternative designs or materials, the Owner’s Budget for the Work, and possible cost reductions.”⁷⁶

⁷² AIA Document A195 – 2008 Standard Form of Agreement Between Owner and Contractor for Integrated Project Delivery, Exhibit A (GMP Amendment) (2008).

⁷³ AIA Document B195 – 2008 Standard Form of Agreement Between Owner and Contractor for Integrated Project Delivery (2008).

⁷⁴ See AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery (2008).

⁷⁵ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, Article 2 (2008).

⁷⁶ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, Article 4 (2008).

The contractor must also provide cost estimating services throughout the design of the project, for review by the architect and acceptance by the owner. At each phase of design, the contractor's estimates will "increase in detail and refinement. . . ."⁷⁷ The contractor is responsible for design services only if the agreement specifically delegates authority to the contractor and the architect or the owner specify all performance and design criteria. The IPD general conditions describe the contractor's services and responsibilities in more detail in Articles 5 through 10, along with the responsibilities of the other project participants.⁷⁸

The IPD general conditions describe the design and construction process in phases that are similar to, but different from, the standard AIA Schematic Design, Design Development, Construction Document, Bidding and Negotiation and Construction Phases. Because IPD requires a high degree of cooperation and coordination, the IPD general conditions describe the responsibilities and authority of the owner, the architect, and the contractor in each phase. The AIA uses new terms for the Project Phases:

(1) Conceptualization Phase, (2) Criteria Design Phase, (3) Detailed Design Phase, (4) Implementation Documents Phase, and (5) Construction Phase

The requirements for the contractor's IPD GMP proposal are essentially the same as the requirements for a construction manager's GMP proposal under A121. The contractor meets with the owner and architect to review the GMP proposal. Once accepted by the owner, the GMP, including the written statement of its basis, will be set forth in an amendment to IPD owner-contractor agreement, a copy of which will be provided to the architect. Upon the owner's acceptance of the GMP proposal, the Detailed Design Documents become part of the GMP Documents.

The Construction Phase processes, right, and responsibilities are virtually identical to those described in B101-2007, A121-2003, and A201-2007, with the advantage of having all provisions related to the owner, architect and contractor compiled in one section.

3. AIA C195 Family (Full Integration)

The C195 Family, on the other hand, is a complete IPD form built upon a Target Cost approach with risk sharing, claim suppression, and incentive provisions encouraging collaboration while discouraging claim assertion. The C195 Family is an attempt to create a contractual model containing many of the principles espoused in the *IPD Guide*. Of the three IPD agreements, the C195 will appear the most different from traditional design and construction contracts.

The Single Purpose Entity IPD Agreement (C195) creates a limited liability company ("LLC" or "Company") for the sole purpose of designing, financing and constructing the project.

⁷⁷ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, Article 4 (2008).

⁷⁸ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, Articles 5-10 (2008).

The owner, architect, and construction manager are Members of the Company (other members of the project team may also be Members of the Company).

The Single Purpose Entity Agreement requires the LLC to retain the architect and construction manager (C197), who are Members of the LLC as the architect and construction manager for the project under separate agreements. The Company also contracts with the owner (C196) for funding and other matters.

The Single Purpose Entity Agreement contains several exhibits:

Exhibit A	Legal Description of the Project
Exhibit B	Owner's Criteria. Owner's Criteria is similar to "Owner's Initial Information" under B101, A141, and A295: Owner's program, general description of the physical parameters for the Project, Owner's budget and schedule, and other "special characteristics or needs of the Project...."
Exhibit C	Member Agreements. Agreements between Company, Non-Owner Members <i>e.g.</i> , Architect and Construction Manager) (C197). Agreement between Company and Owner (C196).
Exhibit D	Workplan. Provides for appointment of a "Project Management Team," with one representative from each Member of the LLC, "responsible for managing and planning design and construction activities required to complete the Project in the collaborative, integrated process intended under the Agreement" for completing the project, including schedule and assignment of responsibilities, subject to updating through all phases of the Project. Exhibit D addresses project phases and use of Building Information Modeling in substantially the same way as AIA Document A295.
Exhibit E	Target Cost Amendment. Amendment to the Single Purpose Entity Agreement, adopted after the Members of the Company define the scope of work and accept a budget, schedule and allocation of responsibilities for completing the Project. It is upon this modification of the LLC agreement that a full-blown IPD agreement to design and build a project comes into existence. Prior to this amendment, the owner is essentially buying pre-construction services at cost. The Target Cost Amendment is composed of the following:
Exhibit AA	Target Cost Breakdown: Itemized cost estimate or schedule of values
Exhibit BB	Project Definition: Detailed statement of program, site information, design criteria, and identification of consultants and contractors.
Exhibit CC	Project Goals: Statement of "Project Goals" (<i>e.g.</i> , cost and schedule) and "Goal Achievement Compensation" (payments to Members for achieving goals).

Exhibit DD	Integrated Scope of Services: Detailed list of project responsibilities and assignment of responsibilities among Members.
Exhibit EE	Project Schedule: Time for completion.
Exhibit FF	Digital Data Protocol. Agreement about standards for sharing electronic information.

The two AIA IPD Families of agreements and the ConsensusDOCS 300 are sufficiently different in style and format to make comparison challenging. Many of the differences are more cosmetic than substantive. Moreover, similarities are also important to understand. Therefore, a limited number of critical topics have been selected for analysis and comparison.

B. Cost Control: The Economic Model

If IPD is to become a viable project delivery method, owners are going to have to come around to the belief that the approach holds more promise for creating value for the money spent than other, more traditional, delivery methods. A key ingredient in value is cost – in whatever measure (*e.g.*, construction cost per square foot, total expected life-cycle cost, actual cost versus budget, etc.). Just as important, for many owners, is cost predictability. The expectation that an agreed-upon cost will not be exceeded. Cost and cost predictability are related. The one influences the other. Greater cost predictability generally entails greater overall cost. This is most commonly seen in lump sum or GMP projects, where cost predictability in the form of a contractor guarantee, is acquired by paying a risk premium.

Under traditional lump sum/GMP contracts, the owner's cost control rests primarily upon the strength of the contractor's promise to complete the work for the sum stipulated (lump sum) or for an amount no greater than a specified sum (GMP). This cost model places the owner's interests in conflict with those of the contractor. From the owner's perspective, once the price is fixed, "value" no longer contains a cost component, as that element has been placed on the contractor's side of the ledger. Instead, value to the owner is measured in terms of work quality, work quantity, and speed of completion. To the extent these "value" components compromise the contractor's price commitment, which often they do, there is the potential for conflict. Too much conflict and litigation results. In the final analysis, the owner's cost control under lump sum or GMP contracts pursued within the framework of traditional delivery approaches rests largely on the character and financial capacity of the contractor. There is, of course, always litigation or the threat of litigation. But litigation is a very inefficient way of managing cost.

Cost control in most IPD models is a more nuanced affair. The AIA IPD transitional model (A195, A295 and B195) is built on a guaranteed maximum price platform.⁷⁹ The GMP is given at the end of the Detailed Design phase.⁸⁰ The Detailed Design Phase is roughly

⁷⁹ See AIA Document A195 – 2008, Exhibit A, Guaranteed Maximum Price Amendment.

⁸⁰ AIA Document A295, § 7.6 (2008).

equivalent to the Construction Documents phase of more traditional approaches.⁸¹

Most IPD agreements do not call for one of the participants to provide a cost guarantee. It is difficult to align all the participants' interests if one of them has taken on the significant responsibility of guaranteeing project cost, particularly where the guarantor has no long-term interest in the project.. The contractor, unlike the owner, has no long-term interest in the project and, therefore, is not assuaged by any long-term benefit the project provides it. The AIA C195 proceeds on a "Target Cost" basis. So does the ConsensusDOCS 300. The primary difference between a GMP and a Target Cost is the consequence of exceeding the set price. Whereas, under a GMP, one party bears all of the economic consequence of failure; the pain is distributed more evenly under a Target Cost model. At paragraph 11.5 of the ConsensusDOCS 300, the parties are required to select a "loss allocation" approach. One alternative is for the owner to bear all costs in excess of the Target Cost, which in effect turns the agreement into a pure cost reimbursable arrangement. The other alternative calls for a sharing of the excess based on specified percentages. If cost overruns are shared, the parties must also decide whether the designer's and constructor's fee is at risk and, if so, whether the fee represents their limit of liability for losses "apportioned pursuant to Paragraph 11.5."⁸²

1. Assuring Cost Integrity Through Incentives

How does an owner reach a level of comfort with respect to cost containment under an IPD Target Cost approach? Most IPD arrangements have a number of features that operate to mitigate against costs exceeding the Target Cost. One method is by constructing incentives to hold down costs while maintaining schedule and quality.

A key feature of most IPD agreements is an alignment of all major participant's interests with achieving defined project goals. Managing costs is nearly always an important project goal. Interests are aligned through the use of incentives. For example, the C195 uses a mix of positive and negative incentives. Positive incentives include a sharing of cost savings below the Target Cost.⁸³ The C195 contains a web of tailored negative incentives, encouraging the Members to

⁸¹ See AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 26 (2007) ("The Detailed Design Phase includes the WHAT phase of the project. During this phase, all key design decisions are finalized. Detailed Design under IPD comprises much of what is left to the Construction Documents phase under traditional practice, thus the Detailed Design Phase involves significantly more effort than the traditional Design Development phase.")

⁸² ConsensusDOCS 300, Standard Form of Tri-Party Agreement for Collaborative Project Delivery, ¶ 11.5 (2007). The parties at ¶ 3.8.2 are asked to make selections with respect to broader risk allocation matters. Under ¶ 3.8.2.2, the parties can elect to limit the designer's and constructor's total liability to a sum certain. Even if the parties do not agree upon such liability limitations, the agreement at ¶ 3.8.3 contains a mutual waiver of consequential damages. Therefore, if the parties agree to cap the designer's and constructor's liability for cost overruns at the amount of their respective fee, their total exposure to the owner is fairly well contained, given the complete waiver of consequential damages.

⁸³ Under the C195, this savings is characterized as "incentive compensation." AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 10.1 (2008). The actual allocation is set forth in the member agreements. AIA Document C197 – 2008, Standard Form of Agreement Between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, § 6.2 (2008). It is important to understand that the percentage interests in the SPE held by Members (§ 4.1 of C195) plays no direct

beat the Target Cost. Members are entitled to recoup only their costs unless Actual Cost comes in under Target Cost.⁸⁴ In other words, under the C195 incentive compensation represents the Non-Owner Members' fee.⁸⁵ An even stronger negative incentive for the Non-Owner Members is the obligation to provide their services at no cost once the Target Cost is exceeded.⁸⁶

role in the distribution of compensation. The SPE is not expected to earn any income or incur any loss. Its expenses are covered under the owner's funding obligation (§ 7.2 of C195) and any monies received are paid out to the Non-Owner Members, trade contractors and others performing services or are otherwise entitled to project funds.

⁸⁴ The Target Cost is subject to adjustment under circumstances where the owner initiates changes in the project definition or the project schedule (C195 at § 5.6.2). Moreover, events falling within Article 14, Force Majeure, giving rise to increased costs, may justify adjusting the Target Cost. The Target Cost is subject to reduction where a project goal identified in the Target Cost Amendment is not achieved and, therefore, goal achievement compensation is not paid (C195 at § 5.6.3).

⁸⁵ See AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 6.2.1.2 (2008); AIA Document C197 – 2008, Standard Form of Agreement Between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, § 6.1.1 (2008).

Under the C195 approach, Non-Members providing consulting and construction services are to be contracted with on stipulated sum or GMP arrangements where possible (§ 6.1.5 of C195). The Target Cost is given at an earlier point in the process than contemplated under the A295 Family or possibly the ConsensusDOCS 300 (§ 8.3.1). Section 5.1.2 of the C195 requires the construction manager and architect to present the Target Cost to the owner no later than at the conclusion of the Criteria Design Phase. Under IPD phasing, Criteria Design is essentially an expanded schematic design which includes a number of activities and elements performed during the design development phase of more traditional delivery approaches. See AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 25 (2007). Depending upon the level of design completeness, it may not be feasible to secure certain Non-Member commitments under a lump-sum or GMP basis, as this would entail paying too much for uncertainty – *i.e.*, contingency amounts built into the price. Moreover, the Members may find that it is advantageous to bring certain Non-Members under the same incentive scheme as applies to the Non-Owner Members.

Where the price (Target Cost/GMP) is provided later in the design process, there is greater opportunity to obtain price certainty in the form of lump-sum/GMP subcontracts. Price certainty, however, is acquired at the expense of the potential for cost savings. This same tradeoff makes it less likely that the designer and constructor under the ConsensusDOCS 300 would consider working at cost and look to the fee in the form of any savings off the Target Cost the later in the process the Target Cost is given. As more of the design is finalized, the less likelihood there is for beating the Target Cost as this must be done primarily during the construction phase (which is possible, but once the design is fixed one of the primary avenues of cost reduction is eliminated). Another risk one runs by postponing the Target Cost later in the design process is the creating of unintended incentives to withhold good alternative ideas until they are difficult to implement given the advanced state of the design.

⁸⁶ AIA Document C197 – 2008, Standard Form of Agreement Between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, § 6.1.2 (2008). The C195 Family is loosely built on an agency construction management platform. The architect and construction manager provide services but are not directly responsible for the construction. Non-members contracting directly with the company are responsible for actual construction. But this is not written in stone and it is possible to include as members entities that perform actual construction. When this occurs, it is unlikely that § 6.1.2 of C197 would apply to a member performing actual construction services, as the risk/reward balance would likely be unacceptable to most members. Because the ConsensusDOCS 300 platform anticipates the constructor performing construction or holding subcontracts for construction, the C195's "work at no cost" negative incentive in such a setting would present a materially different risk/reward calculus.

The C195's "work at no cost" obligation probably falls most heavily on the construction manager, as most of the architect's services would have been provided prior to exceeding the Target Cost. This unbalanced risk is tempered somewhat by the Members' requirement to prepare Recovery Plans if the Target Cost is threatened (C195 at §§ 5.7.5 to 5.7.6). The architect is likely to play a significant role in the development of Recovery Plans, and if its services are not compensated for this work (which is not automatically the case), then there is more balance between

Other approaches include creating varying levels of “cost buffers,” where the non-owner team members take responsibility for specified percentages of costs over the Target Cost.⁸⁷ For ease of administration and dispute avoidance, it is best to avoid “claw back” situations where team members must disgorge money received. There are a number of ways to do this, including pooling retainage or escrowing other project funds for this purpose. This approach provides much flexibility for spreading the risk of cost creep. It is a bit like what one sees in the property insurance field where policies spread risk and encourage sound risk management practices through the use of sub-limits on particular risks and self-insured retentions/deductibles.

2. Assuring Cost Integrity Through IPD Processes

Most IPD contracts, particularly those built on some form of cost reimbursement basis, contain a good deal of planning, budgeting, and cost evaluation and control process. The C195 is a case in point. Prior to establishing the Target Cost, the parties must engage in a series of collaborative undertakings, including:

- **Project Definition:** This activity should result in a mutually understood project scope.⁸⁸
- **Collaboration Standards Workshop:** Here the parties establish protocols, standards, and tolerances for executing the work (e.g., establish quality standards) and modeling protocols.⁸⁹
- **Risk Matrix:** The Members jointly discuss and identify major risks to successful project completion and develop a game plan for handling such risks.⁹⁰
- **Project Goals:** This is a key concept in most IPD agreements as the parties

the construction manager and architect on this score. Nevertheless, it may be necessary to make some adjustments given the potential for unbalanced risks once the Target Cost is exceeded.

⁸⁷ See ConsensusDOCS 300 at ¶ 11.5.2.

⁸⁸ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.1 and Exhibit E (BB) (2008). Reaching a clear understanding with respect to project scope, both early on and as the project proceeds to the design phases, is critical. Owner and contractor groups have long recognized that poor project scope definition is a leading cause of projects exceeding their budgets:

The Business Roundtable Report A-6 stated that “poor scope definition at the time of budgeting ranks as the highest impact item that causes projects to run over budget. Loss of scope control during design ranks second in impact. [Others have] reported that construction industry officials consider lack of scope definition to be the most serious problem on construction projects.

Construction Industry Institute, *Control of Construction Project Scope*, at 5, Source Document 6 (March 1986).

⁸⁹ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.2 and Exhibit E (BB) (2008). At the time the C195 was developed, the AIA had not yet prepared its modeling protocol exhibit (E202 Document). The modeling exhibit is now available and should be consulted when conducting a collaboration workshop. See AIA Document #202 – 2008, Building Information Modeling Protocol Exhibit (2008).

⁹⁰ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.3 and Exhibit E (BB) (2008). The concept of a Risk Matrix is not new. The U.K.’s Be Collaborative Contract employs a similar concept with its Risk Register, see <http://www.constructingexcellence.org.uk>.

commit to make a priority the achievement of mutually agreed-upon project goals – even at the expense of personal gain. As a consequence, project goals must be developed in such a way that all parties willingly buy-in to them. Clear standards need to be developed to determine whether they have been met and what is the consequence of success or failure.⁹¹

- **Integrated Services Matrix:** This exercise focuses upon who is responsible for doing what so that reasonable expectations can be developed between the Members as to what promises and commitments each is making to the others.⁹²
- **Project Schedule:** Because schedule can have a direct bearing on cost, the Members are required to jointly develop a project schedule.⁹³
- **Funding Schedule:** Obviously, it is difficult to finalize a funding schedule until the Members have settled upon a Target Cost, but this exercise is valuable as it necessitates an examination of the Project's cash flow requirements and serves as another tool for evaluating the Target Cost.⁹⁴

Most IPD agreements require the Target Cost be communicated with specificity. Again, the C195 Family follows this approach. The C195 model defines what costs are subject to reimbursement.⁹⁵ The Target Cost is required at a minimum to be broken down to provide costs to plan, design, estimate, schedule, manage, construct, commission, and closeout the Project.⁹⁶ The breakdown must also set out any sums for contingencies, insurance, administrative expense, dispute resolution (*i.e.*, the cost of the “neutral” under § 2.19 of C195) and goal achievement.⁹⁷

⁹¹ See AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.4 and Exhibit E (CC) (2008).

⁹² AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.5 and Exhibit E (DD) (2008).

⁹³ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.6 and Exhibit E (EE) (2008).

⁹⁴ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.2.7 (2008).

⁹⁵ Because it is built on a cost reimbursement platform (at least as respects the architect and construction manager), the C195 Family defines the costs which are subject to reimbursement under the Non-Owner Member agreements. See AIA Document C197 – 2008, Standard Form of Agreement Between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, Article 7 (2008).

⁹⁶ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.3.1 and Exhibit E (AA) (2008).

⁹⁷ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.3.2-5.3.6 and Exhibit E (AA) (2008). It should be stressed that these are “minimum” requirements and that for a project of any complexity, the Target Cost Breakdown is likely to be quite detailed. Whether the breakdown will include price quotes from trade contractors is largely a function of design completeness, which, under the C195 program, is somewhere in the traditional Design Development stage. The C195 addresses the question of contingencies at § 5.1.3: “All fees and contingency amounts in the Target Cost proposal shall be clearly identified and explained.” The issue of contingencies in cost reimbursement contracts is often complex and misunderstood. The requirement that the Members jointly develop a Risk Matrix (§ 5.2.3) is expected to inform the

IPD agreements also focus on monitoring and maintaining the target cost. The C195 requires the Company to make periodic cost projections necessary to satisfy all Members that the Target Cost is being maintained.⁹⁸ These projections are distributed to the Members for review and approval. If any periodic cost projection reveals that the Target Cost is projected to be exceeded, the Company is required to develop a Recovery Plan to maintain the Target Cost.⁹⁹ The Recovery Plan is subject to approval by all of the Members. Moreover, if any Member believes or acquires information suggesting that the Target Cost might be exceeded it is required to notify the other Members, who are required to meet to evaluate the matter. Once again, if the consensus of the Members is that the Target Cost is threatened, the Company shall develop a Recovery Plan.¹⁰⁰ If the Owner declines to approve a Recovery Plan, the Company is required to proceed with the work and take such mitigation steps as are reasonable to keep cost escalation to a minimum.¹⁰¹

The ConsensusDOCS 300 contains a host of mechanisms intended to maintain the integrity of the Target Cost labeled the “Project Target Cost Estimate” or “PTCE”. The owner provides the Management Group its project budget.¹⁰² The designer, in collaboration with the owner and constructor, develops a design budget.¹⁰³ The constructor provides the Management Group with a construction budget, which includes a preliminary estimate of the total cost of construction, a design contingency, a construction contingency, and other contingencies to cover costs for securing bids and material price escalations.¹⁰⁴ The Collaborative Project Delivery (CPD) Team is required to use “diligent” efforts to design the project so it may be constructed without exceeding the construction budget. The construction budget cannot be revised without the owner’s approval.¹⁰⁵

Whereas the construction budget is established “at the beginning of the project” (§ 8.1.3), at such time as the Management Group determines that the project design is sufficiently complete, the parties shall jointly develop a Project Target Cost Estimate (PTCE).¹⁰⁶ The agreement does not address the factors relevant for determining whether the project design is “sufficiently complete” to provide a PTCE. Timing of the Target Cost is a critical issue, as the earlier it is given the greater the incentive and opportunity to innovate during the design phase, thereby enhancing the potential for sharing in cost savings; whereas the later it is given, the more

explanation of contingency amounts in the Target Cost.

⁹⁸ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.7.1 (2008).

⁹⁹ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.7.2 (2008).

¹⁰⁰ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.7.3 (2008).

¹⁰¹ AIA Document C195 – 2008 Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 5.7.5 (2008).

¹⁰² ConsensusDOCS 300 at ¶ 8.1.1.

¹⁰³ ConsensusDOCS 300 at ¶ 8.1.2.

¹⁰⁴ ConsensusDOCS 300 at ¶ 8.1.3.

¹⁰⁵ ConsensusDOCS 300 at ¶ 8.1.4.

¹⁰⁶ ConsensusDOCS 300 at ¶ 8.3.1.

price certainty one acquires but the less opportunity there is for cost savings.

The PTCE includes sums for a variety of contingencies: (1) a contingency for further design development; (2) a permit contingency covering changes required by permitting agencies; and (3) a construction contingency. The use of the construction contingency is subject to the prior approval of the Management Group.¹⁰⁷ Unused contingency monies fund the incentive programs created under the agreement.¹⁰⁸

If the proposed PTCE exceeds the project budget, the owner may either approve an increase in the project budget or terminate the project.¹⁰⁹ In the event the owner elects neither alternative, the Management Group may authorize rebidding or renegotiating any portion of the project or direct the CPD Team to collaborate on revising the project scope to bring it within the project budget.¹¹⁰ Once the PTCE is accepted by the Management Group, the contract shall be so amended to reflect the agreed-upon Target Cost. The constructor agrees not to seek a change in the Target Cost based upon inadequate or insufficient design documents.¹¹¹ The rationale for this limitation is the fact that the constructor has collaborated with the design team during the preconstruction phase.

The ConsensusDOCS 300 allows for the parties to structure incentives, including incentives that bear on project cost. Savings in the form of actual costs less than the PTCE shall be shared as negotiated and set forth in the agreement.¹¹² Losses, in the form of costs in excess of the Target Cost, may be shared or borne entirely by the owner, as set forth in ¶ 11.5 of the agreement. To the extent that the parties share costs in excess of the PTCE, they shall also indicate whether the designer's and constructor's fees are at risk and whether the fee is a limitation of liability for cost overruns.¹¹³

The ConsensusDOCS 300, like the C195 Family, contains a great deal of process intended to monitor and maintain the Target Cost:

- **Target value design:** This approach to design is intended to “inform the overall project design with the critical criteria of quality, cost, schedule and constructability.”¹¹⁴ The Management Group shall develop target value design methods for the designer, constructor, and trade contractors addressing

¹⁰⁷ ConsensusDOCS 300 at ¶ 8.3.2.

¹⁰⁸ ConsensusDOCS 300 at ¶ 8.3.2.3.

¹⁰⁹ ConsensusDOCS 300 at ¶¶ 8.3.5.1 and 8.3.5.4.

¹¹⁰ ConsensusDOCS 300 at ¶¶ 8.3.5.2 and 8.3.5.3. Revising the project scope may necessitate the designer having to revise the drawings and specifications to allow the PTCE to be reduced to 100% of the project budget. Moreover, if the Management Group determines that changes in market conditions, or other conditions beyond the control of the CPD Team, are the cause of the PTCE proposal exceeding the project budget, it may authorize reimbursement for such services from applicable contingency funds (¶ 8.3.5).

¹¹¹ ConsensusDOCS 300 at ¶ 8.3.7.

¹¹² ConsensusDOCS 300 at ¶ 11.4.

¹¹³ ConsensusDOCS 300 at ¶ 11.6.

¹¹⁴ ConsensusDOCS 300 at ¶ 6.13.1.

the establishment of initial target costs for major project components and systems, the formation and conduct of the project design, and cost analysis procedures.¹¹⁵

- **Value identification and creation:** The designer and constructor and their consultants shall continually seek to create value by identifying options to improve constructability and functionality, reduce capital or life-cycle cost, and provide operations flexibility consistent with the owner's programmatic needs.¹¹⁶ As a result of these efforts, a CPDT member may submit a Value Creation Proposal to the Management Group and, if accepted, the designer shall ascertain the design feasibility, compatibility and compliance with buildings regulations and professional standards of care.¹¹⁷
- **Constructability:** The constructor shall conduct constructability reviews in collaboration with the designer to determine that the design documents will result in construction drawings sufficiently complete to reduce the risk of disruption, delay, change orders, and potential claims.¹¹⁸
- **Preliminary planning:** The designer and constructor shall review the owner's program and meet with trade contractors to confer on and verify the requirements of the project.¹¹⁹ The designer and constructor shall provide to the Management Group for its written approval a joint preliminary evaluation of the owner's program and the project requirements, addressing all issues bearing on the success of the project. The joint preliminary evaluation shall propose alternative architectural, civil, structural, mechanical, electrical and other systems for review by the Management Group, to determine the most desirable approach on the basis of cost, technology, quality, and speed of delivery.
- **Cost modeling:** The constructor shall provide on-going cost modeling to inform and promote its target value design efforts.¹²⁰ The constructor shall generate cost model reports as directed by the Management Group. If building information modeling is utilized, the cost reports shall be generated at appropriate milestones, as designated by the Management Group. The agreement sets forth four separate cost models: (1) preliminary cost model; (2) schematic design cost model; (3) design development cost model; and (4)

¹¹⁵ ConsensusDOCS 300 at ¶ 6.13.2. It is not entirely clear what is meant by the Management Group addressing the establishment of, among other things, "the formation and conduct of project design." Professional licensing requirements dictate that the design be within the control of licensed professionals.

¹¹⁶ ConsensusDOCS 300 at ¶ 6.14.

¹¹⁷ ConsensusDOCS 300 at ¶ 6.14. Essentially, this process is a value engineering protocol.

¹¹⁸ ConsensusDOCS 300 at ¶ 6.15.

¹¹⁹ ConsensusDOCS 300 at ¶ 7.1.

¹²⁰ ConsensusDOCS 300 at ¶ 8.2.

construction document cost model.¹²¹ Essentially, the constructor is required to update its cost model during the various design phases with the last cost model developed when the designer's completion of construction documents reaches approximately 50%.¹²² Cost models shall be reviewed on an ongoing basis to determine that the models conform with approved budgets and target costs developed as part of the target value design efforts. To the extent that cost models do not conform with budgets and target costs, the Management Group shall give direction on what actions shall be taken by members of CPD Team.¹²³

- **Lean project delivery methodology:** The agreement adopts a number of lean construction concepts, including the making of “reliable commitments,” “pull-based design,” and “pull planning.”¹²⁴ To the extent that the construction team is comprised of individuals familiar and committed to lean construction principles, the incorporation of these methodologies creates value. On the other hand, confusion can result where the construction team is unfamiliar with lean construction methodology.¹²⁵
- **Quality plan:** Because quality, and particularly the failure to achieve it, can negatively impact cost, the agreement requires the designer and constructor,

¹²¹ ConsensusDOCS 300 at ¶¶ 8.2.1-8.2.4.

¹²² ConsensusDOCS 300 at ¶ 8.2.4.

¹²³ ConsensusDOCS 300 at ¶ 8.2.7.

¹²⁴ ConsensusDOCS 300 at ¶¶ 3.9, 6.5, and 7.2.1.

¹²⁵ This point is made by Jilei Wang in his Masters Thesis, discussing an IPD case study in which lean principles were employed:

At the time the IPD team did not know much about “lean.” Initially Westbrook CEO, Owen Matthews, educated himself on “lean” and held in-house classes to train the rest of the team members. When the IPD team started implementing “lean,” they felt excited about it. They planned to implement “lean” on large construction projects if they had direct control over them. On smaller jobs, they would use many lean principles such as the Last Planner System (LPS – developed by Lean Construction Institute). Since then, the IPD team has tried to utilize lean whenever and wherever they can. It allows the team to maximize its most limited resource – people. . . .

“[L]ean” is not a solution to all problems. When the IPD team started the implementation of “lean,” they planned to use the LPS on every job. But later on they realized that it was not the case since the LPS worked well for some projects but poorly on other jobs. The LPS is not applicable for all projects and should be applied case by case. Projects not subjecting [sic] to a lot of changes are not suitable to use the LPS. It is necessary to evaluate each project in terms of its potential for changes before deciding whether or not to use the LPS.

[Moreover], it was tough to sell “lean” to everybody, especially those who are unfamiliar with it. Many GCs knew little about the LPS and the Last Responsible Moment (LRM) so they were suspicious. They believed late decisions would create poor schedules to release work to downstream crews. It was difficult for them to understand and accept those concepts.

Jilei Wang, *Integrated Project Delivery – Achieving Relational Contracting Through Traditional Project Management Methods*, Graduate Thesis, University of Cincinnati at 32-33 (Aug. 2008).

in collaboration with the CPD Team, to develop a quality plan.¹²⁶ The quality plan shall, at a minimum, address eleven separate issues including clear communication of contract documents to project participants, training workers on standardized work practices and continuous improvement of work practices, quality check lists, training onsite managers in quality assurance, developing work “handoff” protocols, and creating standards by which to measure and track quality performance.¹²⁷

3. Assuring Cost Integrity Through Cost Transparency

IPD models built on cost reimbursement provide for full examination of all cost information. The development of the Target Cost proceeds on a “open book” basis. Under the C195 Family, the Company is required to keep full and detailed records related to the cost of the work, and the owner and its auditors are afforded access to those records.¹²⁸ The owner has similar audit rights under the ConsensusDOCS 300 agreement.¹²⁹

The owner may also conduct verification such as counting employees at the project site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with employees, subcontractors, and material suppliers.¹³⁰ The designer and constructor shall require their consultants, trade contractors, subcontractors, and material

¹²⁶ ConsensusDOCS 300 at ¶¶ 3.10 and 3.10.1.

¹²⁷ ConsensusDOCS 300 at ¶ 3.10.1. Since the time of the pyramids, managing design and construction quality has been a difficult challenge. Management of quality has two broad components: (1) quality assurance, and (2) quality control. Quality assurance are the planned or systematic actions necessary to provide adequate confidence that a product, process, or service will conform to established requirements. Quality control, on the other hand, is inspection, testing, evaluation, or other necessary actions to verify that a product, process, or service conforms to established requirements. See J. L. Burati and J. J. Farrington, *Cost of Quality Deviations in Design and Construction*, Construction Industry Institute, Source Document 29 (Aug. 1987). An example of quality assurance might be reviewing a request for quotation for an equipment item to assure that the design documents for the equipment agree with project specifications. Quality control might include inspecting the equipment during fabrication to ensure that it is manufactured according to specification. See Construction Industry Institute, *Potential for Construction Industry Improvement, Vol. 1 – Assessment Methodology*, § 5.1.2.5, Source Document 61 (Nov. 1990). Beyond managing quality at the project level, emphasis needs to be placed on quality of organizational and management structures within design and construction firms. Commitment to Total Quality Management (TQM) principles is an important partner selection criterion. See Construction Industry Institute, *Guideline for Implementation of CII Concepts: Best Practices for the Construction Industry*, Implementation Resource 42-2 at 13 (Sept. 1995) (identifying “continuous improvement” or Total Quality Management (TQM) as one of thirteen “best practices” for the construction industry).

The quality plan addressed in § 3.10.1 focuses primarily on quality assurance matters, which is appropriate given that quality control is a standard subject covered in construction contracting and a routing practice (performed to varying levels of exactitude) in the field. Paragraph 13.2 calls upon the constructor, trade contractors, and subcontractors to submit to the Management Group for its approval a construction operations quality plan that addresses clean-up, materials management, and standardized construction operation practices. Workmanship, tests and inspection, and correction of work are addressed in Article 13.

¹²⁸ AIA Document C196 – 2008, Standard Form of Agreement Between Single Purpose Entity and Owner for Integrated Project Delivery, § 7.1 (2008).

¹²⁹ ConsensusDOCS 300 at Article 19.

¹³⁰ ConsensusDOCS 300 at ¶ 19.2. This is the construction equivalent of the “trust but verify” principle.

suppliers to comply with the record-keeping and auditing requirements.¹³¹

The ConsensusDOCS agreement contemplates a final accounting where the owner's accountants must seek to conduct this exercise within fifteen days after the constructor's delivery of the final accounting to the Management Group.¹³² Based upon such Cost of the Work as the owner's accountants report as substantiated by the constructor's final accounting, the Management Group either issues a final certificate for payment or notifies the constructor in writing of the reasons for withholding its certificate. Any dispute that arises in connection with the final accounting is resolved pursuant to the agreement's dispute resolution provisions. Pending a final resolution of disputed amount, the owner shall pay the constructor the amount certified as indicated in the final certificate for payment.¹³³

C. Project Control: The Management Model

IPD proceeds by consensus. Consensus requires joint decision-making on most major issues affecting the project. On the other hand, IPD recognizes that the most significant stakeholder in the project is the owner. It is the owner's needs and desires, the most important of which are set forth as mutually agreed-upon project goals, that all participants seek to satisfy. It is the owner's money that funds most, if not all, project activity and, at the end of the day, it is the owner that must live with the outcome. As a consequence, IPD must strike a balance between the owner's right of ultimate control with the collaborative decision-making that is a hallmark of any integrated project delivery approach.

Traditional contracting contains an odd mixture of control points. The owner has nearly unfettered discretion to change project program requirements at any time.¹³⁴ This is the intent behind the typical "changes" clause. As long as the change is not so drastic as to amount to a completely new undertaking (*i.e.*, an abandonment of the original contract sometimes referred to as a "cardinal" change in federal contracting), the owner is free (in a manner of speaking) to make unilateral changes to project scope.¹³⁵ Changes to project scope and the owner's right to

¹³¹ ConsensusDOCS 300 at ¶ 19.3.

¹³² ConsensusDOCS 300 at ¶ 19.4.

¹³³ ConsensusDOCS 300 at ¶ 19.4. It is not clear what happens if the Management Group fails to reach consensus with respect to either issuing a final certificate for payment or agreeing upon the reasons for withholding its certificate. Borrowing from language that is commonly found in agreements addressing similar issues arising in connection with change orders, the owner could be obligated to pay that amount for which there is consensus, with the parties proceeding through the dispute resolution process on the disputed amount.

¹³⁴ Traditional contracting strategy places heavy emphasis on unilateral decision-making with respect to changes while de-emphasizing incentives:

Contract clauses related to change provisions and project control requirements appear to be standard practice with 84% utilization on projects. Alternatively, incentives are only used at a rate of 33% on owner projects. This low level of utilization could be due to recent good economic climate for owners [this study was done in the late 1980s] with its predominance of lump sum contracting as well as the difficulty often associated with administering incentive clauses.

Construction Industry Institute, *Potential for Construction Industry Improvement, Vol. II – Assessment Results, Conclusions and Recommendations*, Source Document 62 at 169 (Nov. 1990).

¹³⁵ *Bruner & O'Connor on Construction Law*, § 4.13 (West Group 2002, Supp. 2008).

make unilateral changes under the changes clause has generated a fair amount of controversy over the years.¹³⁶ The possibility that the owner may make changes to the work often plays as prominent role in risk surveys.¹³⁷ Many owners believe that contractors unfairly use their leverage when pricing change order work. In contrast, many in the construction community believe that owners do not appreciate the disruption that changes can mean to workflow and, ultimately, the “bottom line.” As a consequence, the owner’s unilateral right to make changes has been the source of much dispute over the years.

Traditional contracting approaches, while giving the owner great discretion in making changes to program requirements, also seek to isolate the owner from the decisions of its design and construction professionals. The owner throws its project requirements “over the transom” to the designer, who, in turn, hands over its design to the contractor for execution. The contractor’s choice of “means and methods” are its alone, for which neither the owner nor designer provide any input or take much interest. This segregation of activities is liability driven. The less one knows and plays a role in what others are doing, the more one is shielded from liability in the event they do something wrong. While this approach is understandable, given the current liability environment in the design and construction industry, it makes for poor overall project management and all too often proves counterproductive.¹³⁸

¹³⁶ See Construction Industry Institute, *Control of Construction Project Scope*, at 40-44, Source Document 6 (March 1986) (“Why do problems with changes persist on these [poorly scoped] projects? . . . Without exception, company representatives indicated the need for operator input in project scope development. They listed late input from these personnel as a primary reason for owner-initiated changes and problems. The most vehement complaints, as could be expected, came from contractors. For example, one contractor said of operating personnel, ‘These people are dangerous. They have no concept of what their requests will mean to the project.’ The same contractor encouraged early input followed by a frozen design basis. . . . The difficulties in freezing design on cost-reimbursable design are obvious. As stated earlier, owners often choose to perform the project cost-plus because it affords them the freedom to change their mind. With only one exception, owner organizations admitted in one form or another, ‘We like to say design is frozen, but you never can really freeze it on this type [industrial] project.’ A majority of firms identified piping and instrumentation diagrams as the point in design where a freeze would be most beneficial. . . . While contractors’ change control systems may be capable of reflecting any request’s costs, the time required to provide the estimate might render it useless. Owners complain that contractors are able to provide estimates quickly on lump-sum jobs, but not on cost-plus jobs. Owners admit that this slow turnaround may lead them to request changes without respect to their cost, or to bypass the control system. . . . On cost reimbursable jobs, particularly on those where there is no guaranteed maximum price or where the fee is a percentage of project cost, contractors are economically motivated to permit higher project costs. If changes make projects more expensive, then contractors have incentive to allow changes on projects. The incentive for controlling changes comes from contractors desiring to maintain good client relations. Owners do not like surprises, and mounting change costs that are reported only after they have occurred, may surprise owners. Contractors, then, are in a difficult position. They attempt to provide the project as the owner wants it, but they must provide it at an acceptable cost. Some others have complained that contractors go too far in change control, that owner suggestions are met with artificially high cost estimates to discourage changes.”)

¹³⁷ See American Society of Civil Engineers, *Construction Risks and Liability Sharing*, Vol. II, Appendix 1 (1980); Kumaraswamy & Yogeswaran, *Significant Sources of Construction Claims*, 15 Int’l Constr. L. Rev. 144 (1998).

¹³⁸ The liability concerns that construction presents inevitably leads, under traditional contracting schemes, to clauses seeking to shift liability from one player to another. Inequitable risk allocation, at least as it is so perceived by certain project participants, generates mistrust and can lead to dispute. From a management perspective, risk allocation that places liability on parties who do not have the ability to control or manage the factors essential to

Collaborative contracting approaches are built on a different management model. While the owner retains essential control over its program and project requirements, most other decisions are collective. Moreover, under many IPD models, the owner's program requirements are evaluated by other team members so that the owner may have their input early and make whatever changes it believes are appropriate based upon their review and evaluation.

Most IPD contracts seek to strike a balance between collaborative decision-making and the owner's right of control over major program requirements and project developments. This is often achieved through creation of various management and implementation teams within a contract structure that still provides the owner with unilateral control over changes to its program and the right to terminate the contract at its convenience. The ConsensusDOCS 300 is typical. Under Article 20, the owner may order changes in the work.¹³⁹ Under Article 22, the owner has

controlling the risk is inherently flawed. Nevertheless, this is a typical result of traditional contracting. Risk is flowed downstream to subcontractors, but project control remains largely in the hands of those upstream. Complaints about inequitable risk allocation and the owner's lack of participation in project decision-making have been around for some time:

The owner or its representative has an essential role in improving working relations, contract execution and overall project performance by the decisions made regarding risk allocation. This research documents the general conclusion that use of onerous contract provisions that cause the contractor to assume inequitable, unbearable and uncontrollable risks will directly and negatively impact the owner-contractor working relationship.

Beyond equitable allocation of risks, there are additional steps an owner can take to improve working relationships. Several firms interviewed in this study suggested the development of project problem-solving teams with owner and contractor personnel to anticipate potential project problems and provide workable solutions in advance. Another contributed suggestion was to give increased authority to the owner's on-site project manager so decisions can be made at levels closer to the work.

Improved contract execution can result from owner investment in preconstruction studies to better define risks. Execution can also be facilitated by development of a project execution manual consisting of detailed procedures for handling indemnity problems, consequential damages, differing conditions and delays when they occur. Another suggestion was for more aggressive owner administration and documentation of project problems to prevent unnecessary claims and disputes.

Owners typically resist changing contract content for fear that such changes will adversely disrupt their means of purchasing construction services. The modifications that do occur often focus on allocating additional risks to the contractor. Recommendations included in this report may represent for many firms a dramatic shift from present methods of allocating contractual risk. The research evidence supporting these recommendations, however, is substantial. Both owners and contractors are thus encouraged to use the information contained within this document to stimulate development of contract terms that more positively support project performance and participant working relationships.

Construction Industry Institute, *Impact of Risk Allocation and Equity in Construction Contracts*, Source Document 44 at v-vi (March 1989).

Many of these recommendations are addressed, but at a much more fundamental level, through IPD.

¹³⁹ ConsensusDOCS 300 at ¶ 20.2.1. The clause also permits the constructor to "request" changes in the work. Presumably the difference between "requesting" and "ordering" is one of control. The owner has the right, and therefore controls, changes in the work whereas the constructor does not. Of interest is the fact that the designer is absent from the changes process under the ConsensusDOCS 300 approach.

the right to suspend performance or terminate the contract for its convenience.¹⁴⁰ The project is managed collectively. Article 4 creates a Management Group consisting of representatives from the owner, designer and constructor. Decision-making is by consensus, although the owner “breaks all ties” by having the right to make determinations in the absence of consensus.¹⁴¹ Where the owner makes a decision with a lack of consensus, it is subject to the dispute resolution process in Article 23.¹⁴² Decisions implicating life, health, property and public welfare, and which are required to be made by a licensed design professional, shall be made by the designer.¹⁴³ The Management Group does not make the day-to-day decisions to move the project forward. This is delegated to another collaborative team – the Collaborative Project Delivery (CPD) Team.¹⁴⁴ The CPD Team includes representatives of the owner, designer and constructor as well as design consultants and trade contractors important to the preconstruction phase. These parties are required to sign Joining Agreements as they become members of the team, accepting the principles and methods of collaboration set forth in the ConsensusDOCS 300.¹⁴⁵ The agreement also sets forth meeting requirements and communication protocols between and among teams.¹⁴⁶

Much of the focus of collaborative management under the ConsensusDOCS 300 is on the preconstruction phases:

It would be easy to overstate the “collaborative” nature the ConsensusDocs 300 form of agreement. While the “collaborative principles” described in the agreement are well-stated, and theoretically govern the parties through the entire performance of the project, they are most important through stage one. However, once the price of the project is fixed, the contractor agrees to complete the project for no greater sum than that price. The contractor then performs its work according to the provisions of the contract, which resemble those of most standard

¹⁴⁰ ConsensusDOCS 300 at ¶ 22.1 (Suspension by Owner for Convenience) and ¶ 22.4 (Termination by Owner for Convenience). The owner also has the traditional right to terminate for default (¶ 22.3). The construction and designer also have the right to terminate (¶ 22.5). One of the bases upon which the constructor or designer may terminate is where the owner suspends performance for its convenience (¶ 22.5.1.3). As a result, the owner’s suspension rights are not unfettered, as invoking this right gives either the designer or constructor the right to terminate.

The ConsensusDOCS 300 agreement does not discuss the consequences of contract termination by one of the other parties. What is the effect on the tri-party agreement if one of the parties chooses to terminate another? What rights does the constructor have if, for example, the owner chooses to terminate the designer? Contract termination is a tricky concept in the context of collaborative undertakings. How vital are team members to a team? Employing traditional contract termination concepts to collaborative undertakings is a bit incongruous, as it suggests that team members may be eliminated or exchanged without materially altering the team. Nevertheless, allowance should be made for team members to withdraw or be replaced upon good cause shown or with the consensus of the other team members.

¹⁴¹ ConsensusDOCS 300 at ¶ 4.1 (Management Group) and ¶ 4.6 (Decision-Making).

¹⁴² ConsensusDOCS 300 at ¶ 4.6.

¹⁴³ ConsensusDOCS 300 at ¶ 4.6.

¹⁴⁴ ConsensusDOCS 300 at ¶ 3.3.

¹⁴⁵ ConsensusDOCS 300 at ¶ 3.3.

¹⁴⁶ ConsensusDOCS 300 at ¶¶ 4.7, 4.8, and 4.9.

general conditions. These include the standard remedies for disputes that may wind up in court or arbitration. Thus, for the bulk of the project, the contractor is performing the project under a detailed agreement with the owner similar to traditional agreements, the terms of which were fixed prior to the start of the parties' collaborative efforts.

Unfortunately, this agreement seems to fall into the same trap as previous forms dealing with simpler projects. While the first stage of the project is characterized by collaboration and flexible compensation arrangements, the construction of the project in the second stage involves the parties following a detailed script dictated by the contract with a fixed price. Except for the fixing of the price, this script was written before the project's scope and nature were defined. Much of the advantage of the parties' earlier collaboration is wasted by the structure of the second stage agreement. Is it reasonable to expect that this agreement will be any more likely to avoid disputes by attempting to forecast all of the project's issues than previous forms?¹⁴⁷

The AIA's C195 is perhaps the most aggressive form when it comes to creating novel project management structures. The owner, architect and construction manager (as well as any other primary project participants chosen to be Members) form a separate Company through which to manage the Project. The Company, a limited liability company, holds no property, has no employees, and is only minimally funded.¹⁴⁸ While the structure of the Company is intended to generate no significant profits or losses *at the Company level*, as all revenue is distributed in the form of payments to Members and others providing design and construction services, the creation of a separate legal entity through which to manage the Project is more than a symbolic act. The forming of a company, while a bit more involved than simply writing up a contract, furthers the parties' collaborative undertaking as it requires them to carefully consider governance and financial incentive questions critical to Project success.

Like the ConsensusDOCS 300, the C195 creates a two-tier management structure that presumes consensus decision-making. The mechanics of how this is achieved, however, are different. The limited liability company structure provides a natural platform for collaborative

¹⁴⁷ Allen Overcash, *Will the New Contract Forms for Integrated Project Delivery Make Conflict Obsolete? (Or Are We Still Lost in our Contract Obsession?)*, 3 J. ACCL 19, 32-33 (Winter 2009) (galley proof). While it is understandable how someone might conclude ConsensusDOCS 300 is a fixed-price contract, in reality it more closely resembles a cost reimbursement form.

Others have characterized the ConsensusDOCS 300 as "not significantly different from a design/build contract." Victor O. Schinnerer & Co., Inc., *Guidelines for Improving Practice*, No. 1 at 3 (2008). Whether this assessment is entirely accurate is open to question, but it does highlight some of the perception issues that IPD agreements raise. These agreements are quite different from traditional contracts and yet it is difficult to categorize or understand them entirely separate from familiar customs and practices. The tendency to equate IPD contracts with more familiar contracts and project delivery approaches, while understandable, can lead to some unintended misunderstandings.

¹⁴⁸ At least this is the AIA model. Of course, parties may choose to create a more substantial entity, although this would require a rethinking of the capitalization, distribution and governance provisions which are beyond the scope of our examination.

governance. Article 8 of C195 sets forth the Company's management structure. A Governance Board is created consisting of the five board members, or such other odd number of board members as the Members may determine from time to time.¹⁴⁹ The rationale behind this uneven numerical arrangement is to avoid a deadlock on those matters that the Members have chosen may be decided through majority vote. Authorizations, approvals, or other actions subject to majority rule are essentially within the owner's control because it maintains one more representative on the Governance Board than the total of the other Members.¹⁵⁰ One of the owner's representatives serves as the Governance Board.¹⁵¹

Notwithstanding the owner's numerical control, the underlying governance assumption is unanimity.¹⁵² As a consequence, the Members must give careful thought as to which matters shall be carved for majority rule (*i.e.*, those matters within the owner's unilateral control). The C195 Family does not contain a number of the standard clauses found in construction contracts. For example, there is no changes clause contained in either the C195, C196 or C197. This is not an oversight. Many of the traditional construction contract clauses, including the changes clause, have been sources of much controversy and dispute. The C195, which is the AIA's most aggressive expression of collaborative project delivery, seeks to avoid many of the common pitfalls by hewing closely to tenets of the *IPD Guide*.¹⁵³

Is it imperative for an owner to carve out the right to unilaterally control project scope under the C195? There is, of course, a natural tendency for owners to want to control their own programs. From this perspective, it would not be unusual for the owner to set aside changes in project scope for majority decision-making. Yet, under the C195 model, the failure to carve scope change for majority rule may not make much of a difference. If the Members have done their due diligence and put together a well-functioning team, it is unlikely that disagreement would arise over changes the owner desired to make to the project. While changes to project scope might well have financial consequences to the Members, and therefore a discussion about

¹⁴⁹ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 8.2.1 (2008).

¹⁵⁰ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 8.2.1 (2008) (“The Owner shall appoint a number of representatives to the Governance Board such that the total number of Owner representatives on the Governance Board shall be one more than the total number of Non-Owner Members.”)

¹⁵¹ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, at § 8.2.1 (2008).

¹⁵² AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 8.2.3 (2008) (“Except for those matters specifically set forth in § 8.2.4 allowing the Company to take action by majority vote, all authorizations, approvals, or other actions of the Governance Board shall require the unanimous affirmative vote of the board members.”)

¹⁵³ AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 7, (2007) (“Traditional delivery and contracting approaches contemplate separate silos of responsibility that, in practice, yield inefficiencies whenever there is a hand-off from one silo to another. Additionally, projects delivered traditionally suffer because participant success and project success are not necessarily related. Indeed, it is quite possible for one or more project participants to “succeed,” notwithstanding overall project failure. IPD, however, represents a behavioral sea change in the industry by breaking down the silos of responsibility, requiring close cooperation among all major participants, and aligning participant success to project success.”)

adjusting the Target Cost might be in order, neither the architect or construction manager are performing construction activities (except in the unusual case) and neither of them guarantee construction cost. Moreover, the owner always has the unilateral right to terminate its agreement with the Company at its convenience.¹⁵⁴

Day-to-day management of the Project is accomplished through the Project Management Team.¹⁵⁵ The Project Management Team consists of one representative from each Member. Moreover, the Project Management Team may choose to include, as advisors, representatives, certain Non-Members under contract either to a Member or to the Company in order to bring to bear their unique skills and expertise on particular matters.¹⁵⁶ Exhibit D, the Work Plan to C195, sets forth the structure, duties, and protocols of the Project Management Team. Exhibit D also covers the use of Building Information Modeling (BIM). The Project Management Team commits to use BIM to the greatest possible extent.¹⁵⁷ Models are considered contract documents, although it is anticipated that the Members may supplement these understandings with regard to BIM with supplemental agreements specifying, among other things, which particular models are considered contract documents.¹⁵⁸

The AIA's transitional IPD Family (centered around the A295) achieves collaboration through more traditional means. There are no separate formal committees established. Instead,

¹⁵⁴ AIA Document C196 – 2008, Standard Form of Agreement Between Single Purpose Entity and Owner for Integrated Project Delivery, Article 6 (2008).

¹⁵⁵ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, Exhibit D (Work Plan), § D.1.1 (2008) (“The Members, under their respective Member Agreements, shall establish a Project Management Team responsible for managing the planning, design and construction activities required to complete the Project in the collaborative, integrated process intended under the Agreement. Among other things, the Project Management Team shall be responsible for monitoring and stimulating the progress of the Project and for developing periodic cost projections, benchmarks, metrics, and standards for evaluating the performance of all Members and Non-Members in the achievement of timely and cost effective services and construction on the Project.”)

¹⁵⁶ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, Exhibit D, § D.1.1.3(2008).

¹⁵⁷ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, Exhibit D, § D.3.1 (2008).

¹⁵⁸ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, Exhibit D, § D.3.2 (2008). *See also*, AIA Document E202 – 2008, Building Information Modeling Protocol Exhibit (2008). The E202 Document sets forth a detailed matrix referred to as the “Model Element Table” utilizing the Construction Specification Institute’s UniFormat that allows the project participants to identify the Level of Development (LOD) of particular model elements for purposes of reaching shared expectations with respect to the amount of reliance that may be placed upon model elements for a specified LOD.

The ConsensusDOCS 300 also anticipates the parties will likely utilize BIM technology:

The Parties may establish a building information modeling (BIM) approach to design and construction of the Project, providing continuous and immediate availability of reliable, integrated and coordinated design, scope, schedule and cost information. The use of a building modeling approach, and the processes and technologies necessary to fully utilize such an approach, shall be established as an addendum to this Agreement. If a BIM approach is elected, the Management Group shall establish the BIM parameters, standards and technological requirements.

ConsensusDOCS 300 at ¶ 6.9. The ConsensusDOCS 301 is the organization’s BIM protocol document.

the parties are required to coordinate the services provided by their consultants and subcontractors.¹⁵⁹ Section 4.2 sets forth the contractor's general consultation responsibilities, which include advising the owner and architect on proposed site use and improvements, selection of materials, building systems and equipment. The contractor is also required to provide recommendations on constructability, availability of materials and labor, time requirements for procurement, installation and construction and other factors related to construction cost including, but not limited to, costs of alternative designs or materials.¹⁶⁰

During the various pre-construction phases, the contractor takes on consultation or coordination responsibilities. For example, during the Conceptualization phase, the contractor periodically updates the project schedule in collaboration with the architect and, together with the architect, provides a preliminary evaluation of the owner's program and budget for the work.¹⁶¹ During the Criteria Design phase, the architect and contractor consult on the preliminary design and the criteria design documents.¹⁶² During this phase, the contractor also is charged with obtaining information from subcontractors and material suppliers regarding proposed systems or products, including material procurement scheduling product data sheets, life-cycle and energy efficiency data, cost data necessary to validate estimates and schedules for their scopes of work, tolerances and prefabrication opportunities.¹⁶³ The Criteria Design phase concludes with the owner, architect and contractor meeting to review the criteria design documents, and the contractor updating its estimate and project schedule.¹⁶⁴

During the Detailed Design phase, the architect meets with the owner and contractor as appropriate to review the detailed design documents.¹⁶⁵ The contractor continues to update its estimate and project schedule and, if at the end of the Detailed Design phase the contractor's estimate exceeds the owner's budget, the owner may elect to increase its budget or, in consultation with the architect and contractor, revise the project program or implement any other mutually acceptable alternative.¹⁶⁶ At the conclusion of the Detailed Design phase, the architect submits its detailed design documents which, if approved by the owner, obligates the contractor to prepare a Guaranteed Maximum Price (GMP) proposal for the owner's review and

¹⁵⁹ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 1.6 (2008).

¹⁶⁰ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 4.2.1 (2008).

¹⁶¹ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 5.2 and 5.5 (2008).

¹⁶² AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, §§ 6.1 and 6.2 (2008).

¹⁶³ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 6.4 (2008).

¹⁶⁴ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, §§ 6.6 and 6.7 (2008).

¹⁶⁵ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 7.2 (2008).

¹⁶⁶ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 7.4.1 (2008).

acceptance.¹⁶⁷

Upon joint review of the GMP proposal and the owner's acceptance, the parties move on to the Implementation Documents phase.¹⁶⁸ The architect and contractor prepare implementation documents.¹⁶⁹ The implementation documents illustrate and describe the further development of the approved GMP documents and set forth in detail the requirements for the construction of the work.¹⁷⁰ Under a BIM approach (which the A295 Family anticipates will be utilized) the Implementation Documents phase is a naturally collaborative effort with designers, contractors and material suppliers all contributing to the model. During the Implementation Documents phase, the contractor makes recommendations for substitutions which shall be considered by the architect and both of them incorporate into the implementation documents the design requirements of governmental authorities having jurisdiction over the project.¹⁷¹ At the conclusion of the implementation documents phase, the owner, architect and contractor meet to review the implementation documents and, upon the owner's approval, they become part of the GMP Documents and take priority over the detailed design documents.¹⁷² As the Project moves into the construction phase, the collaboration efforts diminish and the Project takes on more of a traditional flavor.

D. Risk Control: The Liability Model

A principal feature of many IPD agreements, particularly those that strive to realign incentives to foster collaboration, is a new liability model. In some respects, the economic and liability models go "hand-in-hand." A *quid pro quo* for service providers sharing in the

¹⁶⁷ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, §§ 7.5 and 7.6 (2008).

¹⁶⁸ Under IPD phasing, the implementation documents process merges traditional shop drawing activities with the design professional's preparation of construction documents.

¹⁶⁹ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 8.1 (2008).

¹⁷⁰ AIA National/AIA California Council, *Integrated Project Delivery: A Guide*, Version 1 at 27 (2007) ("The goal of the ID [implementation documents] phase is to complete the determination and documentation of how the design intent will be implemented, not to change or develop it. The traditional shop drawing process is merged into this phase as constructors, trade contractors and suppliers document how systems and structure will be created. In addition, this phase generates the documents that third parties will use for permitting, financing, and regulatory purposes. Because the Detailed Design Phase concludes with the design and all building systems "fully and unambiguously defined, coordinated and validated," the Implementation Documents phase comprises less effort than the traditional Construction Documents phase.")

¹⁷¹ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, §§ 8.3 and 8.4 (2008). The extent of the contractor's efforts in reviewing, evaluating, and making recommendations on the design documents must be understood in the context of the A295's general guidance that the contractor is not required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the GMP Documents for a portion of the Work, or unless the contractor needs to provide such services in order to carry out the contractor's responsibilities for the construction means, methods, techniques, sequences and procedures. AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 4.2.6 (2008).

¹⁷² AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 8.7 (2008).

enterprise risk (under the C195 model working at cost, or perhaps without any reimbursement if actual costs exceed the Target Cost) is the restructuring of traditional risk allocation and liability assessment.

Why change the familiar pattern of allocating risk down the contracting chain and leaving the parties, more or less, unfettered to seek redress from one another? Because the current approach simply doesn't work very well. Under traditional contracting schemes, risk is often allocated to parties who are unable to control it or bear its consequences. Seeking redress through arbitration or litigation is highly inefficient, resulting in substantial additional costs and disrupting the parties from tending to more productive matters, often for months and years after project closure. From an industry-wide perspective, utilizing lawyers to move money around from one project participant to another is a highly inefficient and costly process. Nor is litigation consistent with or conducive to collaborative undertakings.

Nevertheless, the need to "blame someone" and exact retribution runs strong in our culture. Moreover, the perceived economic benefits of litigation (often more theoretical than real) are difficult for some to relinquish. Others believe that litigation, or perhaps more precisely the threat of litigation, ameliorates bad behavior and otherwise quells the natural tendency of people to cause harm – a kind of Hobbesian view of project development. All understandable, given the current contracting environment. But under an integrated delivery model, litigation and unenlightened risk allocation are counterproductive. Why misallocate risk when all share in project failure? Why sue someone who is collaboratively working with you to accomplish a mutual goal?

These considerations have a tendency to move IPD participants toward more facilitated dispute resolution models, rather than rigidly formalized dispute processes. IPD liability models often shield participants from liability arising from collective decision-making.¹⁷³ Similarly, service providers, particularly those part of the collaborative team, agree to limit their rights of recovery against other team members, including the owner. Some models, like the Project Alliance, severely limit team members from seeking redress from one another.¹⁷⁴

As between the ConsensusDOCS 300 and the two AIA IPD approaches, the C195 Family presents the greatest departure from traditional construction contracting liability models. On the one hand, the C195 follows the exculpation and indemnification approaches frequently found in limited liability company agreements. Article 12 covers Liability, Exculpation, and Indemnification. Members, *acting in their capacity as members* (as distinct from acting pursuant to separate agreements with the Company) are not liable to the Company or any other Member for good-faith reliance on the provisions of the SPE agreement.¹⁷⁵ Members (including those affiliated with them or their agents – designated as "Covered Persons") are not liable to the

¹⁷³ See ConsensusDOCS 300, ¶ 3.8.2.1.

¹⁷⁴ See Steve Rowlinson, et al., *Alliancing in Australia – No-Litigation Contracts: A tautology?*, J. Prof. Issues in Eng. Ed. & Prac. (Jan. 2006); J. S. J. Koolwijk, *Alternative Dispute Resolution Methods Used in Alliance Contracts*, J. Prof. Issues in Eng. Ed. & Prac. at 44 (Jan. 2006).

¹⁷⁵ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, at § 12.1.2 (2008).

Company or to any other Member (Covered Person) for any loss due to an act or omission performed by it in good faith on behalf of the Company and in a manner reasonably believed to be within the scope of its authority.¹⁷⁶ The Company indemnifies each Member (Covered Person) for acts or omissions performed by it in good faith on behalf of the Company and reasonably believed to be within the scope of its authority.¹⁷⁷ The limitations on Members' liability contained in Article 12 are all limited to the Members' activities as a Member under the SPE, as opposed to the Members' responsibilities under separate contracts with the Company, such as the design and construction management contracts (C196 and C197).

The C195 Family's liability model seeks to contain claims within the membership without jeopardizing rights under required insurance coverages. Article 9 of C197 (Company/Non-Owner Member agreement) and Article 5 of the C196 (Company/Owner Member agreement) contain the key liability provisions. The Company and Members waive the right to make claim against one another, except as otherwise provided in Articles 9 and 5, respectively. Any claim a Member or the Company is entitled to pursue, against one another or other Members, must be done through the dispute resolution process set forth in Article 18 of C195 (the SPE agreement).¹⁷⁸ The heart of the liability scheme with respect to Non-Owner Members is laid out in sections 9.3 through 9.6 of the C197:

§ 9.3 Members Liability to Company Limited to Required and Available Insurance: Except for liability arising out of a Member's willful misconduct, its liability (and the liability of its principals and employees) shall not exceed the proceeds of insurance required under the Agreement and available for the Member's liability.

§ 9.4 Limitation of Member Liability to Other Member Limited to Required and Available Insurance; Member Assigns Claims Against Other Members to Company: With the exception of liability due to a Member's willful misconduct, no Member may recover against another Member for amounts in excess of required and available insurance. Moreover, Members assign to the Company all claims against other Members and empower the Company to resolve the assigned claims and distribute recoveries as it sees fit, subject to the dispute resolution process of C195.

§ 9.5 Company Indemnifies Members Against All Claims Not Paid by Insurance with Exception of Willful Misconduct: Company defends and indemnifies Members (its consultants, contractors, agents and employees) from claims not paid by insurance whether or not the dispute is caused in whole or in

¹⁷⁶ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery at § 12.2 (2008).

¹⁷⁷ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery at § 12.3.1 (2008).

¹⁷⁸ AIA Document C196 – 2008, Standard Form of Agreement between Single Purpose Entity and Owner for Integrated Project Delivery, § 5.2 (2008); AIA Document C197 – 2008, Standard Form of Agreement between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, § 9.2 (2008).

part by the Party indemnified. Company has no obligation to indemnify any Member for claims arising out of willful misconduct.

§ 9.6 Members Assign to Company all Claims Against Non-Members: Members assign to the Company all claims against Non-Members providing services or performing work for the Project and empower the Company to resolve or compromise those claims and distribute any recoveries as it sees fit, subject to the Members' rights under the dispute resolution process of C195.

A similar risk allocation scheme is set forth in Article 5 of the Company/Owner Agreement (C196), except the owner is not shielded from liability to the Company because the owner has the obligation to pay the Company for services provided by or through it with respect to the project.¹⁷⁹ This liability scheme has the effect of funneling claims, whether they be against Members or non-members, through the Company's dispute resolution process.¹⁸⁰

The limited liability structure has the effect of shielding Members from non-members' contract claims. To the extent the organizational structure is recognized and enforced, there should be no joint venture liability between Members.¹⁸¹ Both the C196 and C197 contain standard waiver of subrogation provisions, thereby shielding Members from claims by any insurers "standing in the shoes" of a Member by virtue of paying a claim pursuant to a policy issued pursuant to the terms of the Member's agreement with the Company.¹⁸²

The dispute resolution process under the C195 is also non-traditional. Article 18 of the C195 calls for a ladder dispute resolution process. Presumably, most disputes will be resolved in the field or within the Project Management Team. Members endeavor to resolve all disputes amicably and through mutual consensus. If any Member has a dispute with the Company or another Member (the latter of which is assigned to the Company under § 9.4 of C195), it shall timely give notice of the dispute and a meeting shall be held within fifteen days between representatives of all affected Members in an attempt to reach a mutual resolution. In the event a

¹⁷⁹ AIA Document C196 – 2008, Standard Form of Agreement between Single Purpose Entity and Owner for Integrated Project Delivery, §§ 5.3, 5.4 and 5.5 (2008).

¹⁸⁰ The reason for requiring Members to assign claims against non-members is to avoid the potential or other Members brought into litigation by way of contribution or indemnity due to another Member's attempt to seek redress from a non-member

¹⁸¹ For a discussion of joint venture liability issues arising from construction activities, see *Bruner & O'Connor on Construction Law*, § 7:58 (West Group 2002, Supp. 2008). Moreover, both the C196 and C197 contain the following language:

Nothing contained in this Agreement shall create a contractual relationship of any kind between (1) the Member and any non-member contracting directly with the Company, or (2) the Member and any consultant or subcontractor of any other Member or a non-member.

AIA Document C197 – 2008, Standard Form of Agreement between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, § 11.6 (2008). See also AIA Document C196 – 2008, Standard Form of Agreement Between Single Purpose Entity and Owner for Integrated Project Delivery, § 7.5 (2008).

¹⁸² See AIA Document C196 – 2008, Standard Form of Agreement Between Single Purpose Entity and Owner for Integrated Project Delivery, § 7.2 (2008); AIA Document C197 – 2008, Standard Form of Agreement between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery, § 11.3 (2008).

mutual resolution cannot be achieved, the matter proceeds to the Governance Board for resolution. The Governance Board shall confer on the dispute for the purpose of reaching consensus, and shall render a mutually agreed-upon decision within thirty days of receipt of written notice of the claim or dispute.¹⁸³ If the Governance Board is unable to reach a resolution, the matter is referred to arbitration through a Dispute Resolution Committee for full and final resolution.¹⁸⁴ The Dispute Resolution Committee consists of the chief executive of each Member and the neutral identified in Article 2 of C195. If the Members have failed to select a neutral, the neutral shall be selected by the chief justice of the state supreme court in which project is located.¹⁸⁵

The Dispute Resolution Committee is chaired by the neutral and is entitled to consider such information as the Members mutually agree upon or that the neutral deems appropriate. The neutral first acts as a facilitator, seeking to have the Member representatives of the Dispute Resolution Committee reach a mutually acceptable resolution. If this cannot be achieved within sixty days of the dispute being referred to the Dispute Resolution Committee, the neutral shall decide the matter.¹⁸⁶

The neutral's decision must be consistent with the risk allocation principles set forth in the C195, including any applicable limitations of liability.¹⁸⁷ The neutral shall request the Members provide him or her with whatever documentation they believe is appropriate for resolution. The neutral shall issue a decision within sixty days of the request for documentation, or within such time as the Dispute Resolution Committee deems appropriate. A neutral's decision is final and binding, and any Member may seek entry of judgment on behalf of the Company in accordance with applicable law in any court having jurisdiction thereof.¹⁸⁸

The C195 incorporates a *force majeure* concept excusing performance and allowing an adjustment to the Target Cost for various events beyond the control of Members which adversely impact their ability to perform their contract obligations. Section 14.1 defines "*force majeure* event" by way of example. Section 14.2 sets forth the terms under which performance is excused as a result of the occurrence of a *force majeure* event. Section 14.3 permits the Target Cost to be adjusted based on the reasonable costs incurred as a result of a *force majeure* event.¹⁸⁹

¹⁸³ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 8.2 (2008).

¹⁸⁴ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 18.3 (2008).

¹⁸⁵ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 18.3 (2008).

¹⁸⁶ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 18.4 (2008).

¹⁸⁷ The C195 in Article 6 sets for the risk allocation principles incorporated into the Members' agreements with the Company.

¹⁸⁸ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, § 18.4 (2008).

¹⁸⁹ AIA Document C195 – 2008, Standard Form Single Purpose Entity Agreement for Integrated Project Delivery, §§ 14.1, 14.2, and 14.3 (2008).

The liability model of the ConsensusDOCS 300 is more of a menu approach. While the agreement contains a mutual waiver of consequential damages (§ 3.8.3) and a waiver of subrogation claims by property insurers (§ 21.4.3), the parties are required to elect other risk allocation alternatives. For example, under § 3.8, the parties either agree to release one another from liability for loss occasioned from collaboratively reached and mutually agreed-upon Project decisions, or elect the traditional risk allocation approach of each party being fully liable for its own behavior.¹⁹⁰ If the parties choose traditional risk allocation, they have the opportunity to make a further election with respect to limiting the designer's and constructor's liability.¹⁹¹

Article 11 contains another opportunity for risk allocation election. With respect to liability for actual costs exceeding the Target Cost, the parties are required to decide whether the owner bears the excess costs entirely or whether they are shared between the parties.¹⁹² If the excess costs are shared, the parties are required to elect whether the designer's and constructor's fees are or are not at risk, and whether the total amount of each fee shall or shall not represent the designer's and/or constructor's limit of liability for losses apportioned to Paragraph 11.5.¹⁹³

The ConsensusDOCS 300 contains a number of common construction contract risk allocation provisions. For example, delays encountered by the constructor due to acts or omissions of the owner, the designer, or others shall entitle it to an equitable adjustment of the Target Cost.¹⁹⁴ Some of these clauses are altered due to the integrated and collaborative undertaking. For example, the differing site conditions clause incorporates only Type II conditions (*i.e.*, unusual or unknown physical conditions materially different from those ordinarily encountered). The owner may adjust or reject the constructor's payment obligation for defective work, repeated failure to perform, and other commonly enumerated reasons.¹⁹⁵

The ConsensusDOCS indemnity provision is a bit involved. It consists of three paragraphs, as each party provides indemnity to the other two. Each party's indemnity is limited to the extent caused by its negligent acts or omissions, or anyone else's acts or omissions for which it may be liable. Each party is entitled to reimbursement of any defense costs paid above its percentage of liability for the underlying claim.¹⁹⁶ Under § 21.4.4, the constructor indemnifies and holds harmless the owner for loss arising out of damage or alleged damage to any of the owner's existing adjacent property to the extent of the negligent acts or omissions of the constructor up to the limits of the constructor's commercial general liability insurance.

¹⁹⁰ ConsensusDOCS 300 at § 3.8.2. Even if the parties release one another for loss arising from collaborative decisions (called "safe harbor decisions"), there is an exception for acts or omissions amounting to "willful default" of a contract obligation. ConsensusDOCS 300 at § 3.8.2.1. The "willful default" exception is not expressly incorporated into the traditional risk allocation scheme where the parties agree to a limitation on the designer's or constructor's liability. ConsensusDOCS 300 at § 3.8.2.2.

¹⁹¹ ConsensusDOCS 300 at § 3.8.2.2.

¹⁹² ConsensusDOCS 300 at § 11.5.

¹⁹³ ConsensusDOCS 300 at § 11.6.

¹⁹⁴ ConsensusDOCS 300 at § 15.6.2.

¹⁹⁵ ConsensusDOCS 300 at § 18.3.

¹⁹⁶ ConsensusDOCS 300 at §§ 21.1.1, 21.1.2, and 21.1.3.

The risk allocation program set forth in the AIA's transitional IPD documents follows closely that set out in the Institute's CM-at-Risk documents. There is, however, at least one significant exception. Because the contractor is intimately involved in the design process under IPD, it agrees to forego looking to either the owner or architect for damages resulting from errors, inconsistencies, or omissions in the GMP documents. Section 9.2.4 reads:

Due to the responsibility the Contractor assumes throughout the development of the GMP Documents, neither the Owner nor the Architect shall be liable to the Contractor for damages resulting from errors, inconsistencies or omissions the Contractor reports pursuant to § 9.2.2. However, if the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's request for information pursuant to § 9.2.3, the Contractor shall make Claims as provided in Article 13. If the Contractor fails to perform the obligations of either sections 9.2.2 or 9.1.2 the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations.¹⁹⁷

VIII. CONCLUSION

Integrated Project Delivery holds the prospect of real productivity gains in the provision of design and construction services. Project delivery innovation is long overdue in the construction industry. At present, there are few projects moving forward on an integrated model and, therefore, there is little in the way of hard empirical information as to the expected performance of this delivery model. Nevertheless, there is little doubt that more can be accomplished working collaboratively than not, and much can be done to improve upon traditional delivery models. The industry understands change is necessary and two organizations are leading the way with standard form Integrated Project Delivery agreements. The American Institute of Architects and ConsensusDOCS have issued contract forms that should be of real value to practitioners interested in making a difference by changing to more collaborative delivery models.

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¹⁹⁷ AIA Document A295 – 2008 General Conditions of the Contract for Integrated Project Delivery, § 9.2.4 (2008).

¿Qué sería de la vida, si no tuviéramos el valor de intentar algo nuevo?

Vincent Van Gogh¹

¹ Vincent Van Gogh, Zundert (Holanda) 1853, Auvers (Francia) 1890, pintor y grabador. Uno de los grandes maestros de la historia de la pintura de todos los tiempos, principal exponente del postimpresionismo.



9.- ANEXOS:



9.1.- Anexo 1: Documentos de Trabajo Estudio Delphi:

ENCUESTA PARA TESIS DOCTORAL

1/12

Departamento de Construcción y Tecnología Arquitectónicas (DCTA). Escuela Técnica Superior de de Arquitectura de Madrid (ETSAM). Universidad Politécnica de Madrid (UPM)

Doctorando: Miguel Ángel Álvarez Pérez, Arquitecto, PMP (UPM)

Directores de Tesis: Manuel Soler Severino, Dr. Arquitecto (UPM)

Eugenio Pellicer Armiñana, Dr. Ingeniero de Caminos, Canales y Puertos (UPV)

Fecha: Noviembre 2018

Modalidad: Delphi (anónima, dos vueltas)

Escala Likert

Estimado Colaborador:

La Encuesta que va a realizar consta de cuatro áreas y treinta y tres preguntas en total. Se enfoca a mi investigación sobre la implantación en España de dos técnicas Lean Construction: Sistema del Diseño de Valor Objetivo (Target Value Design o TVD) y Métodos Colaborativos en Construcción (Integrated Project Delivery o IPD).

Ud. ha sido seleccionado como experto en la materia para aplicar el Método Delphi, anónimo en dos vueltas, Escala Likert. Su nombre y filiación aparecerán en la Tesis como participante en la encuesta. Debe elegir, entre las opciones incluidas, una sola respuesta por pregunta, puede añadir al final de cada una un breve comentario sobre la misma, si lo desea.

Su opinión es muy importante para el trabajo que estoy desarrollando y se aplicará a mi Tesis Doctoral que tiene por título: **"La Implantación del Sistema del Diseño de Valor Objetivo y los Métodos Colaborativos (TVD e IPD) en el Proceso Constructivo en España"**.

Agradeciendo su atención y colaboración, reciba un cordial saludo

Miguel Ángel Álvarez Pérez

ENCUESTA DELPHI PRIMERA VUELTA

Area 1: Target Value Design o TVD

Pregunta 1:

La aplicación de la Metodología TVD permite ajustar el presupuesto de los proyectos sin desviaciones económicas en lugar de lo que ocurre actualmente con el método tradicional.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 2:

El mantenimiento del Target Cost inamovible durante todo el desarrollo de un proyecto puede perjudicar su resultado.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 3:

La aplicación de la Metodología TVD incrementa positivamente el valor que se aporta al cliente en un proyecto.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 4:

La Metodología TVD puede aplicarse a proyectos de cualquier cuantía de presupuesto, baja o alta.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Area 2: Integrated Project Delivery o IPD

Pregunta 5:

La aplicación de la Metodología IPD permite reducir los plazos de ejecución de los proyectos en lugar de lo que ocurre actualmente con el método tradicional.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 6:

La aplicación de la Metodología IPD mejora la colaboración entre todos los interesados en el proyecto.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 7:

La selección de los miembros del equipo de trabajo es importante para una correcta aplicación de la Metodología IPD

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 8:

Para un correcto desarrollo del trabajo en equipo con Metodología IPD es necesario el trabajo en "Big Room".

Totalmente de acuerdo:					
De acuerdo:					
Ni de acuerdo ni en desacuerdo:					
En desacuerdo:					
Totalmente en desacuerdo:					

Comentario opcional:

Pregunta 9:

Los miembros del equipo que van a trabajar con Metodología IPD deben tener experiencia previa de haber trabajado con la misma.

Totalmente de acuerdo:					
De acuerdo:					
Ni de acuerdo ni en desacuerdo:					
En desacuerdo:					
Totalmente en desacuerdo:					

Comentario opcional:

Pregunta 10:

La figura de un Facilitador Experto que oriente al equipo de trabajo es necesaria para una correcta aplicación de la Metodología IPD.

Totalmente de acuerdo:					
De acuerdo:					
Ni de acuerdo ni en desacuerdo:					
En desacuerdo:					
Totalmente en desacuerdo:					

Comentario opcional:

Pregunta 11:

La aplicación de la Metodología IPD con "Open Books" mejora la confianza mutua entre los miembros del equipo.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 12:

Mantener reuniones de conjunto, así como colocar información abierta del desarrollo del proyecto en zonas comunes y trabajar en "Big Room", es suficiente para mantener al equipo alineado con IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 13:

El Design Management del proyecto es una cuestión exclusiva del arquitecto y no requiere la intervención de todo el equipo IPD para su éxito.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 14:

La colaboración entre los distintos interesados en el proyecto desde el minuto uno, como propone la Metodología IPD, reduce los riesgos de obtener un resultado negativo en coste, plazo y calidad.

Totalmente de acuerdo:				
De acuerdo:				
Ni de acuerdo ni en desacuerdo:				
En desacuerdo:				
Totalmente en desacuerdo:				

Comentario opcional:

Pregunta 15:

La Metodología IPD puede aplicarse a proyectos de cualquier cuantía de presupuesto, baja o alta y diversa complejidad técnica.

Totalmente de acuerdo:				
De acuerdo:				
Ni de acuerdo ni en desacuerdo:				
En desacuerdo:				
Totalmente en desacuerdo:				

Comentario opcional:

Area 3: TVD e IPD conjuntamente

Pregunta 16:

La aplicación de las Metodologías TVD e IPD requiere la aplicación simultánea de toda la Metodología Lean Construction: Last Planner System, Value Stream Mapping, Choosing by Advantages, BIM, etc.

Totalmente de acuerdo:				
De acuerdo:				
Ni de acuerdo ni en desacuerdo:				
En desacuerdo:				
Totalmente en desacuerdo:				

Comentario opcional:

Pregunta 17:

La aplicación de las Metodologías TVD e IPD debe ser necesariamente conjunta.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 18:

Una formación previa en Lean Construction es necesaria para equipos que vayan a trabajar con Metodologías TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Area 4: Implantación en España de TVD e IPD

Pregunta 19:

Los Promotores Inmobiliarios, las Empresas Constructoras y los Técnicos interesados se adaptarían bien a trabajar en España con Metodologías TVD e IPD en lugar de con las tradicionales.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 20:

La Industria de la Edificación en España (Promotores, Constructores y Técnicos) comprenden las ventajas de la aplicación de Metodologías TVD e IPD en nuestro país.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 21:

La Industria de la Edificación en España (Promotores, Constructores y Técnicos) está preparada para la aplicación de Metodologías TVD e IPD en nuestro país.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 22:

La forma de reparto de beneficios entre los interesados en un proyecto en virtud de los ahorros y y mejoras conseguidos en la obra, según IPD, influye en la falta de interés en España por adoptarlo.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 23:

Es necesaria la especialización de Despachos de Abogados en España en redacción y seguimiento de contratos multiparte para su aplicación a IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 24:

La reserva de información de cada uno de los interesados en un proyecto respecto al resto, característica en España puede superarse mediante la aplicación de Metodologías TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 25:

Los interesados en la edificación en España (promotores, constructores y técnicos) se adaptarían bien a un sistema de riesgos y recompensas compartidos, como lo establecido en la Metodología IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 26:

La actualmente vigente Ley de Ordenación de la Edificación (LOE 1999) dificulta la aplicación de nuevas Metodologías como TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 27:

La nueva Ley de Contratación de los Servicios Públicos (LCSP 2017) facilita que en el futuro se introduzcan Metodologías TVD e IPD en la Edificación Pública en España.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 28:

Debería modificarse la actual Legislación española en materia de edificación para adaptarse a formas más colaborativas de trabajo.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 29:

El aprendizaje en Metodologías TVD e IPD es necesario en España para aplicar a proyectos completos.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 30:

Sería mejor comenzar en España por la aplicación de Metodologías IPDsh aunque no se aplique IPD de forma completa.de momento.

[illegible]

Comentario opcional:

Pregunta 31:

La habitual Contratación a la Baja dificulta conseguir la eficacia de la edificación en España en términos de coste, plazo y calidad.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 32:

España debe plantearse otras alternativas de desarrollo de la edificación respecto a las tradicionales, como TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 33:

La eficacia de la edificación en España mejoraría con la aplicación de Lean Construction y en particular con las Metodologías TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

[illegible]

[illegible]

[illegible]

4	Desacuer.				1				1			1	1	1	1	1	1									41,67	
5	Tot. Desac.											1														4,17	45,83
100,00																											
Pregunta 18																											
1	Tot. Acuer.	1			1	1					1	1	1	1	1	1	1							1	1	45,83	
2	Acuerdo						1		1	1			1						1							25,00	70,83
3	N.Ac. N.Des.							1			1								1	1						29,17	31,82
4	Desacuer.																									0,00	
5	Tot. Desac.																									0,00	0,00
100,00																											
Pregunta 19																											
1	Tot. Acuer.						1												1					1	1	20,83	
2	Acuerdo							1						1											1	16,67	37,50
3	N.Ac. N.Des.								1									1					1			20,83	22,73
4	Desacuer.	1	1			1				1	1								1							37,50	
5	Tot. Desac.																1									4,17	41,67
100,00																											
Pregunta 20																											
1	Tot. Acuer.																									4,17	
2	Acuerdo						1						1													20,83	25,00
3	N.Ac. N.Des.													1									1			12,50	9,09
4	Desacuer.	1				1		1										1								37,50	
5	Tot. Desac.									1	1								1	1					1	25,00	62,50
100,00																											
Pregunta 21																											
1	Tot. Acuer.																									12,50	
2	Acuerdo						1												1							12,50	25,00
3	N.Ac. N.Des.																						1			16,67	13,64
4	Desacuer.	1				1		1										1	1							45,83	
5	Tot. Desac.																									12,50	58,33
100,00																											
Pregunta 22																											
1	Tot. Acuer.																									4,17	
2	Acuerdo																		1							16,67	20,83
3	N.Ac. N.Des.						1												1				1			41,67	45,45
4	Desacuer.																									20,83	
5	Tot. Desac.	1																						1	1	16,67	37,50
100,00																											
Pregunta 23																											
1	Tot. Acuer.	1					1												1							1	33,33

Pregunta 29																				
1	Tot.Acuer.	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	50,00
2	Acuerdo		1		1			1							1			1		25,00
3	N.Ac.N.Des.									1				1	1	1		1		20,83
4	Desacuer.																			0,00
5	Tot.Desac.								1											4,17
																			100,00	
Pregunta 30																				
1	Tot.Acuer.				1	1				1	1							1		29,17
2	Acuerdo	1			1			1	1				1	1	1	1		1		41,67
3	N.Ac.N.Des.		1			1										1		1		20,83
4	Desacuer.										1									8,33
5	Tot.Desac.																			0,00
																			100,00	
Pregunta 31																				
1	Tot.Acuer.	1		1	1	1		1			1	1	1	1	1	1	1	1	1	70,83
2	Acuerdo		1								1									16,67
3	N.Ac.N.Des.									1										8,33
4	Desacuer.															1				4,17
5	Tot.Desac.																			0,00
																			100,00	
Pregunta 32																				
1	Tot.Acuer.	1			1	1	1	1		1		1	1	1	1	1	1	1	1	66,67
2	Acuerdo		1				1								1			1		29,17
3	N.Ac.N.Des.								1								1			4,17
4	Desacuer.																			0,00
5	Tot.Desac.																			0,00
																			100,00	
Pregunta 33																				
1	Tot.Acuer.	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	75,00
2	Acuerdo								1									1		16,67
3	N.Ac.N.Des.																1			9,09
4	Desacuer.																			0,00
5	Tot.Desac.																			0,00
																			100,00	

ENCUESTA PARA TESIS DOCTORAL

1/12

Departamento de Construcción y Tecnología Arquitectónicas (DCTA). Escuela Técnica Superior de de Arquitectura de Madrid (ETSAM). Universidad Politécnica de Madrid (UPM)

Doctorando: Miguel Ángel Álvarez Pérez, Arquitecto, PMP (UPM)

Directores de Tesis: Manuel Soler Severino, Dr. Arquitecto (UPM)

Eugenio Pellicer Armiñana, Dr. Ingeniero de Caminos, Canales y Puertos (UPV)

Fecha: Enero 2019

Modalidad: Delphi (anónima, dos vueltas)

Escala Likert

Estimado Colaborador:

La Encuesta que va a realizar consta de cuatro áreas y treinta y tres preguntas en total. Se enfoca a mi investigación sobre la implantación en España de dos técnicas Lean Construction: Sistema del Diseño de Valor Objetivo (Target Value Design o TVD) y Métodos Colaborativos en Construcción (Integrated Project Delivery o IPD).

Ud. ha sido seleccionado como experto en la materia para aplicar el Método Delphi, anónimo en dos vueltas, Escala Likert. Su nombre y filiación aparecerán en la Tesis como participante en la encuesta. Debe elegir, entre las opciones incluidas, una sola respuesta por pregunta, puede añadir al final de cada una un breve comentario sobre la misma, si lo desea.

En esta Segunda Vuelta, conociendo los porcentajes obtenidos por cada una de las respuestas en la Primera Vuelta, según el listado que se acompaña, puede modificar su respuesta si lo desea, esta última será la que tendré en cuenta para la Encuesta, en caso de no modificarla no es necesario que la marque, se tendrá en cuenta la anterior. Agradeciendo su atención y colaboración, reciba un cordial saludo

Miguel Ángel Álvarez Pérez

ENCUESTA DELPHI SEGUNDA VUELTA

Area 1: Target Value Design o TVD

Pregunta 1:

La aplicación de la Metodología TVD permite ajustar el presupuesto de los proyectos sin desviaciones económicas en lugar de lo que ocurre actualmente con el método tradicional.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 2:

El mantenimiento del Target Cost inamovible durante todo el desarrollo de un proyecto puede perjudicar su resultado.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 3:

La aplicación de la Metodología TVD incrementa positivamente el valor que se aporta al cliente en un proyecto.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 4:

La Metodología TVD puede aplicarse a proyectos de cualquier cuantía de presupuesto, baja o alta.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Area 2: Integrated Project Delivery o IPD

Pregunta 5:

La aplicación de la Metodología IPD permite reducir los plazos de ejecución de los proyectos en lugar de lo que ocurre actualmente con el método tradicional.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 6:

La aplicación de la Metodología IPD mejora la colaboración entre todos los interesados en el proyecto.

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 7:

La selección de los miembros del equipo de trabajo es importante para una correcta aplicación de la Metodología IPD

Totalmente de acuerdo:		
De acuerdo:		
Ni de acuerdo ni en desacuerdo:		
En desacuerdo:		
Totalmente en desacuerdo:		

Comentario opcional:

Pregunta 8:

Para un correcto desarrollo del trabajo en equipo con Metodología IPD es necesario el trabajo en "Big Room".

Totalmente de acuerdo:				
De acuerdo:				
Ni de acuerdo ni en desacuerdo:				
En desacuerdo:				
Totalmente en desacuerdo:				

Comentario opcional:

Pregunta 9:

Los miembros del equipo que van a trabajar con Metodología IPD deben tener experiencia previa de haber trabajado con la misma.

Totalmente de acuerdo:				
De acuerdo:				
Ni de acuerdo ni en desacuerdo:				
En desacuerdo:				
Totalmente en desacuerdo:				

Comentario opcional:

Pregunta 10:

La figura de un Facilitador Experto que oriente al equipo de trabajo es necesaria para una correcta aplicación de la Metodología IPD.

Totalmente de acuerdo:				
De acuerdo:				
Ni de acuerdo ni en desacuerdo:				
En desacuerdo:				
Totalmente en desacuerdo:				

Comentario opcional:

Pregunta 11:

La aplicación de la Metodología IPD con "Open Books" mejora la confianza mutua entre los miembros del equipo.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 12:

Mantener reuniones de conjunto, así como colocar información abierta del desarrollo del proyecto en zonas comunes y trabajar en "Big Room", es suficiente para mantener al equipo alineado con IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 13:

El Design Management del proyecto es una cuestión exclusiva del arquitecto y no requiere la intervención de todo el equipo IPD para su éxito.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 14:

La colaboración entre los distintos interesados en el proyecto desde el minuto uno, como propone la Metodología IPD, reduce los riesgos de obtener un resultado negativo en coste, plazo y calidad.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 15:

La Metodología IPD puede aplicarse a proyectos de cualquier cuantía de presupuesto, baja o alta y diversa complejidad técnica.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Area 3: TVD e IPD conjuntamente

Pregunta 16:

La aplicación de las Metodologías TVD e IPD requiere la aplicación simultánea de toda la Metodología Lean Construction: Last Planner System, Value Stream Mapping, Choosing by Advantages, BIM, etc.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 17:

La aplicación de las Metodologías TVD e IPD debe ser necesariamente conjunta.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 18:

Una formación previa en Lean Construction es necesaria para equipos que vayan a trabajar con Metodologías TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Area 4: Implantación en España de TVD e IPD

Pregunta 19:

Los Promotores Inmobiliarios, las Empresas Constructoras y los Técnicos interesados se adaptarían bien a trabajar en España con Metodologías TVD e IPD en lugar de con las tradicionales.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 20:

La Industria de la Edificación en España (Promotores, Constructores y Técnicos) comprenden las ventajas de la aplicación de Metodologías TVD e IPD en nuestro país.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 21:

La Industria de la Edificación en España (Promotores, Constructores y Técnicos) está preparada para la aplicación de Metodologías TVD e IPD en nuestro país.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 22:

La forma de reparto de beneficios entre los interesados en un proyecto en virtud de los ahorros y y mejoras conseguidos en la obra, según IPD, influye en la falta de interés en España por adoptarlo.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 23:

Es necesaria la especialización de Despachos de Abogados en España en redacción y seguimiento de contratos multiparte para su aplicación a IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 24:

La reserva de información de cada uno de los interesados en un proyecto respecto al resto, característica en España puede superarse mediante la aplicación de Metodologías TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 25:

Los interesados en la edificación en España (promotores, constructores y técnicos) se adaptarían bien a un sistema de riesgos y recompensas compartidos, como lo establecido en la Metodología IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 26:

La actualmente vigente Ley de Ordenación de la Edificación (LOE 1999) dificulta la aplicación de nuevas Metodologías como TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 27:

La nueva Ley de Contratación de los Servicios Públicos (LCSP 2017) facilita que en el futuro se introduzcan Metodologías TVD e IPD en la Edificación Pública en España.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 28:

Debería modificarse la actual Legislación española en materia de edificación para adaptarse a formas más colaborativas de trabajo.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 29:

El aprendizaje en Metodologías TVD e IPD es necesario en España para aplicar a proyectos completos.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 30:

Sería mejor comenzar en España por la aplicación de Metodologías IPDsh aunque no se aplique IPD de forma completa.de momento.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 31:

La habitual Contratación a la Baja dificulta conseguir la eficacia de la edificación en España en términos de coste, plazo y calidad.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 32:

España debe plantearse otras alternativas de desarrollo de la edificación respecto a las tradicionales, como TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Pregunta 33:

La eficacia de la edificación en España mejoraría con la aplicación de Lean Construction y en particular con las Metodologías TVD e IPD.

Totalmente de acuerdo:			
De acuerdo:			
Ni de acuerdo ni en desacuerdo:			
En desacuerdo:			
Totalmente en desacuerdo:			

Comentario opcional:

Resp.	2ª Vuel.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	% Ind.	% Suma	
Pregunta 1																													
1	Tot.Acuer.				1					1			1			1				1				1		1	28,00		
2	Acuerdo	1	1	1	1	1	1	1	1		1	1		1			1	1				1					52,00	80,00	
3	N.Ac.N.Des.														1			1				1			1		20,00	20,00	
4	Desacuer.																										0,00		
5	Tot.Desac.																										0,00	0,00	
																												100,00	
Pregunta 2																													
1	Tot.Acuer.			1			1								1						1				1		20,00		
2	Acuerdo	1		1	1			1	1		1	1	1		1								1			1	32,00	52,00	
3	N.Ac.N.Des.		1		1						1				1	1		1				1					28,00	28,00	
4	Desacuer.							1										1									12,00		
5	Tot.Desac.									1															1		8,00	20,00	
																												100,00	
Pregunta 3																													
1	Tot.Acuer.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1	76,00		
2	Acuerdo										1								1			1					16,00	92,00	
3	N.Ac.N.Des.							1													1						8,00	8,00	
4	Desacuer.																										0,00		
5	Tot.Desac.																										0,00	0,00	
																												100,00	
Pregunta 4																													
1	Tot.Acuer.	1	1			1	1	1	1		1	1	1	1	1	1					1				1	1	52,00		
2	Acuerdo			1				1					1					1	1								20,00	72,00	
3	N.Ac.N.Des.				1				1								1					1	1			1	28,00	28,00	
4	Desacuer.																										0,00		
5	Tot.Desac.																										0,00	0,00	
																												100,00	
Pregunta 5																													
1	Tot.Acuer.			1	1		1	1	1		1		1	1	1	1		1	1	1	1		1		1	1	56,00		
2	Acuerdo	1	1			1				1		1					1					1		1			36,00	92,00	
3	N.Ac.N.Des.								1																1		4,00	4,00	
4	Desacuer.														1												4,00		
5	Tot.Desac.																										0,00	4,00	
																												100,00	
Pregunta 6																													
1	Tot.Acuer.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	88,00	
2	Acuerdo																								1		12,00	100,00	

[illegible]

2	Acuerdo																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			

Pregunta 18															
1	Tot.Acuer.	1			1	1			1	1	1	1	1	1	48,00
2	Acuerdo			1	1		1		1				1		24,00
3	N.Ac.N.Des.		1				1					1	1		28,00
4	Desacuer.														0,00
5	Tot.Desac.														0,00
															100,00
Pregunta 19															
1	Tot.Acuer.		1								1		1		20,00
2	Acuerdo		1						1					1	12,00
3	N.Ac.N.Des.			1		1				1		1	1		28,00
4	Desacuer.	1	1		1	1	1	1	1		1				40,00
5	Tot.Desac.														0,00
															100,00
Pregunta 20															
1	Tot.Acuer.												1		4,00
2	Acuerdo	1		1											16,00
3	N.Ac.N.Des.							1					1		12,00
4	Desacuer.	1	1	1	1	1			1		1			1	40,00
5	Tot.Desac.				1	1	1	1	1		1			1	28,00
															68,00
															100,00
Pregunta 21															
1	Tot.Acuer.									1				1	12,00
2	Acuerdo		1								1				8,00
3	N.Ac.N.Des.	1					1						1		16,00
4	Desacuer.	1		1	1	1			1	1		1		1	52,00
5	Tot.Desac.					1				1					64,00
															100,00
Pregunta 22															
1	Tot.Acuer.														4,00
2	Acuerdo					1					1				12,00
3	N.Ac.N.Des.	1		1	1	1	1	1	1	1			1	1	52,00
4	Desacuer.	1	1								1				20,00
5	Tot.Desac.												1	1	12,00
															32,00
															100,00
Pregunta 23															
1	Tot.Acuer.						1							1	32,00
2	Acuerdo	1		1		1			1	1		1	1		56,00
3	N.Ac.N.Des.		1												8,00
4	Desacuer.		1												0,00
5	Tot.Desac.						1								4,00

[illegible]

[illegible]



9.2.- Anexo 2: Publicaciones y Actividades desarrolladas durante el Doctorado. Difusión de Resultados, 2015-2020:



9.2.1.- Curso 2015-2016:



ANEXO 2.- ACTIVIDADES DESARROLLADAS DURANTE EL DOCTORADO

2015-2020:

9.1.- Curso 2015-2016:

9.1.1 Actividades Doctorado UPM

10-12-2015

Presento a la Comisión de Doctorado dentro de la convocatoria de diciembre mi Propuesta de Título de Tesis y Codirectores de esta.

15-12-2015

Recibo comunicación de la Comisión del Doctorado sobre la no aprobación de mi propuesta de Título y la aprobación de uno solo de los Codirectores propuestos: El profesor Dr. Manuel José Soler Severino de la Escuela Técnica Superior de Arquitectura de Madrid (ETSAM) de la Universidad Politécnica de Madrid (UPM).

16-12-2015

Asisto en la ETSAM a la lectura de Tesis de D. Xavier Brioso dirigida por el profesor Dr. Antonio Humero, que fue aprobada.

10-12-2015 al 13-06-2016

Continúo con mis trabajos de estudio de la metodología Lean Construction y sus técnicas asociadas: Métodos Colaborativos (IPD), Diseño de Valor Objetivo (TVD), Sistema de Último Planificador (LAST PLANNER SYSTEM ®), etc. bajo la dirección del profesor Soler.

05-02-2016

Me presento al examen de inglés TOEIC organizado por la Universidad, dentro de las Actividades del Doctorado.

13-06-2016

Presento dentro de la Convocatoria de junio una nueva propuesta de Título de Tesis, basada en una de las líneas de investigación abiertas por la Tesis aprobada de D. Xavier Brioso, así como propongo nuevamente como Codirector de mis Tesis junto con el Profesor Dr. Manuel José Soler Severino al Profesor Dr. Eugenio Pellicer Armiñana de la Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos de la Universidad Politécnica de Valencia.



20-06-2016

Recibo comunicación de la Comisión de Doctorado de la aprobación de mi propuesta de Título de Tesis, así como de los Codirectores propuestos.

20-06-2016 al 20-10-2016

Continúo con mis trabajos de estudio de las metodologías contempladas en el Título aprobado de mi Tesis: Sistema de Diseño de Valor Objetivos (TARGET VALUE DESIGN, TVD) y Métodos Colaborativos (INTEGRATED PROJECT DELIVERY, IPD) bajo la dirección de mis codirectores de Tesis.

9.1.2 Índices de Calidad

15-07-2015

Hago el Curso del Instituto Arquitectura del Colegio Oficial de Arquitectos de Madrid (COAM): “Claves para la investigación de arquitectura. Hacer una Tesis Doctoral”.

05-06-2016

Imparto clases en el Máster en Dirección de Proyectos de la Universidad de Salamanca, Campus Zamora, sobre Lean Construction, Métodos Colaborativos (IPD) y Diseño de Valor Objetivo (TVD).

El Instituto Arquitectura y en su nombre
la Secretario, certifica que

Miguel Angel Alvarez Perez

Ha realizado el curso de

**Claves para la investigación de arquitectura. Hacer una
Tesis Doctoral**

Celebrado entre las fechas: 06/07/2015 y 14/07/2015
Con una duración de 16 horas lectivas

Madrid		15		Julio		2015

Curso acreditado por:

COAM | COLEGIO
OFICIAL
ARQUITECTOS
DE MADRID

 **CSCAE**

UICPD
CONTINUING PROFESSIONAL DEVELOPMENT
Quality Label



José María Ezquiaga Domínguez
DECANO



Elena Sarabia Castello
SECRETARIO



CERTIFICATE OF ACHIEVEMENT

This is to certify that
Miguel Ángel Álvarez Pérez
achieved the following scores on the
TOEIC® Listening & Reading Test

Listening	405
Reading	425
Total	830

as administered under the auspices of:

Universidad Politécnica de Madrid

at:

Madrid, Spain

date:

05-febrero-2016

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This is presented in recognition of your achievement.
An official score report must be submitted to organizations that require a TOEIC score.

David L. Hunt

David L. Hunt
Senior Vice President
Global Division and Workforce Division, ETS



**UNIVERSIDAD
DE SALAMANCA**

CAMPUS DE EXCELENCIA INTERNACIONAL

JUAN LUIS GARCÍA ALONSO, Director Académico del Centro de Formación Permanente de la Universidad de Salamanca,

CERTIFICA:

Que **D. MIGUEL ÁNGEL ÁLVAREZ PÉREZ**, con DNI número **05409142W** ha impartido 5 horas de docencia en la asignatura “**COSTES Y PRESUPUESTOS**” cuyo contenido es: BIM, LEAN, KANBAN, MÉTODOS DE TRABAJO COLABORATIVO en el “**MÁSTER EN DIRECCIÓN Y GESTIÓN DE PROYECTOS**”, Título Propio de la Universidad de Salamanca, durante el curso académico 2015-16.

Y para que conste a los efectos oportunos, expido el presente certificado en Salamanca a dieciocho de enero de dos mil diecisiete.



CENTRO DE FORMACIÓN PERMANENTE



9.2.2.- Curso 2016-2017:



9.2.- Curso 2016-2017:

9.2.1 Publicaciones

06-10-2017

Presento juntamente con mis Codirectores de Tesis un artículo científico titulado “TARGET VALUE DESIGN. A different way of approaching the constructive process in Spain”, a la Revista Científica Journal of Modern Project Management, que tiene un SJR de 0,302 en 2016 y está en el Q3 en Management of Technology and Innovation con un índice H de 3 en 2016. **REVISTA INDEXADA Q2.**

23-10-2017

Presento un artículo científico juntamente con el arquitecto D. Carlos Pampliega y el ingeniero en informática D. Alfonso Bucero, ambos, como yo, certificados Project Management Professional (PMP ®) y miembro del Project Management Institute (PMI ®), titulado: “INTEGRATED PROJECT DELIVERY. An alternative to the usual form of construction in Spain”, a la revista Building & Management de la Escuela Superior de la Edificación (ETSEM) de la UPM. **REVISTA NO INDEXADA.**

9.2.2 Congresos

12-12-2016

Presento juntamente con mis Codirectores de Tesis dos Resúmenes de dos intervenciones escritas en el 2º Congreso Internacional de Innovación de la Construcción CITE 2017, en Madrid, organizado por la Escuela Técnica Superior de la Edificación ETSEM) de la UPM. Uno sobre Métodos Colaborativos (IPD) y otro Diseño de Valor Objetivo (TVD).

11-01-2017

Ambos Resúmenes antes descritos son aprobados por el Comité Científico del citado Congreso para su desarrollo.

27-02-2017

Presento una Ponencia de nuestra intervención en el mencionado Congreso sobre Métodos colaborativos (IPD), que es admitido e incluido en su documentación para publicaciones.



8,9,10-03-2017

Asisto al 2º Congreso Internacional de Innovación en la Construcción CITE 2017, en Madrid, organizado por la Escuela Superior de la Edificación (ETSEM) de la UPM. En el cual se presenta en formato poster nuestra comunicación sobre Método Colaborativos (IPD) el 8 de marzo y se publica en los documentos del Congreso.

9.2.3 Actividades UPM

23-03-2017

Asisto a la clase de Doctorado impartida por el Catedrático D. Francisco Hernández Olivares y el Profesor David Sanz Arauz, Presidente y Secretario respectivamente de la Comisión del Doctorado en Construcción y Tecnologías Arquitectónicas de la ETSAM.

9.2.4 Índices de Calidad

19-05-2017

Imparto clases en la Máster en Dirección de Proyectos de la Universidad de Salamanca, Campus Zamora, sobre Lean Construction, Métodos Colaborativos (IPD) y Diseño de Valor Objetivo (TVD).

13-06-2017

Asisto al Taller Lean Construction en España, THINK TANK 2017, que se celebra en el Colegio de Aparejadores de Madrid.

Los Métodos Colaborativos (Integrated Project Delivery), una metodología Lean Construction que mejora el proceso constructivo

¹Manuel Soler Severino 1^{er} Autor; ²Eugenio Pellicer Armiñana 2º Autor; ³Miguel Angel Alvarez Perez 3^{er} Autor

¹ Filiación 1er. Autor: Dr. Arquitecto, Profesor Asociado DCTA, ESCUELA TECNICA SUPERIOR DE ARQUITECTURA, UNIVERSIDAD POLITECNICA DE MADRID.

² Filiación 2º Autor: Dr. Ingeniero de Caminos, Canales y Puertos, Profesor Titular DIC, ESCUELA TECNICA SUPERIOR DE INGENIEROS DE CAMINOS, CANALES Y PUERTOS, UNIVERSIDAD POLITECNICA DE VALENCIA.

³ Filiación 3^{er} Autor: Arquitecto, Doctorando DCTA, ESCUELA TECNICA SUPERIOR DE ARQUITECTURA, UNIVERSIDAD POLITECNICA DE MADRID.

Palabras Clave: *Integrated Project Delivery IPD*

LA ACTUALIDAD

- Proyecto- Concurso-Construcción un foco interminable de conflictos.
- Establecimiento de remuneraciones y responsabilidades enfrentadas entre los diversos agentes intervinientes.
- Inadecuación de la Legislación en materia de construcción permitiendo solamente actuar de este modo.
- Obsolescencia en los métodos de trabajo en construcción que redundan en la ineficacia del proceso constructivo.
- Ineficacia es despilfarro.

LA ALTERNATIVA

- La Construcción como un esfuerzo colaborativo de los agentes intervinientes con una meta única.
- Remuneraciones y responsabilidades compartidas entre todos.
- Necesaria adecuación de la Legislación en materia de Construcción abriéndose a nuevas posibilidades.
- Puesta al día de los métodos de trabajo en Construcción que redundará en una mayor eficacia del proceso constructivo.
- Eficacia es ahorro.

Esto se puede lograr con Métodos de Trabajo Colaborativo en Construcción (Integrated Project Delivery, IPD)

El AIA ha actualizado en 2014 su definición de IPD:

- *“Es un método de entrega de un proyecto que integra a las personas, los sistemas, las estructuras de negocio y las prácticas, en un proceso que de forma colaborativa pone a trabajar los talentos y visiones de todos los participantes para reducir las pérdidas y optimizar la eficiencia a través de*

todas las fases de diseño, fabricación y construcción. El Método Integrated Project Delivery contiene, como mínimo todos los siguientes elementos:

- 1.- Implicación continua del propietario, así como de los diseñadores y constructores clave.
- 2.- Intereses de negocio alineados a través de un sistema compartido de riesgo/beneficio, incluyendo ganancias financieras por riesgo, que dependan de los resultados del proyecto.
- 3.- Control del proyecto conjunto del propietario así como de los diseñadores y constructores clave.
- 4.- Contrato común entre todas las partes o con condiciones de participación obligatorias y específicas.
- 5.- Responsabilidad compartida por el propietario y los diseñadores y constructores clave”

Por el momento en España la teoría respecto a IPD se encuentra en fase de conocimiento, como ocurre con todas las técnicas Lean Construction, y está poco formalizada. El objetivo de este artículo es profundizar en el conocimiento de IPD y su aplicabilidad en nuestro país, así como realizar una revisión sobre el estado del arte y la bibliografía de lo escrito hasta la fecha en torno al tema, organizarla y presentarla.

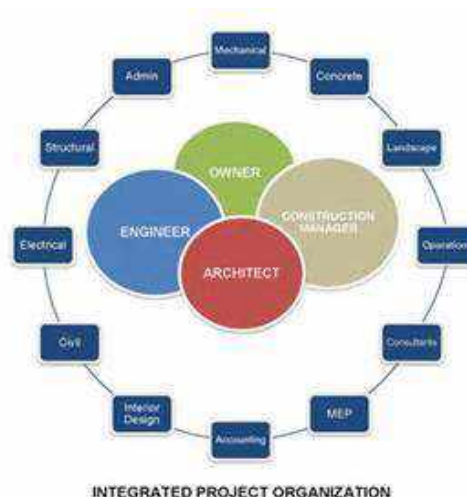


Figura 1: Integrated Project Delivery como un esfuerzo colectivo coordinado para el desarrollo del proyecto

REFERENCIAS

- (1) INTEGRATED PROJECT DELIVERY: AN UPDATED WORKING DEFINITION. AIA California Chapter.
- (2) UNDERSTANDING CONSTRUCTION INDUSTRY EXPERIENCE AND ATTITUDES TOWARD INTEGRATED PROJECT DELIVERY David C. Kent; and Burcin Becerik-Gerber.
- (3) THE OWNERS' GUIDE TO STARTING INTEGRATED BUILDING PROJECTS Oscia Wilson
- (4) INTEGRATED PROJECT DELIVERY AN EXAMPLE OF RELATIONAL CONTRACTING Owen Matthews and Gregory A. Howell

El Sistema del Diseño de Valor Objetivo (Target Value Design), una metodología Lean Construction que mejora el proceso constructivo

¹Manuel Soler Severino 1^{er} Autor; ²Eugenio Pellicer Armiñana 2º Autor; ³Miguel Angel Alvarez Perez 3^{er} Autor

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³ Filiación 3^{er} Autor: Arquitecto, Doctorando DCTA, ESCUELA TECNICA SUPERIOR DE ARQUITECTURA, UNIVERSIDAD POLITECNICA DE MADRID.

Palabras Clave: Target Value Design TVD

Tradicionalmente, el coste ha sido un resultado del diseño.

- TVD es una práctica de gestión que pretende hacer que el coste objetivo sea quien decida el diseño.
- Utiliza objetivos de coste, planificación y entrega de valor como los criterios primarios para el diseño desde las fases más tempranas del proyecto.
- Utiliza curvas de aprendizaje constante entre las decisiones de diseño y los resultados de coste y planificación en lugar de esperar hasta el final de la fase de diseño para hacer una estimación del coste.

ES DAR LA VUELTA AL PROCESO: SE DISEÑA PARA EL OBJETIVO QUE SE QUIERE CONSEGUIR.

NO SE PRESUPUESTA LO QUE SE HA DISEÑADO

El Sistema del Diseño de Valor Objetivo, (Target Value Design o TVD, en inglés) es un enfoque de gestión Lean Construction que consiste en identificar lo que genera valor para el cliente y orientar los objetivos de los equipos integrados a diseñar un producto según los requerimientos del mismo y las limitaciones del proyecto (costo, plazo, etc.).

Este enfoque surge entre los años 2005 y 2007 en Estados Unidos para aplicarse a proyectos de construcción de hospitales y centros educativos.

Los componentes principales del TVD son cinco (Macomber, Howell y Barbeiro 2007):

- Target Costing
- Estructura de trabajo definida
- Colaboración
- Set Based Design
- Co-locación

Por el momento en España la teoría respecto a TVD se encuentra en fase de conocimiento, como ocurre con todas las técnicas Lean Construction, y está poco formalizada. El objetivo de este artículo es profundizar en el conocimiento de TVD y su aplicabilidad en nuestro país, así como realizar una revisión sobre el estado del arte y la bibliografía de lo escrito hasta la fecha en torno al tema, organizarla y presentarla.

TVD es un enfoque de gestión amplio, que altera la organización, el sistema operativo y los términos comerciales del proyecto llenándolos de métodos de trabajo Lean Construction

Por esa razón, este artículo abarca también los temas relacionados con la organización del proyecto, el sistema operativo y los términos comerciales que sirven como medio para que el TVD pueda realizarse y alcanzar el valor objetivo del proyecto, en relación a las metodologías utilizadas de forma tradicional.

Algunos de los componentes antes mencionados son esenciales para la implementación de TVD. Otros no lo son tanto, pero permiten potenciar la herramienta y lograr mejores resultados.



Figura 1: Target Value Design como el coste objetivo central para el desarrollo del proyecto

REFERENCIAS

- (1) TARGET VALUE DESIGN: THE CHALLENGE OF VALUE GENERATION
Luciana I. Gomes Miron, Amit Kaushik and Lauri Koskela.
- (2) TARGET VALUE DESIGN: NINE FOUNDATIONAL PRACTICES FOR DELIVERING SUSPRISING CLIENT VALUE
Hal Macomber and John Barberio
- (3) UNDERSTANDING OF TARGET VALUE DESIGN FOR INTEGRATED PROJECT DELIVERY WITH THE CONTEXT OF GAME THEORY
Wooyong Jung; Glenn Ballard; Yong-Woo Kim; and Seung Heon Han

LOS METODOS COLABORATIVOS (INTEGRATED PROJECT DELIVERY), UNA METODOLOGIA LEAN CONSTRUCTION QUE MEJORA EL PROCESO CONSTRUCTIVO

¹Manuel Soler Severino 1^{er} Autor; ²Eugenio Pellicer Armiñana 2º Autor; ³Miguel Angel Alvarez Perez 3^{er} Autor

¹ Filiación 1er. Autor: Dr. Arquitecto, Profesor Asociado DCTA, ESCUELA TECNICA SUPERIOR DE ARQUITECTURA, UNIVERSIDAD POLITECNICA DE MADRID.

² Filiación 2º Autor: Dr. Ingeniero de Caminos, Canales y Puertos, Profesor Titular DIC, ESCUELA TECNICA SUPERIOR DE INGENIEROS DE CAMINOS, CANALES Y PUERTOS, UNIVERSIDAD POLITECNICA DE VALENCIA.

³ Filiación 3^{er} Autor: Arquitecto, Doctorando DCTA, ESCUELA TECNICA SUPERIOR DE ARQUITECTURA, UNIVERSIDAD POLITECNICA DE MADRID.

Resumen

La construcción es, dentro de los sectores productivos, aquel que probablemente ha experimentado una menor evolución en la forma de producirse desde sus inicios, tan antiguos como la propia humanidad, y no nos referimos a los materiales y medios técnicos con los que se desarrolla, sino a la metodología empleada para su ejecución, a la forma en que la en los diferentes agentes intervinientes se relacionan.

Es evidente, para cualquier profesional involucrado en estas tareas, que la eficacia dista mucho de ser habitual en el sector, que existe un gran margen de mejora, y que este se debe acometer de inmediato para lograr que se equipare a los demás en su progreso hacia cotas de mayor productividad y satisfacción para los intervinientes en el mismo.

Trata este trabajo de exponer qué son los Métodos de Trabajo Colaborativo (Integrated Project Delivery o IPD en terminología inglesa y como se implementan, así como las ventajas que su utilización está trayendo en especial en Estados Unidos, en el que su uso está desarrollado, y en el que existen numerosos ejemplos de edificios construidos con el mismo.

Palabras clave: Integrated Project Delivery

1. INTRODUCCIÓN

Para comprender que es IPD tenemos que remontarnos en primer lugar a saber que es Lean Construction, ya que IPD es una de las metodologías Lean que se emplean para mejorar el proceso constructivo.

1.1 TOYOTA PRODUCTION SYSTEM

A partir de 1980 en todo el mundo occidental empezó a llamar la atención la invasión cada vez mayor, sobre todo en Estados Unidos, de los automóviles de fabricación japonesa. Eran más ligeros que los americanos, consumían menos

combustible, pero sin embargo eran muy sólidos, tenían menos reparaciones y además eran más baratos de producción y en consecuencia de venta ¹.

Planta de montaje de Framigham de General Motors versus Planta de montaje de Takaoka de Toyota - 1986		
	Framigham	Takaoka
Horas de montaje bruto por coche	40,7	18,0
Horas de montaje ajustado por coche	31	16
Defectos de montaje cada 100 coches	130	45
Espacio de montaje por coche	8,1	4,8
Existencia de inventario (promedio)	2 semanas	2 horas

Fig. 1: Fuente: Estudio del PIVM del MIT. “La Máquina que cambio el mundo”

Quedaba claro que había algo especial en los coches japoneses y sobre todo en los Toyota, incluso en relación a otros fabricantes nipones.

Era el Toyota Production System o TPS, algo ignorado hasta entonces en Estados Unidos, pero cuyo conocimiento revolucionaría la fabricación.

La industria americana de la automoción continuaba utilizando la “Producción en Cadena” que Henry Ford había introducido en 1913, a partir de la “Gestión Científica” que Frederick Taylor propugnaba para la industria a principios del Siglo XX.

Pero en Japón ya en 1890 un joven ingeniero fabricante de telares llamado Sakichi Toyoda estaba revolucionando la forma en la que trabajaban sus máquinas. Conocía, y le había impresionado mucho, el libro de Samuel Smiles “Autoayuda” (posiblemente el primer libro sobre la materia publicado en el mundo), que se había presentado en el Reino Unido en 1859.

Una gran novedad para la época fue que los telares de Toyoda se paraban automáticamente si un hilo se rompía, este era el principio del denominado “jidoka” o “autonomía por fallo”.

¹.- Kim Clark y Takahiro Fujimoto, Harvard Business School, 1991:

“Un coche japonés totalmente nuevo requería 1,7 millones de horas de trabajo de ingeniería por término medio y ente el primer diseño y las primeras entregas a los clientes pasaban 46 meses.

El promedio de los coches americanos y europeos necesitaba 3 millones de horas de ingeniería y no se podían entregar hasta los 60 meses”

Además de ésta introdujo otras muchas innovaciones que hicieron que fuera muy exitoso y vendiera abundantemente su producción.

No obstante, Toyoda era consciente de que la siguiente generación de la familia debería dar el salto a una industria más innovadora y de mayor futuro: La Automoción.

Para ello envió en 1929 a su hijo Kiichiro Toyoda al Reino Unido a vender la patente de sus innovadores telares, que tanto éxito tenían. Y así fue, la patente fue vendida a Platt Brothers por 100.000 Libras, una cifra muy importante para la época, y ese fue el capital fundacional de la nueva industria de los Toyoda: Toyota Motor Corporation.

Kiichiro Toyoda viajó posteriormente a mediados de los años 30 a Estados Unidos para estudiar la forma en la que trabajaba la mayor fábrica automovilística de la época: Ford Motor Company, y se encontró con una enorme acumulación de stocks de automóviles fabricados, esperando ser entregados a los potenciales clientes a medida que eran demandados.

Por otra parte, también conoció algo que entonces no existía en Japón: Los Supermercados, y vio que el sistema de reposición de los productos en las estanterías a medida que eran consumidos, pero no antes, podría ser aplicable a la industria automovilística reduciendo los stocks. Este fue el principio del “just in time”, base del método Kanban.

No obstante, Kiichiro vivió la Segunda Guerra Mundial y los graves problemas que tuvo la economía japonesa tras la misma. Toyota Motor Corporation no fue ajena a esos problemas y en 1948 dimitió como Presidente de la Compañía, asumiendo de forma personal la culpa por las drásticas reducciones de plantilla y recorte de gastos que hubo que realizar para mantener la empresa a flote.

Tomó el relevo en 1957 su primo Eiji Toyoda, pero entre tanto, el Ingeniero Jefe, que Kiichiro había nombrado, estuvo al frente de la producción, llegando a ser Director General y fue la persona clave que recogiendo los conocimientos adquiridos por las generaciones anteriores los formalizó y convirtió en el Toyota Production System, esta persona fue: Taiichi Ohno.

Ohno tuvo el apoyo de la familia Toyoda en todo momento y continuó ocupando su cargo de Director General con Eiji Toyoda de Presidente, era también un gran admirador de la Ford Motor Company, conocía y apreciaba desde su época de estudiante de ingeniería el libro de Henry Ford: “Today and Tomorrow”, que había sido publicado en 1926.

En 1950 residió durante un año en Estados Unidos para estudiar también la industria automovilística americana, llegando a las mismas conclusiones que Kiichiro Toyoda 20 años antes: Exceso de producción que producía stocks innecesarios.

Pasó más tarde a formalizar su teoría y las de sus antecesores en Toyota, partiendo de un principio básico de la cultura japonesa y del taoísmo: El Kaizen, que viene de las palabras Kai = Cambio y Zen = Lo bueno, Kaizen es un cambio a mejor, lo que occidentalmente conocemos como la mejora continua. En Japón esto no es solo un concepto filosófico, es un compromiso del equipo de trabajo, buscar el beneficio común del mismo, pero también el de la empresa, el de la comunidad, el de la sociedad.

A partir del Kaizen implementó otros principios como el Jidoka, al que antes hemos referido, o el Just in Time, al que Ohno le dio un nuevo contenido mediante el sistema de aviso de finalización de stock con una tarjeta o señal que va al principio de la cadena y que será denominado Kanban.

Su concepto de eliminación de la cadena de producción de todo aquello que no aporte valor al producto, quitar el desperdicio: La Muda en japonés, analizando para ello intensamente todo el proceso, será revolucionario en los métodos de fabricación, produciendo enormes ventajas a Toyota. Había en ello un gran margen de mejora y Ohno supo verlo. Identificó siete pérdidas en la producción que había que mejorar, pero la peor de todas para él era la sobreproducción ya que era la que provocaba que sucedieran todas las restantes.

Las siete pérdidas identificadas por Ohno son:

- Gasto por la sobreproducción (gran pérdida)
- Pérdida de tiempo a mano (esperando)
- Gasto de transporte
- Gasto por procesarse a sí mismo
- Gasto del inventario que está a mano
- Gasto por movimiento
- Gasto por hacer productos defectuosos

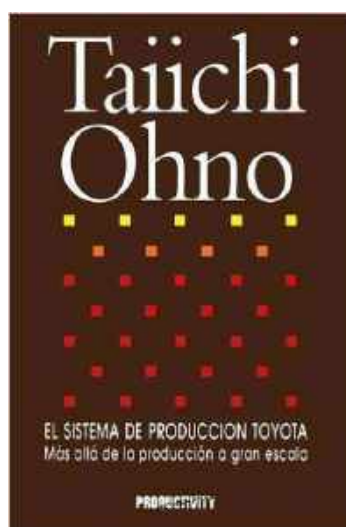


Fig. 2: Libro de Taiichi Ohno: El Sistema de Producción Toyota

Todas sus teorías aplicadas por Toyota están contenidas en el libro cuya portada de la edición en español reproducimos en la figura 2.

A Taiichi Ohno le sucedió su discípulo Fujio Cho, que continuó aplicando y mejorando sus enseñanzas y mediante su Sistema de Producción Toyota la empresa salió fortalecida tras la crisis del petróleo en 1973, ya que a partir de esa fecha la competencia automovilística quedó claramente establecida en términos de calidad y no de cantidad, algo que era una divisa en Toyota desde mucho antes.

A Fujio Cho se debe el desarrollo de la marca de gran calidad de Toyota: Lexus y la introducción de los automóviles híbridos, en especial el modelo Prius, movimientos industriales que luego otros muchos siguieron. Es actualmente Presidente Honorario de Toyota Motor Corporation, aunque se retiró de la Compañía en el año 2013²

1.2 LEAN PRODUCTION SYSTEM:

El Toyota Production System y toda la filosofía de esta empresa es la base en la que se fundamentan los principios Lean.

Como hemos dicho, en los años 80 comienza en Estados Unidos a estudiarse a fondo esta forma de producir, que tan buenos resultados estaba dando a sus competidores japoneses, y que estaba amenazando a su propia industria.

Los intercambios en materia de gestión industrial, fabricación y productividad entre Estados Unidos y Japón habían empezado ya en los años 50, una vez superadas las heridas de la Segunda Guerra Mundial. El gran teórico de la calidad W. Edwards Deming era bien conocido en Japón por sus numerosas conferencias allí, así como Joseph Moses Juran, su camino fue seguido por el otro gran estudioso de esta materia, el japonés Kaoru Ishikawa y mediante ellos ya en Toyota, como hemos dicho antes, descubrieron tras la crisis del petróleo de 1973, que fijarse en la calidad del producto reducía más el coste que si el foco de la producción estaba solo en este último.

Pero había que investigar más y tras los numerosos intercambios entre ambos países y la enseñanza impartida, empezaron a fraguar en Estados Unidos los conceptos del TPS. En su traslación se utilizó el término Lean, que en inglés significa magro, es decir libre de todo lo superfluo, por tanto: Neto, limpio, sin

² “Desde la Fundación de Toyota nos adherimos al principio básico de contribuir a la sociedad a través de la fabricación de productos y servicios de alta calidad. Nuestras prácticas de negocio y actividades basadas en ese principio básico, crearon métodos de valores, beneficios y negocio que a través de los años fueron la fuente de nuestra ventaja competitiva. Estos son los valores de gestión y de negocio que se conocen colectivamente como el Método Toyota”. Fujio Cho, Presidente de Toyota en “The Toyota Way” de Jeffrey K. Liker.

añadidos que no aportan nada al producto, ni a su fabricación, y puesto que se estaba estudiando el TPS se le denominó: Lean Production System o LPS.

De las Universidades y la teoría se pasó a su aplicación práctica en la fabricación, impregnando la producción americana desde los años 80 hasta nuestros días, en un proceso de mejora continua que sigue avanzando.

Hitos fundamentales de esta convicción fueron varios libros publicados en los años 90 y siguientes, que pronto calaron en los responsables de producción y eficacia empresarial estadounidense, tales como: Lean Thinking de James P. Womack y Daniel T. Jones, La Máquina que Cambió el Mundo de los mismos autores junto con Daniel Roos, Las Claves del Éxito Toyota de Jeffrey K. Liker e incluso La Meta: Un Proceso de Mejora Continua de Eliyahu M. Goldratt.



Fig. 3: Libro de Jeffrey K. Liker: Las Claves del Éxito de Toyota

Los catorce principios Lean que parten del TPS enunciados por Jeffrey K. Liker en “Las Claves del Éxito de Toyota” son:

SECCIÓN 1: FILOSOFÍA DE LARGO PLAZO

1. Base sus decisiones de gestión en una filosofía a largo plazo, aún incluso a costa de sacrificar objetivos financieros a corto plazo. Este principio es básico para todos los demás, la implantación de una filosofía Lean en una organización es un proceso lento, de mejora continua, que debe involucrar a todos los actores del proceso productivo, esto es lo que hemos visto anteriormente como filosofía Kaizen.

SECCIÓN II: EL PROCESO CORRECTO PRODUCIRÁ LOS RESULTADOS CORRECTOS

2. Cree un flujo continuo para que los problemas salgan a la luz, al emplear esta técnica aparecerán los siete desperdicios que hay que eliminar y que Taiichi Ohno había descrito y antes hemos mencionado:

Gasto por la sobreproducción (gran pérdida)
Pérdida de tiempo a mano (esperando)
Gasto de transporte
Gasto por procesarse a sí mismo
Gasto del inventario que está a mano
Gasto por movimiento
Gasto por hacer productos defectuosos

3. Utilice sistemas pull y evitará la sobreproducción excesiva, es la traslación del principio Just in Time del que antes hemos hablado, producir aquello que pida la demanda y solo aquello que pida la demanda, cuando lo pida, evitando stocks innecesarios.
4. Nivele la producción, este principio en japonés se denomina Heijunka lo que significa que es mejor trabajar como la tortuga que como la liebre, consiguiendo un equilibrio y ritmo constante de trabajo en cada línea de producción y no cambiando de objetivos, lo que redundaría en ineficiencias y retrasos.
5. Construya una filosofía de parar la producción si se detecta un defecto, buscando conseguir la calidad en el primer intento, esto es lo que Sakichi Toyoda introdujo en sus telares y que denominó Jidoka, o autonomía por fallo, según antes hemos visto, todos los miembros del equipo estén o no en la línea de producción pueden parar la misma si detectan un fallo.
6. Las tareas estandarizadas son la base de la mejora continua y de la autonomía del empleado, al estandarizar los procesos, el empleado podrá controlar mejor los tiempos que dedica a cada tarea y así irlos mejorando con la práctica.
7. Utilice el control visual para que los problemas no se escondan, para ello se deben utilizar indicadores que dejen bien visible el fallo, indicando cual es el fallo detectado y si fuera posible la solución que se propone.
8. Utilice siempre tecnología fiable, ampliamente probada y contrastada que dé servicio adecuado a los empleados y a los procesos. Se trata de utilizar las mejores herramientas para ayudar a las personas en su trabajo, rechazando aquellas tecnologías o sistemas que den problemas y dificulten la producción.

SECCIÓN III: AÑADA VALOR A SU ORGANIZACIÓN DESARROLLANDO A SUS EMPLEADOS Y SOCIOS

9. Haga crecer en su organización líderes que, comprendiendo el trabajo de forma global, vivan la filosofía de la empresa y la enseñen a otros

compañeros. Para conseguir este objetivo es importante que estos líderes crezcan dentro de la propia organización, para que conozcan bien los objetivos marcados.

10. Desarrolle personas excepcionales y equipos que sigan la filosofía de la empresa, estos deben ser capaces de conseguir metas extraordinarias, dentro de la cultura Lean de la propia organización. Se debe hacer un esfuerzo continuo para enseñar a las personas a trabajar conjuntamente como un equipo en pos de una meta común.
11. Respete a su red de socios y proveedores, motivándolos y ayudándolos a mejorar, deles un trato como si fueran de la propia compañía, comprometiéndolos con la filosofía de la misma para que cumplan los objetivos marcados como si fueran propios.

SECCIÓN IV: LA RESOLUCIÓN CONTÍNUA DE LOS PROBLEMAS FUNDAMENTALES CONDUCE AL APRENDIZAJE DE LA ORGANIZACIÓN:

12. Vea por sí mismo la situación para poder comprenderla totalmente, este principio se denomina en japonés Genchi Gebetsu, es importante no teorizar ni tomar decisiones a distancia sin ver personalmente los problemas “in situ”. Una vez conocida la situación de primera mano se podrá pensar en las soluciones.
13. Tome las decisiones lentamente, por consenso, considerando todas las posibles opciones, pero una vez decidido impleméntelas rápidamente, en japonés Nemawashi es precisamente esta forma de proceder, significa debatir y analizar todas las posibles opciones, pero no dudar una vez decidido y fijarse en el objetivo.
14. Convierta a su organización en una empresa de aprendizaje continuo mediante la reflexión: Hansei en japonés, y la mejora continua, volviendo nuevamente al principio básico del Kaizen que vimos al principio, la base que impregna todo el TPS y en consecuencia el LPS.

Se comprende por tanto que se trata de otra filosofía, de otra forma de afrontar la fabricación distinta a la de la Cadena de Producción de Henry Ford.

1.2 LEAN CONSTRUCTION:

Como ya había ocurrido en su momento con el Project Management, desde la eficacia industrial se comienza a pensar en aplicar esta misma filosofía a la construcción.

Si el LPS era aplicable a la fabricación de productos ¿Por qué no podría serlo también a la Construcción?

Es el Profesor Lauri Koskela de la Universidad Tecnológica de Helsinki en Finlandia quien abre este camino en su Tesis Doctoral presentada en la Universidad de Salford, Reino Unido, en el año 1992, titulada: “An exploration

towards a production theory and its application to construction”, en español: “Investigación de una teoría de producción y su aplicación a la construcción”. La que el Profesor Koskela denomina “teoría de producción” no es otra que el Lean Production System, al que antes nos hemos referido, y aplicándolo a la construcción se había creado el Lean Construction o La Construcción sin Pérdidas en terminología española.

Posteriormente varios Profesores de la Universidad de Berkeley en California, Estados Unidos, convergen en esta teoría y comienzan a desarrollar trabajos de aplicación del Lean Production System a la Construcción. Ellos son: Glenn Ballard, Greg Howell, Will Lichtig y otros, a los que más adelante se une el Profesor Luis Fernando Alarcón de la Universidad Católica de Santiago de Chile.

Este grupo de Profesores e investigadores son los responsables de la difusión e implantación del Lean Construction, habiendo escrito numerosos libros, artículos científicos e impartido conferencias y cursos sobre la materia en todo el mundo. Juntos fundan en 1993 el International Group for Lean Construction o ILCG³, , así como el Lean Construction Institute⁴ plataformas que en desde su fundación han contribuido de forma notable al desarrollo e implantación de esta disciplina.

En España las primeras noticias sobre la materia parten de un Artículo del año 2009 en la Revista de Obras Públicas, Órgano Profesional de los Ingenieros de Caminos, Canales y Puertos, titulado: “Un nuevo enfoque en la gestión: La Construcción sin Pérdidas”, de los Profesores Luis Fernando Alarcón de la Universidad Católica de Chile y Eugenio Pellicer de la Universidad Politécnica de Valencia.

Es precisamente en esta Universidad de Valencia donde se produce la mayor implantación y desarrollo de “La Construcción sin Pérdidas” con los Profesores: Eugenio Pellicer, Fernando Cerveró, Juan Felipe Pons, José Luis Ponz y otros, que en el año 2011 constituyen el “Spanish Group for Lean Construction”⁵ plataforma básica para la difusión de estas técnicas en nuestro país.

Existen ya algunos libros españoles como: “Introducción al Lean Construction” de Juan Felipe Pons editado por la Fundación Laboral de la Construcción en 2014 o “Lean, Diseño y Construcción. Un cambio necesario” de Cristina Ayats, editado por la Editorial Círculo Rojo en 2015, siendo varios los artículos científicos publicados sobre la materia, así como algunas Tesis Doctorales que tocan aspectos de la metodología.

³ www.iglc.net

⁴ www.leanconstruction.org

⁵ www.leanconstruction.es

Son numerosas las técnicas que a través de Lean Construction se han ido creando desde su implantación. Estas son las herramientas prácticas por medio de las cuales se alcanzan los objetivos de “La Construcción sin Pérdidas”.

Destacamos como más importantes las siguientes:

- Sistema del Último Planificador, en inglés: Last Planner System.
- Diseño de Valor Objetivo, en inglés: Target Value Design.
- Métodos Colaborativos en Construcción, en inglés: Integrated Project Delivery.

Veámoslos con mayor detalle:

Last Planner System es un Sistema de Planificación de obras creado por los Profesores Glenn Ballard y Greg Howell a finales de los años 90 que adopta métodos colaborativos para su desarrollo. En consecuencia, el plan finalmente obtenido es un documento consensuado y un compromiso de todos los participantes es llegar a cumplirlo.



Fig. 4: Lean Construction + Last Planner

Permite:

- Optimizar los recursos, reducir los costes y mejorar la productividad
- Proteger a la producción de la incertidumbre.
- Identificar tempranamente riesgos y oportunidades.
- Mejorar el ambiente de trabajo consiguiendo una mayor integración y conexión con otras empresas.
- Cada subcontratista se compromete a través de la metodología colaborativa.
- Alentar al equipo a comprender y eliminar las restricciones que impiden el trabajo.

Los Métodos Colaborativos (Integrated Project Delivery), una metodología Lean Construction que mejora el proceso constructivo

- Entender las dependencias con las otras sub-contratas.

Target Value Design es una práctica de gestión que hace que el coste objetivo sea quien decida el diseño.

Utiliza objetivos de coste, planificación y entrega de valor como los criterios primarios para el diseño desde las fases más tempranas del proyecto.

Así mismo utiliza curvas de aprendizaje constante entre las decisiones de diseño y los resultados de coste y planificación, en lugar de esperar hasta el final de la fase de diseño para hacer una estimación del coste.



Fig. 5: Target Value Design

Consiste en dar la vuelta al proceso tradicional: Se diseña para el objetivo que se quiere conseguir, no se presupuesta lo que se ha diseñado.

Analizaremos a continuación los Métodos Colaborativos, Integrated Project Delivery o IPD⁶

2. LOS METODOS COLABORATIVOS EN CONSTRUCCIÓN (INTEGRATED PROJECT DELIVERY)

2.1 ¿POR QUÉ METODOS COLABORATIVOS?:

Está demostrado estadísticamente que la industria de la Construcción es la de más baja productividad entre los sectores económicos.

⁶ Nos referiremos en el texto indistintamente a una de estas acepciones.

Los Métodos Colaborativos (Integrated Project Delivery), una metodología Lean Construction que mejora el proceso constructivo

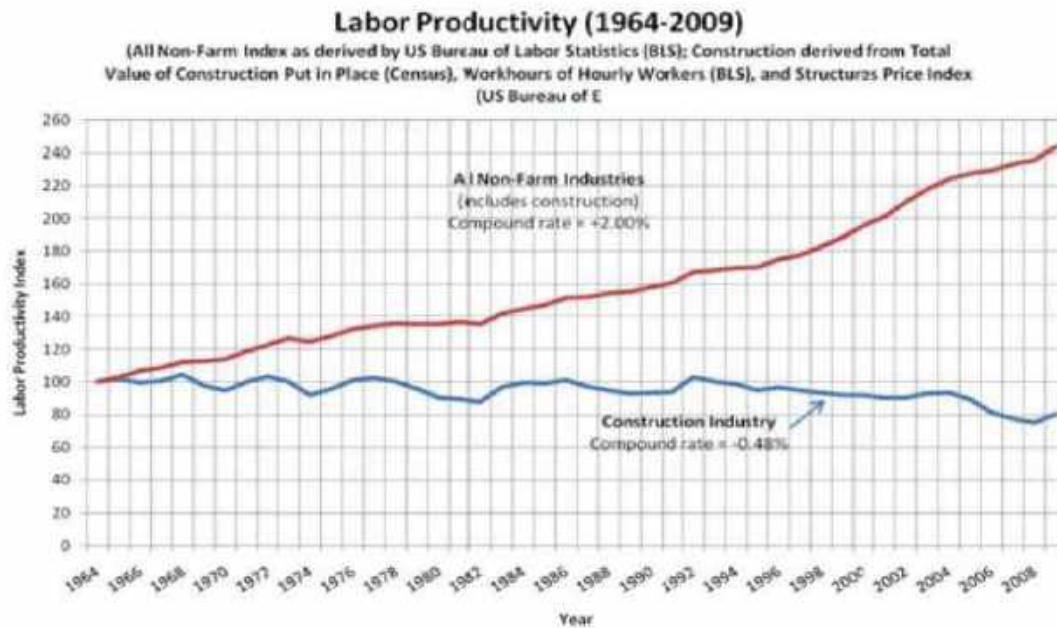


Fig. 6: La productividad laboral en Estados Unidos entre 1964 y 2009. Fuente: Chapman and Butry, “Measuring and Improving the Productivity of the U.S. Construction Industry: Issues, Challenges and Opportunities.” Building and Fire Research Laboratory, National Institute of Standards and Technology: Gaithersburg, MD.

El Profesor Glenn Ballard, señala que según sus estudios los proyectos de construcción generalmente operan entre el 55% y el 60% de fiabilidad en la finalización de las tareas del día siguiente⁷, es decir, la construcción hoy en día logra terminar un poco más de la mitad de lo que se planea hacer 24 horas antes.

En consecuencia, es absolutamente necesario plantear nuevos métodos de gestión que mejoren estos resultados.

La causa fundamental está en la forma de trabajar en construcción, algo que consideramos inamovible, el famoso sistema: Diseño, concurso, construcción, Design, Bid, Build en inglés.

Paradigma que ha demostrado abundantemente a lo largo de la historia ser un foco interminable de conflictos, ya que se basa en el pernicioso esquema de que todo el mundo está, desde el principio, enfrentado con todo el mundo y en consecuencia que cada uno solo se preocupa de defender su propia parcela en contra de la de los demás, el resultado de esta confrontación es el edificio, y por el camino se van produciendo una serie de vencedores y vencidos cuyas circunstancias influyen negativamente en este resultado. No obstante, continuamos utilizándolo de forma reiterada, considerando que es la forma natural y única de trabajar en Construcción.

⁷ www.leanconstruction.org

Esta situación tiene que cambiar si queremos progresar y evitar los problemas del viejo e ineficaz paradigma. En otros países, en especial en Estados Unidos, ya está cambiando, mediante la aplicación de Métodos de Trabajo Colaborativo.



Fig. 7: Esquema de IPD. Fuente: Introducción al Lean Construction, Juan Felipe Pons, Fundación Laboral de la Construcción

El modelo se basa en los principios del liderazgo colaborativo, en el papel que éste juega en las nuevas formas de producción, se trata de un nuevo estilo de liderazgo consistente en facilitar la inteligencia colectiva en contra de la tradicional forma de trabajar en pirámide.

Esta colaboración implica derechos y deberes, pero también que el beneficio se comparta de forma reglada y con ello se optimicen los resultados del proceso constructivo, trabajando todos unidos en pos de un mismo fin y eliminando en consecuencia los conflictos entre las partes.

2.2 BREVE HISTORIA DEL IPD:

- 1995.- Un grupo de Compañías de la Industria de la Construcción en Orlando, Florida (EE.UU.), comienzan a trabajar de forma colaborativa, constituyen la Compañía IPD, Inc. y patentan el Método Integrated Project Delivery en el año 2000.
- 2001.- Los Profesores Greg Howell y Glenn Ballard del Lean Construction Institute (LCI) se entrevistan con los fundadores de IPD Inc. interesándose por esta Metodología. El IPD comienza su difusión académica.
- 2007.- El American Institute of Architects (AIA) publica su primer documento sobre la definición de esta forma de trabajo. La Metodología IPD adquiere una base profesional.
- 2007.- La Compañía Sutter Health pone en marcha el primer Proyecto totalmente desarrollado con Metodología IPD, mediante un Integrated Form of

Agreement (IFOA) con los anteriormente citados. El IPD se prueba en un Proyecto real con éxito.

- 2008.- Sutter Health cede los derechos del IFOA al LCI y entre todos los intervinientes: IPD Inc., LCI, AIA, e incluso la Associated General Contractors (AGC) etc., se suscribe el conocido como ConsensusDoc 300. El IPD se convierte en una realidad plena en EE. UU.

2.3 DEFINICION DE IPD

El AIA ha actualizado en 2014 su definición de IPD respecto a la publicada en 2007:

“Es un método de entrega de un proyecto que integra a las personas, los sistemas, las estructuras de negocio y las prácticas, en un proceso que de forma colaborativa pone a trabajar los talentos y visiones de todos los participantes para reducir las pérdidas y optimizar la eficiencia a través de todas las fases de diseño, fabricación y construcción. El Método Integrated Project Delivery contiene, como mínimo todos los siguientes elementos:

- 1.- Implicación continua del propietario, así como de los diseñadores y constructores clave.*
- 2.- Intereses de negocio alineados a través de un sistema compartido de riesgo/beneficio, incluyendo ganancias financieras por riesgo, que dependan de los resultados del proyecto.*
- 3.- Control del proyecto conjunto del propietario, así como de los diseñadores y constructores clave.*
- 4.- Contrato común entre todas las partes o con condiciones de participación obligatorias y específicas.*
- 5.- Responsabilidad compartida por el propietario y los diseñadores y constructores clave.”*

Es importante destacar de la definición anterior que IPD integra a ambos lados del diseño y la construcción en un equipo, incluyendo también en el mismo a la propiedad.

Un equipo integrado pone a todos en el mismo barco y por tanto si hay problemas son de todos, tanto el propietario como los diseñadores o constructores deben tener un incentivo financiero que haga que se ayuden a tener éxito.

Al estar compartiendo riesgos y recompensas todos deben también compartir el control del proyecto. Lo habitual es crear un equipo de gestión en el que estén todas las partes implicadas y lleguen a acuerdos sobre la toma de decisiones.

En el aspecto legal este método de contratación requiere un contrato múltiple en el que todas las partes establezcan sus derechos y deberes.

Así mismo se debe establecer la responsabilidad compartida y las compensaciones a las partes por perjuicios causados al objetivo común.

En Estados Unidos existen ya despachos de abogados especializados en este tipo de Contratos basados en el ConsensusDoc 300, al que anteriormente nos hemos referido.



Fig. 8: La Organización de un Proyecto IPD

Habitualmente en los proyectos IPD se realizan las siguientes tareas para alinear los intereses de negocio:

- Se fija un objetivo de coste y plazo del proyecto en etapas tempranas. Dado que el diseño aún no está finalizado, para establecerlos se parte de ratios de proyectos similares existentes. Esto es lo que se conoce en inglés como benchmarking, que significa punto de referencia.
- Se establecen los costes para el equipo de diseño y para la empresa constructora, estos costes deben ser lo más reales posible y no incluir beneficio. Esto es una base que ambos actores saben que van a percibir como mínimo.
- Se crea una base de incentivos económicos, que será compartida proporcionalmente a su aportación por el equipo de diseño y por la empresa constructora. Esta base de incentivos debe ser fijada por la propiedad y contiene todos los beneficios esperados que la propiedad pueda compartir con los otros actores., normalmente se tienen en cuenta también los sobrecostes que contingentemente se puedan producir.
- Se incentiva a equipo a reducir el coste y el plazo estimados mediante la disposición de la base de incentivos en caso de éxito.

- Se penaliza al equipo si se producen costes por encima de los objetivos o retrasos en el plazo estimados, mediante la reducción de su participación en la base de incentivos. Los sobrecostes producidos se detraen directamente de la misma.
- Se incentiva a la propiedad a ayudar al equipo de diseño y a la empresa constructora a tener éxito, tras haber fijado unos objetivos de coste y plazo realistas en la fase inicial, requiriéndole a que, si el resto del equipo cumple sus cometidos, sea la propiedad quien cubra la base de incentivos reduciendo su beneficio en la operación.

Evidentemente todas estas condiciones son las que se establecen detalladamente en el Contrato común al que antes nos hemos referido.

La idea clave que subyace en esta metodología es la de la mejora del todo en lugar de la de cada una de las partes y la única forma de conseguirlo es definir con claridad los objetivos de valor que se quieren lograr en el edificio, para posteriormente rodearse de un equipo de colaboradores motivados a conseguirlo.

Es obvio que para que haya una auténtica colaboración debe combinarse la confianza con el respeto mutuo y un sentimiento de objetivo conjunto. Para ello deben seleccionarse muy bien a las personas que van a participar en el equipo y rechazar a aquellas que no acepten estos valores.

El objetivo conjunto se da cuando todos los actores tienen un sentimiento de propiedad sobre la obra que se está desarrollando, para ello esta metodología requiere que sea el mismo equipo el que está trabajando desde los primeros bocetos hasta la entrega del edificio⁸.

El respeto se produce cuando se buscan profesionales competentes y con experiencia, que tengan buenas habilidades interpersonales y cuyas actitudes y lenguaje demuestren consideración hacia sus compañeros.

La confianza se logra cuando el equipo combina transparencia en la información a los demás, se utiliza un entorno de trabajo seguro en el que se busca el bien de todos y se reparten riesgos y beneficios.

Otro potente incentivo para unir a todo el equipo es la posibilidad de continuar trabajando juntos de esa manera en futuros proyectos. Conseguir una relación del largo recorrido es sin duda uno de los motores principales del sector de la Construcción, que normalmente suele ser recurrente en sus emprendimientos.

Existen importantes empresas en Estados Unidos como Sutter Health, Autodesk o Biogen, que desarrollan todos sus proyectos con IPD, recurriendo

⁸ El Design-Build Institute of America (DBIA) promueve la idea de que: "Integrated Project Delivery se refiere a una metodología en la que los actores principales colaboran en el proyecto desde su concepción hasta su finalización" Fuente: The Owner's Guide to Starting Integrated Building Projects, autor: Oscia Wilson.

habitualmente a técnicos y constructoras ya probadas en anteriores experiencias exitosas.

2.4 EL IMPACTO DE LA TECNOLOGÍA:

Las mejoras tecnológicas impactan de forma muy positiva en el desarrollo de los Métodos Colaborativos, permitiendo una mejor y más directa relación entre los miembros del equipo.

En particular la utilización de BIM es algo ineludible para el mejor funcionamiento de la metodología.

BIM es el acrónimo de Building Information Modeling que se puede traducir al español como: Información del Modelado de la Construcción.

Según lo ha definido el Ministerio de Fomento en la constitución de la Comisión para su implantación en España, en Julio de 2016, es:

“Una herramienta tecnológica para la gestión de proyectos, a través de un modelo digital 3D, que reduce costes, acorta tiempos de diseño y producción y mejora la calidad de los proyectos de ingeniería, arquitectura y construcción.”

Desde este punto de vista si bien se hace una definición de algunas de las ventajas que su utilización produce, se contempla BIM como “herramienta tecnológica” y en nuestra opinión la realidad es que es mucho más.

La modelización completa y parametrizada de un edificio es una revolución en el mundo de la construcción, en realidad consiste en “construir” virtualmente el mismo, incluyendo todos sus atributos constructivos, todas las definiciones en cada una de las unidades que lo componen, llegando a un nivel de detalle previamente fijado, en función de las necesidades del proyecto.

Así visto, nosotros creemos que sería mejor considerar BIM como el acrónimo de: Building Information Management, una Metodología de Trabajo que nos va a permitir gestionar, con una eficacia hasta ahora impensable, todo el ciclo de vida del proyecto de construcción.



Fig. 9: El Ciclo de Vida del Proyecto

BIM impacta positivamente en la Metodología Integrated Project Delivery, ya que el equipo de proyecto puede trabajar simultáneamente en el mismo modelo, detectándose de forma inmediata las interferencias y las aportaciones de cada uno de sus componentes y cómo afectan al conjunto. Esto permite, ahora más que nunca, desarrollar Métodos Colaborativos en Construcción

El hecho de trabajar desde su concepción sobre un único modelo virtual es algo que incrementa la transparencia y la confianza, además permite que todos los miembros del equipo hagan sugerencias “on line”.

La parametrización de las unidades constructivas mediante la cual cada entidad utilizada en el dibujo contiene todos sus atributos, hace que el conocimiento del desarrollo del proyecto sea mucho más completo y real.

La posibilidad de edición de todas las vistas, plantas, alzados, secciones, axonometrías o render, incluso videos instantáneos amplia de forma ingente la comprensión de la evolución del proyecto.

La detección temprana de interferencias entre elementos de construcción, como estructuras, albañilería, falsos techos e instalaciones, etc. hace que la calidad del proyecto sea mucho mayor, y redunde sin duda alguna en una mejora muy importante de cara a la ejecución, y a evitar problemas habituales hoy en día por falta de definición o definición errónea en los documentos de obra.



Fig. 10: Building Information Modeling

Finalmente, el crecimiento y mejora de la comunicación en la nube hace que la localización de los miembros del equipo ya no sea un factor determinante hoy en día y permite una relación mucho más fluida y rápida en todo momento.

2.5 VENTAJAS QUE SE RECONOCEN POR LOS USUARIOS EN ESTADOS UNIDOS TRAS LA APLICACIÓN DE IPD:

Para la Propiedad:

- Conocimiento temprano del costo del edificio.
- Precio fiable (sin cambios por parte de Técnicos y/o Empresa Constructora).
- Lograr un menor costo del edificio o una mejor calidad.
- Auténtica Ingeniería de Valor.
- Dejar de hacer siempre el papel de árbitro.
- Menor probabilidad de litigio.

Para la Empresa Constructora.

- Dejar de ofertar siempre a la baja.
- Mejores relaciones con la Propiedad.
- Posibilidad de influir durante el diseño del edificio.
- Oportunidad para incrementar el beneficio.

Para los Técnicos.

- Aprender algo nuevo de los demás intervinientes.
- Menor presión para terminar cuanto antes el Proyecto.
- Mejores relaciones con la Propiedad.
- Oportunidad para incrementar el beneficio.
- Menor probabilidad de litigio.

Podemos ver en la figura posterior cómo la utilización de IPD (curva gris) adelanta la toma de decisiones sobre el proyecto y conduce a una forma más barata y eficaz de gestionar la Construcción que el método tradicional (curva verde).

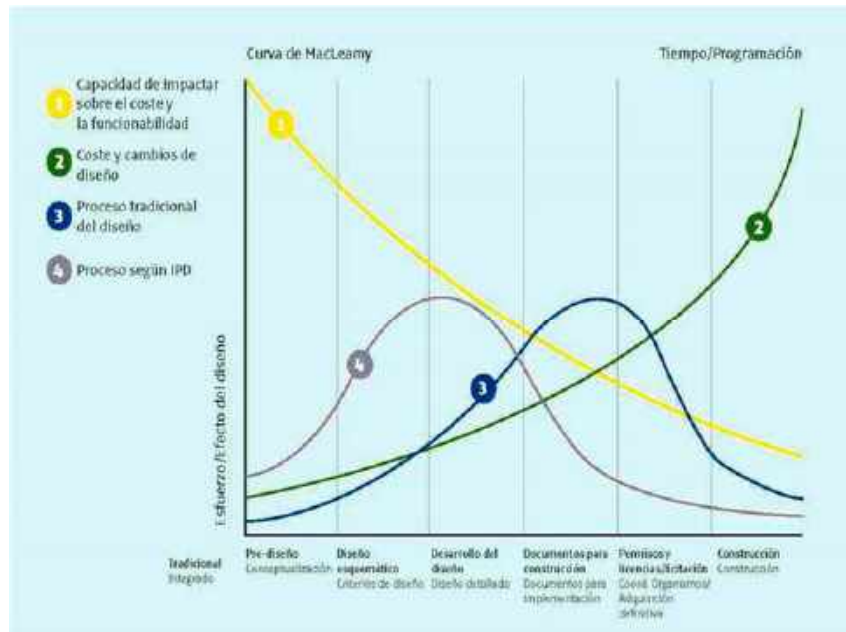


Fig. 11: Curva de MacLeamy. Adaptado de “Integrated Project Delivery: A Guide” (2007). The American Institute of Architects (AIA) (Juan Felipe Pons, Fundación Laboral de la Construcción, 2014)

Según las estadísticas que figuran en la publicación: “Project Delivery Systems”, publicada por Mac Graw Hill en Estados Unidos en el año 2014, más de un tercio aproximándose a la mitad de las personas que han tenido experiencias con la metodología IPD, la encuentran como la mejor para optimizar: Comunicación, Procesos, Eficiencia y Productividad en la Construcción.

Así mismo, se señala que aquellas personas que se han familiarizado con Metodologías Colaborativas esperan incrementar su uso en los próximos tres años.

2.6 EJEMPLOS DE EDIFICIOS DESARROLLADOS CON IPD EN ESTADOS UNIDOS:



Fig. 12: Sutter Health Fairfild Medical Office Building, año 2007. Fairfield, California. Presupuesto: 19.462.103 \$

Los Métodos Colaborativos (Integrated Project Delivery), una metodología Lean Construction que mejora el proceso constructivo



Fig.13: Cardinal Glennon Children's Hospital Expansion, año 2008. St. Louis, Missouri
Presupuesto: 45.572.449 \$



Fig.14: St. Clare Health Center, año 2008. Fenton, Missouri. Presupuesto: 148.300.000 \$



Fig.15: Walter Conkrite School of Journalism, Arizona State University, año 2008. Phoenix, Arizona.
Presupuesto: 63.822.794 \$



*Fig.16: Autodesk Inc. Solutions Division Headquarters, año 2008. Waltham, Massachusetts.
Presupuesto: 12.117.000 \$*



Fig.17: Biogen Offices, año 2012. Cambridge, Massachusetts. Presupuesto: 500.000.000 \$

3. CONCLUSIONES

Como conclusión comparamos los efectos del Sistema Tradicional: Diseño-Concurso-Construcción con los Métodos Colaborativos.

3.1 METODO TRADICIONAL: DISEÑO-CONCURSO-CONSTRUCCIÓN:

- Proyecto- Concurso-Construcción un foco interminable de conflictos.
- Establecimiento de remuneraciones y responsabilidades enfrentadas entre los diversos agentes intervinientes.
- Inadecuación de la Legislación española en materia de construcción permitiendo solamente actuar de este modo.
- Obsolescencia en los métodos de trabajo en construcción que redundan en la ineficacia del proceso constructivo.

- Ineficacia es despilfarro.

3.2 METODOS COLABORATIVOS: INTEGRATED PROJECT DELIVERY:

- La Construcción como un esfuerzo colaborativo de los agentes intervinientes con una meta única.
- Remuneraciones y responsabilidades compartidas entre todos.
- Necesaria adecuación de la Legislación española en materia de Construcción abriéndose a nuevas posibilidades.
- Puesta al día de los métodos de trabajo en Construcción que redundará en una mayor eficacia del proceso constructivo.
- Eficacia es ahorro.

Por tanto, cuanto antes nos incorporemos a estas nuevas corrientes, antes obtendremos los beneficios de su aplicación.

El paradigma de la forma de trabajar en Construcción ha cambiado por completo, abramos los ojos a todas estas nuevas realidades que no van a permitir continuar con los métodos tradicionales.

Caminemos por esta nueva senda que nos traerá grandes beneficios, incorporando: Lean Construction, Integrated Project Delivery y BIM, en un conjunto exitoso para la Construcción.

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Spanish Group for Lean Construction. www.leanconstruction.es

Madrid 24 de Febrero de 2017



2º Congreso Internacional de
Innovación Tecnológica en
Edificación



POLITÉCNICA

CERTIFICADO DE ASISTENCIA OTORGADO A:

D. Miguel Ángel Álvarez Pérez

por su participación en el

CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN CITE2017

celebrado en la Escuela Técnica Superior de Edificación de la Universidad Politécnica de Madrid,
los días 8, 9 y 10 de marzo de 2017

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Edificación de Madrid (ETSEM – UPM)

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Director del Departamento
de Tecnología de la Edificación
ETSEM - UPM



**Congreso Internacional de
Innovación Tecnológica en
Edificación - CITE2017**



POLITÉCNICA

CERTIFICADO OTORGADO A:

D. Miguel Angel Alvarez Perez

por su participación como ponente, con la comunicación "*Los métodos colaborativos (integrated project Delivery), una metodología lean construction que mejora el proceso constructivo*" en el

CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN CITE2017

celebrado en la Escuela Técnica Superior de Edificación de la Universidad Politécnica de Madrid,
entre los días 8,9 y 10 de marzo de 2017

D.ª. Nuria Liauradó Pérez
Secretaria académica
de la Escuela Técnica Superior de
Edificación de Madrid (ETSEM – UPM)



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de Tecnología de la Edificación
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JUAN LUIS GARCÍA ALONSO, Director Académico del Centro de
Formación Permanente de la Universidad de Salamanca,

CERTIFICA:

Que **D. MIGUEL ÁNGEL ÁLVAREZ PÉREZ**, con DNI número **05409142W** ha impartido 5 horas de docencia en la asignatura "COSTES Y PRESUPUESTOS" cuyo contenido es: BIM, LEAN, KANBAN, MÉTODOS DE TRABAJO COLABORATIVO en el "MÁSTER EN DIRECCIÓN Y GESTIÓN DE PROYECTOS", Título Propio de la Universidad de Salamanca, durante el curso académico 2016-17.

Y para que conste a los efectos oportunos, expido el presente certificado en Salamanca a tres de julio de dos mil diecisiete.



CENTRO DE FORMACIÓN PERMANENTE

Certificado de asistencia

MIGUEL ÁNGEL ÁLVAREZ PÉREZ

por asistir al taller de

Lean Construction y Last Planner System

Impartido el 21 de junio de 2017 en la sede del Colegio Oficial de Aparejadores de Madrid,
como parte del evento

THiNK TANK 2017
Lean Construction en España

Y para que así conste, se expide el presente certificado en Valencia, a 21 de junio de 2017



Fernando Cerveró Romero
CEO



M^{ra} Jesús Lledó Pardo
COO



9.2.3.- Curso 2017-2018:



9.3.- Curso 2017-2018:

9.3.1 Publicaciones

Septiembre-diciembre 2017

Título: “Métodos colaborativos, un cambio para la Construcción en España”.
“Integrated Project Delivery, an alternative of the usual form of Construction Work in Spain”.

Revista: Building & Management, ISSN 2530-8157 (Publicada por la ETSEM, UPM). **REVISTA NO INDEXADA**. Volumen I, número 3, páginas 27-33.
Coautores: Alfonso Bucero y Carlos Pampliega.

Enero-abril-2018

Título: “Target Value Design, a Different way of approaching the constructive Process in Spain”.

Revista: Journal of Modern Project Management, ISSN 2317-3963 (Publicada por la Editorial Mundo). **REVISTA INDEXADA Q2** con un SRJ0,302, Q2, H Index 3. Volumen V, número 3, páginas 50-55.

Coautores: Manuel Soler Severino y Eugenio Pellicer Armiñana.

Mayo 2018

Título: “How to Create and Manage a Team to Apply Collaborative methods in Construction (IPD) in Spain”.

Revista: International Journal of Latest Research in Engineering & Tecnology, ISSN 2454-5031 (Publicada IJLRET) **REVISTA NO INDEXADA**. Volumen IV, número 5, páginas 23-33.

Coautores: Manuel Soler Severino y Eugenio Pellicer Armiñana.

9.3.2 Congresos

7,8,9-03-2018

Asisto como ponente al III Congreso de Innovación Tecnológica en la Edificación, CITE 2018, ETSEM, UPM. Título de la ponencia: “Como crear y Gestionar un Equipo para aplicar Métodos Colaborativos en Construcción (IPD) en España”.
Coautores: Manuel Soler Severino y Eugenio Pellicer Armiñana.



14-12-2017

Asisto a la Jornada Precongresual del I Congreso Internacional de Gestión En Edificación, BIMIC 2018, ETSEM, UPM. Título de la ponencia: “Lean Construction y BIM Principios y Sinergias”. Ponente: José Luís Ponz Tienda, Universidad de los Andes, Departamento de Ingeniería civil.

9.3.3 Actividades UPM

Noviembre 2017

Programa de Formación Transversal para Doctorandos UPM.

Curso: Identidad Digital del Investigador (20 horas).

Profesores de UPM: Oriol Borrás Gené y Alegría Blázquez Sevilla.

Enero-febrero 2018

Ciclo de apoyo al Doctorado y la Investigación 2017-2018, Subdirección de Investigación Doctorado ETSAM, UPM. Asistencia a las sesiones 3, Tipografía y Bibliografía Académicas (2 horas), 4, El Arte de Titular (2 horas) y 5, Presentaciones Académicas con Power Point (2 horas).

Profesor: Joaquín Sainz Avia, UPM, Departamento de Composición de ETSAM.

Julio-2018

Asisto al Curso: GRADCOMMX celebrado en la ETSI Caminos Canales y Puertos de Madrid, dentro del Programa de Formación Transversal para Doctorandos de la UPM.

9.3.4 Índices de Calidad

Junio-Septiembre-2018

Contrato ELSEVIER como revisor de artículos en Revistas Indexadas de Construction Management.

Ficha ORCID.



Revisión de 2 artículos Científicos para la **REVISTA INDEXADA Q2:** International Journal of Construction Management, publicada por la Editorial Taylor & Francis, Reino Unido.

1º.- Título: “Re-defining flow in construction Process for facilitating the identification and quantification of generic overruns existing industry today”. Recomendación que he hecho tras la revisión: Revisión Menor.

2º.-Título:” Life Cycle Environmental Impact Assessment and Optimize Construction Waste Using Building Information Modeling (BIM)”. Recomendación que ha hecho tras la revisión: Revisión Menor.

Renovación de mi Certificación Project Management Professional (PMP ®) en el Project Management Institute periodo 2017-2020.

Tras mi Curso de Identidad Digital del Investigador, abrí mis paginas científicas para divulgar las investigaciones de mi Tesis, en las que continúo publicando:

ResearchGate

https://www.researchgate.net/profile/Miguel_Angel_Alvarez-Perez

En esta página tengo 16 Publicaciones, he recibido 10.195 lectores de todo el mundo, tengo 4 citas y un RG Score 1,43.

Academia.edu

<https://upm-es.academia.edu/miguelangelalvarezperez>

En esta página tengo 15 publicaciones, 1.416 lectores de todo el mundo y 1 cita.

Mendeley:

<https://www.mendeley.com/profiles/miguel-angel-alvarez-perez/>

En esta página tengo 16 publicaciones.

Google Scholar:

<https://scholar.google.es/citations?user=DSkGP38AAAAJ&hl=es>

En esta página tengo 13 publicaciones, 5 citas y un índice h = 1

Integrated project delivery, an alternative to the usual form of construction work in Spain

Métodos colaborativos, un cambio para la construcción en España

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- ◊ The productivity of construction in Spain is lower than that of other sectors.
- ◊ IPD is applied in other countries improving the experience of construction players.
- ◊ Take advantage of BIM and IPD in search of greater efficiency in construction sector.
- ◊ IPD is a Lean methodology that has a positive impact on the construction process.
- ◊ A change of mentality is necessary in the way in which construction takes place in Spain.

The productivity of the construction sector in Spain is very low, as compared to other economic sectors, as with other countries in our environment. It takes us to a deep reflection on whether we are doing things right and what improvements can we introduce to increase production. These improvements must necessarily be technological and methodological, since there is a good training of the equipment both at the managerial level, as well as at the technical and in most of the labour levels, it is to exploit the full potential of new IT tools, especially Building Information Modelling (BIM) and the new methodologies that, from the industry, look for greater efficiency of the process and the elimination of all type of losses, like Lean Construction. A change of mentality, necessary to rethink the way of work in which we have been working for so many centuries, as the only possible paradigm, to replace confrontation as a way of producing construction through collaboration between all the agents involved in the work. We will speak in this article about Integrated Project Delivery (IPD), as one of the Lean methodologies that enable a profound improvement, we will see its definition, its essential components, and how its application can positively influence the construction process in Spain as it has already demonstrated in others.

Integrated Project Delivery (IPD); Lean Construction; Building Information Modelling (BIM); Project & Construction Management (P&CM)

- ◊ La productividad de la construcción en España es menor que la de otros sectores.
- ◊ IPD se aplica en otros países mejorando la experiencia de los agentes del proceso constructivo.
- ◊ Aprovechar BIM y metodologías como IPD buscando una mayor eficacia en la construcción.
- ◊ IPD es una metodología Lean que incide positivamente en el proceso constructivo.
- ◊ Es necesario un cambio de mentalidad en la forma en que se produce la construcción en España.

La productividad del sector de la construcción en España es muy baja, tanto comparativamente con otros sectores económicos, como con la de otros países de nuestro entorno. Se hace necesaria una profunda reflexión sobre si estamos haciendo bien las cosas y qué mejoras podemos introducir para incrementar la producción. Estas mejoras han de ser necesariamente tecnológicas y metodológicas, ya que existe una buena capacitación de los equipos tanto a nivel directivo, como en la escala técnica y en muchos casos en la laboral, es decir, se trata de aprovechar todo el potencial de las nuevas herramientas informáticas, especialmente Building Information Modelling (BIM) y de las nuevas metodologías que, provenientes de la industria, buscan una mayor eficacia del proceso y la eliminación de todo tipo de pérdidas, como Lean Construction. Un cambio de mentalidad necesario, que pasa por replantearnos la forma de trabajo en la que llevamos tantos siglos empeñados, como único paradigma posible, sustituir el enfrentamiento, como forma de producir la construcción, por la colaboración entre todos los agentes intervinientes en la obra. Hablaremos en este artículo de los Métodos Colaborativos en construcción, que en inglés se han denominado Integrated Project Delivery (IPD), como una de las metodologías Lean que posibilitan una profunda mejora, veremos cuál es su definición, componentes esenciales, y cómo su aplicación puede incidir positivamente en el proceso constructivo de nuestro país al igual que ya lo ha demostrado en otros.

Integrated Project Delivery (IPD); Lean Construction; Building Information Modelling (BIM); Project & Construction Management (P&CM)

1. INTRODUCTION

Among the various productive sectors of Spain, construction has traditionally been one of the most important, for several reasons: We are a great tourist power as well as for

our climate, our history, our monuments, our natural beauty, our gastronomy, etc. for our built infrastructure that we must maintain, improve and expand. We also have a very old built heritage, and we are not only referring to our innumerable monumental buildings, but to everyday buildings such as houses, which require a permanent rehabilitation.

On the other hand, construction has been, is, and will be a locomotive sector of the economy that not only creates many jobs, but has a multiplier effect in many other sectors, contributing in an exceptional way to our economic growth.

Consequently, we should be mostly interested in the effectiveness of this sector and in a continuous improvement of the methods by which it occurs.

Instead, we continue to build in the same ways we did centuries ago, we have legislation in the field that faithfully reproduces those obsolete methods, both in terms of building management and public contracting, we consider that the only possible paradigm with which a building can be built is that, and contracting down is the great invention to make public works, and in most cases private ones, in Spain [1].

We will develop in this article some of our errors in the methodology we apply, how there is another way of working, another approach to the constructive fact much more effective and that allows us to leave them, improving a sector so important to our economy and our well-being.

As for all changes, it is required an open mind, breaking down paradigms is not easy, or comfortable, it requires courage and be convinced of the possible improvements, Einstein said we cannot expect new results if we continue doing the same.

Construction can, and must, be more efficient in Spain, we can build better, cheaper, with less means and meet deadlines, but we must look forward, we must recognize our mistakes and be willing to implement new methodologies persevering in them until we will master them. In other countries of our environment this is already a reality, let's do not be late again.

2. PRODUCTIVITY IN SPAIN AND CURRENT STATE

Productivity rates in the construction sector in Spain can be vastly improved when compared to the industrial sector. It seems, however, that at least before the real estate crisis the operating construction system itself in Spain did not call for any change in the use of building systems and working methodologies in the construction sector.

The main reason why there has not been a need for a change so far is its economic impact. The incidence of constructions costs on the price formation of a building was abnormally low (around 25%) compared to the ground costs (40%) and the rest of the financial costs, taxes, marketing, etc. (35%). Thus, any investment intended to enhance the construction process and its management did not imply a solid improvement on the final cost of the real estate product.

The cost of labour also influences the implementation of more advanced construction systems. In countries with a lower labour cost, more industrialized and higher quality processes are less used.

Years before the real estate crisis, the labour force in the construction sector in Spain was extensive and low-skilled, with cheap hiring costs that made unprofitable the

implementation of more productive construction systems that require less skilled and better-paid labour [1].

In the last few years, we have noticed how this distribution of the percentage of the final price has changed, and the construction cost is reaching up to 60% of the final product.

Our construction sector and its labour market are approaching the average of countries surrounding ours, by implementing more modern systems with a more skilled workforce. Therefore, it is urgent to increase the productivity in the sector as it significantly improves the final product.

There are other aspects that need to be improved as much as productivity, aiming at looking for alternatives and new procedures: The delays in the execution times, cost overruns, lack of planning, reworks, ineffective logistics, unnecessary consumption of raw materials, CO₂ emissions, maintenance costs and the lack of quality in a sector with a traditionally under-trained labour and under-industrialized systems, especially in Spain [1].

3. INDUSTRIAL EFFICIENCY

As it has happened so many times, construction must learn from industry, although there are many differences in the way both sectors are produced, it is obvious that the great methodological changes under construction have always come from the application of improvements in the industrial processes, which have then been transferred to it [2].

After World War II a defeated and wounded in its pride Japan wanted to return to occupy the position that corresponded to him among the industrialized nations, but it could not be done using the same methods, the same forms of its competitors, especially of the United States, who saw in the chain of production the paradigm that had made them powerful and had contributed to their success in the War.

In the American industries, the prophecies of Henry Ford, published in his 1926 book "Today and Tomorrow", continued to resonate: To produce and produce, to create a large stock of products that the commercial departments of the companies would care in the market.

They are firstly Kiichiro Toyoda and then Taiichi Ohno, who study their competition thoroughly residing in the United States for a while. Both oversaw the Toyota automobile company and understood that their success had to be based on other principles.

Very impressed by the large parking lots in which hundreds of finished cars were waiting for a customer's order, they realized that this was a major failure of the American industry, a large unproductive immobilizer that in many cases had no outlet and was directly lost.

It was in the improvement where they could give the battle of effectiveness, and above all Ohno was applied to it with the greatest interest, structuring it in the basic principles that would be the Toyota Production System or TPS.

Walking the years, in the eighties, Japan began to flood the

United States with its cars, lighter, less fuel consumers, with good quality, less defects and cheaper than Americans. In this country, many managers began to think that they were the ones who now had to learn from the Japanese and reversed the journey which Toyota managers had made in the 1950s.

What they found was a clean production of everything that did not contribute to their development and improvement, with the focus on the customer, without losses, without useless stocks, without immobilization, a continuous and open collaboration of the work teams and a maximum fixation on quality. It was the TPS, those were the principles that Taiichi Ohno had applied at Toyota.

"The Machine That Changed the World" by professors James P. Womack, Daniel T. Jones and Daniel Roos, is the title that leads to the Massachusetts Institute of Technology or M.I.T. these principles. From that point on, industrial production in the United States revolved around hundred and eighty degrees, and it began to be fixed in improvement as a goal. Japan had understood that competition lay in the lack of defects and in obtaining it with the least possible means.

A good word to define this way of producing was "Lean", which means: Clean, without superfluous elements, to do things with just, but to do them well. This is how the Toyota Production System is renamed the United States Lean Production System or LPS.

There are many titles which from that moment begin to be published there on the Lean philosophy and Toyota heritage, inevitably come loaded with principles and even Japanese words.

For us it stands out above all of them "kaizen" which derives from two words: Kai (change) and zen (good), change to better, something that pervades everything, a principle on which teamwork is based, the collaboration in the search for continuous improvement, in a permanent way, that was the idea force that the TPS printed to production, everything was based on it [3].

It was another way of naming the W. Edwards Deming Cycle: Plan, Do, Check, Act or PDCA, who through his teachings in Japan in the 1950s on continuous improvement, had influenced the TPS too.

4. LEAN CONSTRUCTION

The LPS is implemented and developed in the North American industry for the manufacture of all types of products, the losses are reduced to a minimum, the production chain is balanced, it is produced based on the demand of the customers, not to sell what has been manufactured, but manufacture what has been sold.

"Just in Time" or JIT is the new way of making production profitable, everything has started from Toyota, but has been internalized in the United States as its own, it has been researched and deepened in improving, achieving very positive results that still exist today.

It is in the year 1992 when Finnish professor Lauri Koskela

presents a scientific paper at Stanford University, United States, which in 2000 will develop as Doctoral Thesis at Helsinki University of Technology, Finland: "An exploration towards a Production theory and its application to construction" [4].

This research will lead to the application of Lean's industrial production methodology to construction. Professors Glenn Ballard and Greg Howell of the University of Berkeley in California, USA, were investigating along the same lines.

From the confluence of this knowledge is born Lean Construction, later joining to this group the professor Luis Fernando Alarcón of the Pontificia Universidad Católica de Chile, together they will constitute the International Group for Lean Construction or IGLC, and from their work will be born a whole series of techniques that will develop Lean methods in construction [5].

The substrate that have all these techniques is common sense, collaboration between work teams and focus on people rather than processes. The phrase of Fujio Cho, one of the presidents of Toyota: "Before we make cars, we make people", is a good definition of the methodology.

Over the years Lean Construction work techniques have been growing and have been refined, as well as demonstrating their effectiveness with positive results in concrete works [6].

The most important ones are:

- ◆ Last Planner System.
- ◆ Value Stream Mapping.
- ◆ Target Value Design.
- ◆ Integrated Project Delivery.

All these techniques would require a concrete study of each one of them, since they can contribute to an improvement in the construction processes in Spain (Pons Achel J.F., 2014) [7], but in this article, we want to focus on Integrated Project Delivery or IPD.

5. INTEGRATED PROJECT DELIVERY

We assume that the Spanish construction has a single form of development: Design, Bid, Build, this is our paradigm, a truth assumed as if there was no other alternative, just consult our Legislation in the matter to realize how far it is. It does not matter that this way of working does not leave us satisfied neither with the process itself, nor with the results.

A work is undertaken by the confrontation from the zero minute between the main actors of the same: The Property, The Constructor, The Design Technicians and the Directors of Work. Each one of them will defend a plot against the others, and for this they will not exchange his information with the others, but will use it privately for his own benefit.

The designers will develop the project without taking into account the construction company, or many times the property, and once finished they will realize a budget which they know that will not be fulfilled, but that will serve to summon a

competition between constructing companies, which again will go to falsify the data by offering to do the work at such a low price and with such short deadlines that it will only serve for the property, delighted with that misleading offer, awards them the work.

In the execution phase, all this will explode, in the first place, the construction company will start trying to lower the quality and or present contradictory prices that allow it to balance its accounts. A very important weapon that they will use for this purpose will be the project, which will most often be poorly defined or poorly projected.

The project planners-directors by their part will defend their project, but rather from an aesthetic point of view, thinking about the publication of the photos of the building in the corresponding magazines, to enhance their ego and increase their future commitments, but not so much from the quality, the price or the execution period of the work, since they are aspects that in the bottom they worry less.

Who is going to pay the broken dishes of all this mess is the property, who trying to defend itself from that expensive "party", will hire a Project Manager that will help to put a little order in the chaos, but who won't be able to achieve all its objectives because what is badly designed is the system itself.

IPD [8], completely returns to this process, and what it proposes is that from the very beginning of the design the main actors, mentioned above, work collaboratively in a single team, and that all the information of the project and of the work will be always available to all members of the same. Open books are the formula.

By being open the information the property, the constructor and the technicians will also be able to give an opinion on the development of building issues. This ends the surprises, but also ends up taking advantage of them to cover incompetence or defects of their own.

To work as such, IPD includes that the benefits of the professionals involved are obtained based on the degree of success or failure achieved, measured in terms of price compliance, execution time and quality of the building [9]. There is a prior recognition of costs for the builder and the design team, but the profits will be based on what I mentioned before. This creates a true team spirit, a real interest in things to go well, is what is commonly said in football: "To kick all for the same goal", and not going each one by his side, his own interests, to the detriment of the fulfilment of common objectives.

Advancing the decision making constituting the team at the beginning, contributes to a greater efficiency of the process. There are many studies that attest to this, such as those of Patrick Mac Leamy for HOK (Hellmuth Obata and Kassabaum, one of the most important architectural studies in the world) presented at the American Institute of Architects (AIA): "As early you make a decision on the project it will be cheaper and more effective".

Leamy points out the cost of the decision making and changes caused by the projects throughout their life cycle. Statistics show that we can positively influence the project in its starting phases by making decisions that also have a lower economic impact whereas when construction is advanced, decisions and changes over the project imply overruns (Fig. 1).

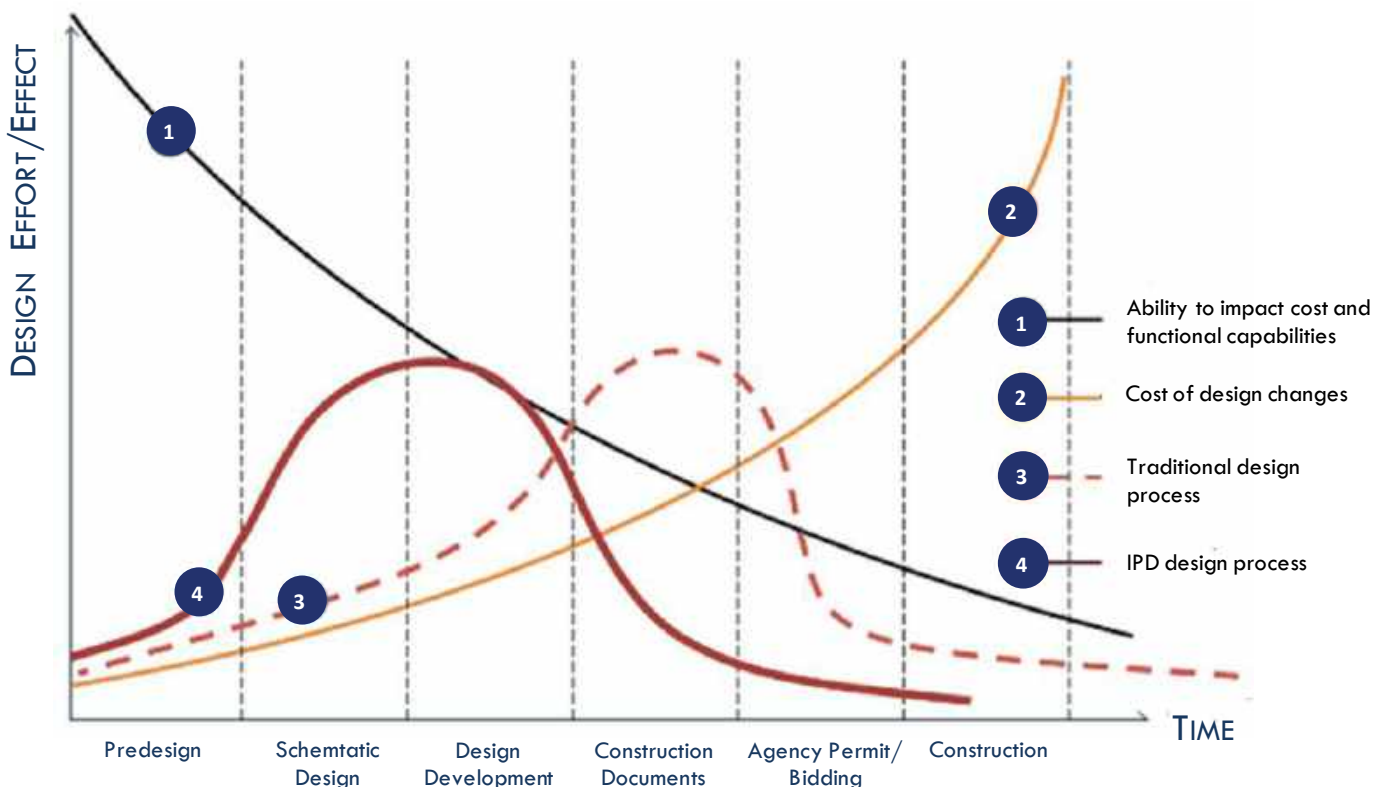


Figure 1: The MacLeamy Curve (Pons Achell, J. F. Introducción a lean construction. Available at: www.fundacionlaboral.org).

This particular fact about the construction projects might be what separates us the most from other industries, especially those related to knowledge and information technology (IT). In construction, prototypes are made of concrete and steel, and any modification on site implies overruns which are much time unfeasible. This factor inevitably determines the management process of the project.

As a result, it is necessary for the future agents of the project to be involved in it since its early phases, so that we can benefit from their experience and knowledge during its design and we can avoid modifications and reworks during the construction phase.

By doing so, technicians from the construction companies will carry out a re-engineering work by providing their expertise and adapting the design to their own working needs. In practice, this calls for a lower cost of the work, higher quality, and greater choices for the client-promoter to adjust the early design of the project to their needs. As outlined below, by involving the agents who are going to perform certain tasks from the beginning, the risks to the property will greatly reduce [10].

An important point in this methodology is the drafting of the agreement under which all parties will relate and share their interests and risks, but there is already in the United States a basis for action in the matter that is: Integrated Form of Agreement or IFOA, such as ConsensusDoc 300, signed by AIA, IGLC and the Associated General Contractors of America (AGCA), which can serve as a model for Collaborative Contracts [11]. It opens here a great field of action for offices of Spanish lawyers who can become experts in this matter, as is already happening in America.

The construction practice shows that 85% of the chances to manage the outcome of the project arises before the awarding of the construction contracts. The involved agents must work together from the beginning to set the strategy for the design management, costs and the subsequent work procurement.

Using IFOA contracts, the main involved agents develop and validate together the objectives of the project by sharing its risks and rewards, based on each one's abilities. During procurement, the company executing the work must make emphasis on who is going to take on those known risks and look for procurement formulas to share the risks of the project.

The risk is allocated through a contract based on procedures defined by the principals (owners of the construction project) which should obey the good practice that says: "Allocate the risk to those who can manage it the best". This means that each risk must be allocated to the party that can best manage, control and mitigate the risk and can withstand its consequences.

This way, the risk management, the decision making and the project control will be executed in collaboration based on the

Collaborative Contract itself that involves all of them [11].

A key factor derived from the Lean philosophy is the importance of the relationship with the client throughout the entire process. In the IPD approach and the Collaborative Contracts between different agents, it states that the work of the team in charge of the development of the project firstly focuses on the client's needs.

The main point of a Collaborative Contract will be to define what the client wants clearly and to define the objectives of the project, the focus that must guide any decision or change on the design. Beyond the quality obtained, the schedule and the cost of the work and the client's needs will be the key points on which the rewards of each part are based [12].

The client's relationship with the rest of the parties benefits from the use of IPD, taking advantage of the experience of architects, technical-architects, engineers, construction companies and suppliers capable of providing solutions that enhance the performance of the project while saving costs and improving deadlines.

The new technologies increasingly facilitate this interaction and the collaborative participation of all parties. The customer is evidently the centre of the IPD process, and there are examples worldwide where new technologies support the inclusion of the customer's needs, whether the promoter or the end customer. Big Data technology is already being used to monitor the usage and habits of building users, gaining valuable information that improves the design and subsequent maintenance of buildings.

Further examples, such as virtual reality, allow us to include the client in the design process in a real and inclusive way. Based on the client's experience, we will create virtual twins, or digital models, that will facilitate communication with the rest of the technicians and suppliers [13].

Accordingly, the development of this tool is contributing as no other to the implementation of IPD: Building Information Modelling or BIM.

The fact that the whole team can work on a single virtual model of the building using BIM has been the biggest step that technology has taken to facilitate this way of working. Also, the use of the cloud for the exchange of information allows the relocation of the equipment and a degree of flexibility that enhances the team work as it had never happened before BIM.

The use of digital models produced with BIM will not only be key during the planning and design of the project but also for communication and re-engineering during the work and subsequent maintenance in a much more advantageous way [14].

The BIM Commission of the Spanish Ministry of Development has announced that from 2020 its use will be mandatory in Spain; therefore, we must catch up on this methodology which

strengthens like never the collaborative work.

6. WHAT DO WE NEED TO CHANGE IN OUR SECTOR?

The construction process in Spain is governed by a general law: LOE, based on very specific procedures and roles, which do not facilitate the implementation of new management methodologies such as IPD.

Artificially, the relationship with other agents that are not reflected in the LOE is based on the jurisprudence reinterpreting this law. The inclusion of new agents involved in the construction project will force the administration, insurers and legal departments of companies to establish norms and protocols adapted to the law.

In Spain, the management of public contracts is based on an obsolete legislation that encourages the previous situation of confrontation between the parties we are criticizing. It is possible to make possible different types of contracts, such as Integrated Project Delivery, Construction Management or Design and Build, whose main difference with Spanish public contracts is the margin left for collaboration between the parties and those who assume the responsibility and risks of the project.

To that effect, our companies are accustomed to carrying out projects with these forms of public-private collaboration contracts when they compete for international contracts. The Directive 2014/24 of the European Union on Government Procurement; the FIDIC international contracts; or the World Bank contracts; include aspects related to proposals for changes, modifications to the project, risk sharing, which facilitate the management of projects and expedite the treatment with the contracting administration [15].

Another key element of our sector, which we can extend to the rest of the national economy, is the lack of a collaborative business culture. Many hours of education and training in the various tools related to Lean Construction will be necessary, starting with IPD. But knowledge of these methods will be useless if there is no culture that favours collaboration. That has necessarily to do with the legal part reflected in the contracts, the process of rewards, remuneration, civil liability, and trust building among all agents.

In this credibility building process during the project, the Project Manager [16], a job not efficiently used in Spain, should be converted into a change agent in organizations that fosters a collaboration culture. The "Project Manager" role is key as the main responsible for the IPD project. His/her role is the change leader, he has to believe in the project, convince the rest of stakeholders and sell it to them focusing on "why IPD".

The Project manager needs to be somebody who has good technical skills but mainly very good soft skills, because he/she will have to deal with many obstacles within organizational storms. Skills like effective communication, conflict

management, adequate delegation, internal Project selling, negotiating and even the adequate use of good humor and politics, adequate decision making and influence, are absolutely necessary for good project performance. Knowing how to swim in turbulent waters, popular sentence used by elder people, is the product of wisdom and experience. For instance, all things related to management, monitoring, control and influence about Project stakeholders is a skill the Project Manager needs to know better than nobody and it is crucial for organizational success [17].

Fostering and always practicing a positive attitude from IPD conception to implementation is key for project success. 3Ps development (Passion, Persistence and Patience), necessary skills to develop and practice for all implementation projects, are indispensable for an IPD project too.

Passion is the enthusiasm that the Project Manager needs to develop and maintain, persistence is the perseverance to obtain stakeholders support during the whole project life cycle. And patience is to understand that not all the Project stakeholders follow the same pace that a project manager needs to have.

Knowing how to play with technical and soft skills and having a positive attitude are fundamental keys for project and organizational success. The Project Manager needs to keep the credibility title very high. Credibility is finally the result of some actions and details that we do among Project stakeholders and it takes time, but it is not impossible [18].

7. CONCLUSIONS

It is not an utopia; it is being applied with flying colours in Anglo-Saxon countries where many buildings are constructed in this way, and many companies have been long using it: Sutter Health, Autodesk, Biogen Chemicals, etc. with great results in cost, term, quality and satisfaction of stakeholders [19].

Technology is boosting the implementation of more industrialized and productive models of management and construction. The construction sector is not an island separated from the rest of the economy and will not remain oblivious to what is happening in other sectors.

Technology and innovation that is permeating all industries will also influence construction, mainly in three areas. The first one will be the way of producing: The sector will be industrialized, adopting more industrialized construction systems. The second segment that will undergo changes will be demand, as the customer will become the centre of the entire management process, and will call for more from the builders. And finally, the transformation will also influence a finished product with higher quality.

Other sectors of the economy have long been adapting to a more liquid and collaborative society. In other industries, collaborative methods such as Agile in Information

Technologies (IT), are being implemented and affecting the way of working and creating teams, not as opposed roles, but flatter and capable of deciding at an early stage on issues that concern them. And especially the client is involved as the centre of the project.

Although Agile's iterative frameworks cannot be equated with waterfall projects in construction, it is possible to adopt the imperative that the client participates more in the whole process. It is quite clear the relationship of all this to the Lean philosophy, with its application in Lean Construction and Collaborative Methods in Construction as Integrated Project Delivery.

In a first approximation, it is more important to introduce this culture of behaviour in all the parties involved in the construction process than developing the corresponding techniques which will be explained below.

The main work of organizations in the future will be to determine on what to base our trust and collaboration [20]. Therefore, let us contribute all together to a change of mindset in the way in which construction takes place in Spain and then we will implement the methodology for the improvement of the whole process.

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Theory of Constraints, Critical Chain, Process Improvement, Mapping, Work Flow.

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02

Dynamic capabilities, International public procurement, Learning and knowledge management, SME.

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03

Public-Private Partnerships (PPP), Critical Success Factors, Construction Projects, Project Cognizance, Confirmatory Factor Analysis (CFA)

VIJAYABANU
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04

Project Success Factors, Project Performance, Quality Function Deployment (QFD), Mean Square Error (MSE), Decision Making

DROR
ELIEZER

05

Target Value Design, Target Cost, Value Stream Mapping, Integrated Project Delivery, Lean Construction

ÁLVAREZ-PÉREZ
PELLICER
SOLER

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Innovation, Project management, Delivering results, Theoretical model

ALBAIDHANI
ROMERO

07

Project management, Project crashing, Serious games, Game-based learning, Simulation, Training, education, Complexity, Learning method preference

RUMESER
EMSLEY

08

Project Management, Governance, Strategic Planning

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Time issues, Causes of delay, Cures for delays, Norwegian construction projects

ZIDANE
ANDERSEN

10

Success, Project management, Success management, Project success, Project management success, Process, Process model.

VARAJÃO

11

Living Lab, Co-creation process, Service-oriented perspective

LE DINH
CHIEN VU
AYAYI, NOMO

12

Industrialisation Production system development, integrated product and production development, Operations management.

CHIRUMALLA



PROJECT DELIVERY

KEYWORDS

- Target Value Design • Target Cost • Value Stream Mapping
- Integrated Project Delivery • Lean Construction.

TARGET VALUE DESIGN

A different way of approaching
the constructive process in Spain

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• ABSTRACT •

The knowledge and deepening of the Lean Construction methodology, as well as its practical application in the construction industry in Spain, can produce great benefits and the general improvement of a process that continues to be anchored in anachronistic procedures for too long. It is necessary to divulge this methodology with greater intensity, so that once known, and with its positive effects in the matter of the Triple Constraint: Cost, time and quality, proven in other countries, will be applied in a generalized way in ours. We look at this article in a technique belonging to Lean Construction: Target Value Design. Like many other techniques Lean parts from its application in Toyota, in this case of Target Cost, and was used in the 70s by Taiichi Ohno with the name of Genka Kikaku, producing very good results for the Company in the matter of productivity and profitability. As with other Toyota Production System techniques, it was later incorporated to Lean Construction as Target Value Design to bring greater Value to the customer within a fixed Cost. We will see how the Target Cost can become the center of the project and the construction of the building to reach the values required by the client.

1.INTRODUCTION

The Spanish construction industry requires great improvements in its efficiency and productivity. Of all the economic sectors, it is one of the lowest performance measured in terms of Gross Value Added (GVA) per hour worked.

According to the BBVA Research Report of April 2016 on the Real Estate Situation in Spain: "The first thing to note is that the growth rate of productivity in the construction sector has historically been lower than in the rest of Spanish economy."

Although, according to the same Report, this is not an exclusive case of our economy: "However, what is common in all countries is that the productivity growth of the construction sector is historically lower than the rest of the economy. At this point, growth accounting reveals how in almost all countries construction has grown by accumulating productive factors, especially employment and non-productive capital, and not by developing new technological processes. "

The evolution of this sector is very slow throughout the world and is anchored in paradigms of the past, not in new technologies or processes, which modify the current status. It consists of repeating again and again obsolete methods, before rethinking what we could do again with the technology we have. We assume with absolute naturalness that this is irremovable and we cannot think of any improvement.

The McKinsey & Company Report published in October 2016 on "The Digital Future of Construction", indicates, among other things, a major need for improvement at the sector: "Transparency and risks sharing in contracts. Habits are difficult to change, and a habit is to view contracts as opportunities for confrontation to avoid risks. Instead contracts should be tools that allow a fair exchange of risks and rewards that will help both parties success. This will happen if contracts clearly define responsibilities and allow owners and contractors to share the benefits of adopting technological and process innovations."

Another source, in the same way, is the article published in Time magazine about the challenges that the Trump Government will face for the next ten years in improving built infrastructures in the United States (Della Rocca, Duvall, and Palter, Time Magazine April 10th, 2017), also based on a McKinsey & Company Report indicates: "Productivity in the US construction sector is lower today than it was in 1968, while other major industrial sectors experienced impressive improvements. We need a national effort that systematically unlocks productivity by applying innovations. "

About other countries, we can add the article in The Economist, stressing the same approach (The Economist August 17th, 2017): "The problem of productivity in the construction sector and how governments can catalyze the change: Since 1995 growth in the construction industry in France and Italy has declined by one-sixth, and in countries such as Germany or Japan, construction productivity has remained static during the same period. Only a few builders in the world are experimenting with 3D printing, drones, laser scanners or remote-controlled cranes."

When all these publications insist on technological innovations, processes, and a method of exchange of risks and rewards, are clearly indicating the necessary application of Integrated Project Delivery (IPD) and Building Information Modeling (BIM) in construction (AIA California Council 2007, 2014, AIA Minnesota University, 2012). Both techniques representing collaborative work and sharing all project information openly among all team members.

As we have said, in this article we are going to try another technique contained within the Lean Construction methodologies, but which is directly related to the IPD (Mathews and Howell, 2005), with collaborative methods, representing an innovation in the approach of constructive process and affecting the improvement of the productivity and the efficiency of which the sector is so needed, as we have seen before. This is: Target Value Design.

2. WHAT IS TARGET VALUE DESIGN?

Based on Lean Construction principles as an evolution in the construction of the Toyota Production System (TPS) (Koskela, 2000), we can establish that the basis of a Lean application is collaboration, trust, willingness to learn and continuous improvement (Mossman, Ballard and Pasquire, 2013), all this is the origin of Target Value Design, (TVD).

TVD seeks to achieve the highest value for the client as the main objective of the design and construction of the building. According to Professor Glenn Ballard of the University of Berkeley, California, USA, 2005, TVD is: "A management practice whose objective is to generate the maximum value for the client, at a fixed target cost, below the market price, and at the same time a method of continuous improvement and reduction of waste". Other writers such as Daria Zimina of Loughborough University, Leicestershire, UK, 2012, define it as: "A driver of design that seeks the highest value for the customer in terms of design, cost, schedule and constructability, and by this mode reduces waste, satisfying and even surpassing their expectations". Therefore, in both definitions we see that there are two basic factors of TVD, which are: Customer Value and Target Cost. Consequently, to deepen its study we must analyse both concepts.

First, Customer value is a relationship between the customer's perception of satisfaction with the result obtained and the perception of the customer's cost (Ballard and Reiser, 2004). To know what adds value or not for the client in a process, we must make an analysis of it, seeing all its steps and phases and identifying those tasks that may or may not be necessary, which we see are not necessary, or are not in the extent in which they are carried out, can be eliminated or modified to suit the effectiveness of the process. All of this is another Lean technique called Value Stream Mapping (VSM) or Value Chain Mapping (Rother and Shook, 1999) that we will discuss later.

As for the objective cost, we must go back to the origins of Lean Construction, to its starting point in the industry, since from the industrial application and in particular in the TPS adapted its principles to the construction. According to Jeffrey Liker in his book "The Toyota Way", 2004, this Company established as one of its fundamental principles of automobile

production Target Cost (TC) and, ultimately, TVD is the application of Target Cost to construction (Rother and Shook, 1999). Toyota analysed each and every one of its costs and made its suppliers do so, in order to adapt to the established target cost, which would determine the selling price of their cars, but always from a point of view of providing value to the customer and without reduce the quality of the product.

3. VALUE STREAM MAPPING

We will deepen in knowing how we can proceed to reach greater Value for the client and of which techniques we can serve to reach it. For this we will start from the principles of Lean Construction methodology. The management of processes under the Lean philosophy means, according to Professor Greg Howell of the University of Berkeley, California, USA, in his speech. at the 7th meeting of the 1999 International Group for Lean Construction (IGLC):

- Have a set of clear objectives.
- Focus on maximizing performance for the client at the project level.
- Simultaneous design of both the product and the process.
- Apply production controls throughout the life cycle of the project.

As we see, the concepts expressed broaden and develop the Project Definition of the Project Management Institute (PMI) in its PMBOK Guide 5th Edition, 2013¹ on what is a Project: "A Project is a temporary effort that is carried out to create a unique product, service or result. This means that:

- It has a defined beginning and end, so a project is something temporary.
- It represents a certain volume of work that requires a given type of organization; otherwise it would not be an effort.
- It is not a routine job, it does not follow normal procedures because there is something that makes it unique.
- Creates a result, which can be a product, a service or a result."

Obviously the PMBOK 5th Edition, 2013, refers to Projects in general, not specifically to construction, but to any Project of the nature or productive sector you want: Information Technology, financial, chemical, construction etc., it is because the PMBOK Guide is a standard, a basic conceptual framework of good practices that allows to manage, in a homogeneous and grouped way different business processes (Brioso, 2015). Therefore, to make the Construction a Lean process we should aim to: Minimize the peculiarities that this industry has, related to its production on site, tending to use techniques of the manufacturing industry. This means increasing the use of prefabrication, ensuring that most of the components of the construction come from the factory, not only the individual components such as awnings, facades, structures, etc., but also more complex units such as sanitary zones, kitchens, or why not? the complete housing. And on the other hand, develop and apply techniques appropriate to the dynamism of construction. Therefore, change traditional planning by Last Planner System, use Target Value Design, Integrated Project De-

livery and Building Information Modelling (Mossman, Ballard and Pasquiere, 2010), in short, all Lean Construction techniques.

To achieve this, it is necessary to begin by doing an in-depth analysis of the way in which we work. The applicable technique is the so-called Value Stream Mapping (VSM) (Rother and Shook, 2003), it will first lead us to study construction as a process flow and start visualizing all the actions of the value chain of a Project and their flows, beyond analysing a process each time.

VSM is to identify what contributes Value to the customer from the design stage, identifying the waste present in the chain to eliminate them, and even the source of such waste, as well as opportunities for improvement and future actions that generate Value. It will help us to see the losses and use a common language to find the processes that are productive and those that are not, will also make evident the decisions about the flows of the activities of the production chain and will be the basis of an implementation plan of the same once it has been purified.

For its application we will make a previous diagnosis of the current situation, which will reveal the inefficiencies that exist and a future diagnosis that reflects the proposed improvements. VSM is an effective tool to simultaneously improve productivity and eliminate losses in construction (Rosenbaum, Toledo and Gonzalez, 2014).

4. TARGET COST

Within the production strategy that Taiichi Ohno was implementing in Toyota with the TPS in 1970, the Target Cost was used under the name of Genka Kikaku (Liker, 2004). Toyota's application of this technique is explained below: After establishing through market studies, what is the price that a final consumer is willing to pay for a car of certain characteristics, and always seeking to offer the highest possible quality, you get the Target Price of sale. Next, the commercial margin (Target Margin) that the manufacturer wants to obtain for that product is estimated and consequently the Target Cost (TC) is obtained by deduction. If this first rough approximation is initially feasible, a Business Plan and Feasibility Study or Feasibility Study of the Business Plan is elaborated. For this purpose, this Business Plan is analysed in various specialized workshops, such as: Initial Values, Design and Restrictions. These workshops consist of specialized work teams that analyse the product from each of the different points of view.

After this analysis, the following coordination workshops are held: One to identify misalignments between values, design and constraints, and another to align values, design and constraints, some of the team members may be part of these workshops reviewed or be different people. And only once this analysis has been made, after concluding its conclusions, the TC is established and begins the design stage, with this as a condition of the project, the TC will be immovable throughout the production process, discarding all the solutions of design or execution that cause the Target Cost to be exceeded.

5. THE TARGET VALUE DESIGN SYSTEM

According to Josh Brontitsky, Project Manager at DPR Construction, in

Denver, Colorado, USA.², TVD seeks: "The lowest cost, the right design and the maximum value defined by the owner." This philosophy is once again coincident with that of PMI, since one of the Knowledge Areas of the PMBOK 5th Edition, 2013 is precisely the management of stakeholders, which includes all necessary steps to identify the individuals, groups or organizations that may affect or be affected by the Project. The stakeholders' expectations, and their impact on the project, their impact and their needs are analysed, and appropriate management strategies are developed to involve them and to establish effective communication with them throughout the life cycle of the project (Soler Severino, 2013).

Comparing with the traditional method used in construction, the TVD application consists of the following, starting with Macomber, Howell and Barbeiro, 2007:

- Instead of estimating based on a detailed design, design based on a detailed estimate.
- Instead of evaluating the constructability of a design, design what can be built.
- Foster innovation.
- Apply a greater effort as soon as possible, which will lead to a lower cost.
- Know perfectly what the client expects and how much he is willing to pay for it.
- Communicate in a transparent way to all team members the results obtained in savings in relation to the Target Cost (TC).
- In general share the good and bad news about the development of work with all members of the team.
- The whole effort of the team must be fixed in locating Value to boost it and losses to eliminate them.
- Work in an Integrated Big Room, where efforts and achievements are shared.
- Build virtually with BIM to test the ideas before hiring the work and repeat, if necessary, the tests, eliminating the losses.
- Design and then evaluate with BIM to compare with Target Cost (TC).
- Make repetitive mapping of processes looking for continuous improvement (VSM).
- Make Pull Planning with Last Planner System.
- The golden rule of TVD is that the Target Cost

can never be exceeded for any reason. If we compare with the Traditional Method starting from Pons Achell, 2014, we can say that in this:

- Cost is a consequence of design.
- The work is started by means of an Estimated Budget, which is never known whether it will be fulfilled or not.
- Since the beginning of the work there is a total adherence to the solutions designed without thinking about its cost.
- It is designed first and then calculated the cost of what has been designed (what is in the plans).
- The landlord is provided with cost estimation tables, which vary as the work progresses, usually upwards.
- Design efforts are wasted as costs, constructability and customer preferences are late for the designer; who must adapt the design to the work in progress.
- Construction costs are high due to the "protection mattresses" that the contractor puts in the offer, raising prices and design flaws.
- Change orders and additional items are presented frequently because errors are detected late, usually on site.
- The number of queries that the contractor makes to the designers increases, since he knows the Project when he must execute it.
- All this leads to relationships in the team becoming adverse and there are frequent disputes between designers, contractor and property.

On the other hand, in TVD based again on Macomber, Howell and Barbeiro, 2007:

- Cost is an important entry that conditions the design in the project phase.
- From the beginning of design, information is shared frequently among all members of the team and their opinions are collected.
- It is based on a rapid estimate based on the BIM model and the design is refined until reaching the Target Cost.
- Multiple solutions are produced on

the BIM model to compare its value and cost. • A permanently updated development diagram is available so that the various stakeholders involved in the project can see their evolution.

- It contemplates the project always and for all the members of the team under the responsibility of all, a teamwork and collaborative one.
- The objective cost is the common objective of the whole team.
- Engineering of different disciplines and constructability condition the design, there are no surprises on site.

- Despite the contingencies that may arise in all this process, the objective cost is never lost.

To apply TVD, it is very important that all team members believe in the collaborative culture, just as with IPD, however, it is necessary to differentiate both concepts, IPD is a project management system (Matthews and Howell, 2005), while TVD is a management tool or practice. A project management system like IPD can be broken down into three main elements: Project Organization, Operating System and Commercial Terms.

TVD belongs to the Operating System category, it is not necessary to opt for a relational contract for its implementation, but to align objectives it is advisable to have at least a shared profit and loss mechanism (Lichtig, 2008), such as the Integrated Form of Agreement (IFOA), which Lichtig defines. When all parties involved in the team share gains and losses as well as responsibilities, it is when real collaboration occurs, aligning common goals and interests is what most can help to achieve the TC.

The application of TVD requires what is called a Cluster organization consisting of several working groups led by each one of them by a Leader Cluster that commits itself to the team as a whole to carry out the task entrusted to its group. Each one of them must arrive at the own objective cost that has assigned its task. In turn, the Leaders of each cluster are integrated into a group called Core Group or Integrated Group, which coordinates all the tasks of the Project and checks the progress of the project in relation with the total CT of the Project.

According to Hal Macomber, Greg Howell and John Barbeiro of the Lean Project Consulting company in Bloomington, Indiana, USA³, 2007, the nine basic practices of TVD are:

1. "Engage deeply with the client to establish

¹ The 6th Edition of the PMBOK has just been published on September 5th, 2017, which has not yet given time to analyze, but in these concepts, coincides with the 5th Edition.

² DPR Construction is one of the United States Construction Companies which most uses Lean methods in construction and in particular TVD and IPD.

³ Company that based on the academic knowledge of its components is specialized in the implementation of TVD processes in buildings.

built with a target cost of 230,000,000 US \$ and a 30% execution time reduction over the estimate for a facility of this type in California.

It was very important for this implementation, as for all subsequent in Sutter Health , the strong support of Digby R. Christian, Project Delivery Director of the group, who after the good results obtained in this experience has become an advocate of the methodology in all kinds of international forums, giving lectures on the subject, as well as adopting it as the usual work form of the Sutter Health Group, for the construction of its various hospitals, offices and all types of buildings. In this case, the parties involved in the design and construction management team were 11, among them the architects: Devenney Group Ltd. Architects, an integrator of the Lean-BIM Project; Ghafari Associates and the Construction Company DPR Construction, to the which we mentioned earlier.

The most important measures for the implementation of Lean Construction adopted were:

- The agreement came from an Integrated Form of Agreement (IFOA) based on the one written by Will Lichtig in 2005.

- The team was divided into several groups or Cluster existing a Core Group that coordinated all actions.

- The ownership was involved in the entire development from the outset, the decisions of the Core Group were taken by consensus and in case of a tie decided ownership.

- Each Cluster had to reach the Target Cost assigned to it, every two weeks the Total Cost of the building was updated, adopting the corrective measures necessary in case of deviation from the Total Target Cost, which were sent to each of the groups for its application.

- In addition, Sutter Health developed a Risk and Opportunity Registration process, which the Core Group periodically evaluated and shared with all team members, this has constituted an interesting repository of lessons learned in the experience that has been used in later ones.

With the adoption of Lean Construction (Mossman, Ballard and Pasquire, 2013) the objectives were achieved, customer satisfaction was also achieved and the target cost was

maintained. This case has been analysed in depth by the Project Production Systems Laboratory (P2SL), Laboratory of Systems of Project Production, University of Berkeley, California, USA, in an interesting study, P2SL's Target Value Design Research Group was created in 2009 to study the design and construction of hospital projects in California, which use TVD and IPD. The purpose of the studies undertaken by this group is to analyse the problems that arise in these Projects, and to obtain a record of lessons learned to improve the process. Several studies have been carried out in previous years, such as: Sutter Castro Valley (Budget: US \$ 230 million), Sutter Alta Bates (Budget: US \$ 220 million) and USCF Mission Bay Medical (Budget: US \$ 750 million).

New buildings are being studied to analyse in this same sense, which indicates the importance of the implementation of TVD and IPD in the construction in USA and the desire is to deepen and expand the use of these techniques in that Country. It is not only the Sutter Health Group who applies them, but many other high-level economic and efficiency companies such as Autodesk or Biogen Chemicals do it, and more and more organizations are adopting the same based on their magnificent results.

7. CONCLUSIONS

Target Value Design is a Lean Construction Operating System that seeks the highest value for the customer from a fixed Target Cost that will be immovable throughout the entire design and construction process of the building. Therefore, the Value for the client and the Cost Objective are their fundamental points of support.

The work team should consider the project as a whole and as a shared responsibility that it will be developed collaboratively, even if in an operative way it works in several groups or Cluster, everyone will be able to have all the information of the Project in an Open Books format.

In order to achieve the pre-set objectives, the BIM modelling of the building will be a basic aid tool, which will make it possible to carry out various tests of the building in the pre-construction phase and to easily develop the verification of the cost of the building, as well as its deviation from the Target Cost during the construction, to adopt the necessary measures, which lead to its alignment prior to the beginning of the work.

Parallel to the design of the building will be also considered the construction process, to improve not only in the definition of materials but also in the

way of execution. This will be the true Value Engineering that will be done with TVD. Keeping the Target Cost as the centre of the entire process will be required the adoption of project solutions that will help to keep it unmoved.

While it is not necessary for TVD to be developed together with IPD, it is true that all participants in the building design and execution team must be willing to do so in a collaborative way, this working philosophy is fundamental to applying Lean Construction and Target Value Design, collaborative methods are what allow us to achieve common goals and feel involved in the joint task.

To know in depth what brings Value or not to the client it is necessary to apply

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the technique of Value Stream Mapping and to analyse the whole process to eliminate what is unnecessary or what it is in the measure in which it was being applied, in an iterative way and not stop only in the design phase, but also be applied in the execution phase. The concept of Value for the client must be permanently updated, considering its involvement in the Project. Parallel to achieving the Target Cost, the focus should also be on eliminating waste and inefficiencies in the design and construction process. This is the purpose of implementing Lean Construction, eliminating losses or Muda as it is said in Toyota, while with TVD we improve the Value which we deliver to the customer and maintain the proposed Target Cost. ◆



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⁴ Sutter Health is a powerful American healthcare group that since this implantation realizes all its buildings applying lean construction methodologies for the good results obtained.



How to Create and Manage a Team to Apply Collaborative Methods in Construction (IPD) in Spain

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Summary

"Teamwork is the ability to work together towards a common vision. The ability to direct individual achievements towards organizational objectives. It is the fuel that allows ordinary people to achieve uncommon results." Andrew Carnegie.¹

Abstract: The Collaborative Methods² in Construction (Integrated Project Delivery or IPD) are based precisely on a good functioning of the team. IPD is built around it. The formalization of these techniques is still incipient in Spain, very little by little there are beginning some works by applying them, it is necessary that we expand our knowledge to improve the efficiency and productivity of the construction sector in our country, and its successful application spread as it is already doing in others. Construction is an inefficient industry in Spain because it is not developed with collaboration, if we manage to introduce this collaborative methodology, our results will improve.

Keywords: Team, Collaborative Methods, Integrated Project Delivery, IPD

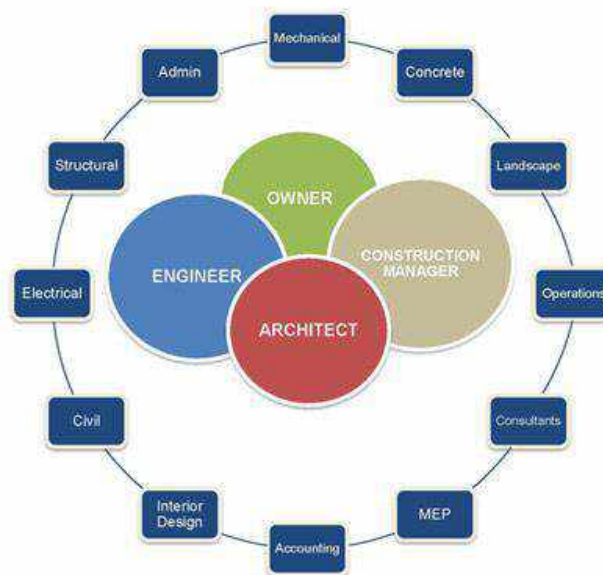
1. Introduction:

Without a team IPD would not work. In the Collaborative Methodology "the management of the team is not a work of supervision but of leadership" (Deming, 1982), and in that sense it is very important to know how to implement it and exercise it without impositions. We will develop in this article the way to carry out a collaborative work that motivates the team and contributes to achieving its objectives.

According to the latest IPD definition of the American Institute of Architects (AIA, 2014) a collaborative team must be composed at least by: The property, the technicians and the builder, however, as the work develops and grows, other stakeholders are going to be part of it, as we see represented in Figure 1, and therefore the management of its components will be more complicated.

¹ American businessman and philanthropist native from Scotland, UK (1835-1919)

² Along this text we will use alternatively the synonym expressions: Collaborative Methods, Integrated Project Delivery or IPD indistinctively.



INTEGRATED PROJECT ORGANIZATION

Figure 1: Integral Project Delivery as the collective effort of a coordinated team for the development of the project (SSA Engineers, Prahadevi, Mumbai, 2009)

We will study how good preparation is necessary for an effective team management. To maintain the motivation and objective between the ones of the project, communication and information are essential, all the components of the team must know the achievements and failures which occur in the development of the assigned tasks, as well as act proactively based on the same. The use of Building Information Modelling (BIM) tools is an important support to achieve it. How to give that information and implement an efficient communication is also another objective included in the article.

Finally, another aspect of vital importance for the good development of the IPD team, the sharing of content, which is essential for a true IPD methodology, sharing duties and profits is a point of support for the whole team to feel united, to feel that has a single shared objective, that all members are aligned, and that the participation of each one of them depends on the objectives of the project. This vital aspect is also analysed, based on the experiences which have already been applied in the United States and other countries, as well as the results obtained in them.

2. The Preparation of the Team

The early incorporation of key participants is one of the more important basis for the IPD project success, this is managed by committees with members representing these key participants, as minimum: Property, technicians and contractor, is what is called as "core team" or leading team. His main responsibilities are (Ashcraft, 2011):

- "Establishment of the Objectives of the Project.
- Provision and allocation of resources.
- Financial supervision.
- Select the members of the functional teams.
- Tutoring of team members.
- Administration of contracts (work orders, corrections, etc.).
- Conflict resolution".

For the success of the IPD team, its components must really believe in the methodology, and support its development, it is impossible to carry out the purposes outlined above starting from an ignorance of what it really means to work collaboratively, from the renounce to "false individualism, the selfish and self-centred one, and assuming the true individualism, the one contributing to the group" (Hayek, 2009), and that of complementarity work among the members that should be sought with teamwork.



Since the constitution of an IPD team people from different cultures and coming from different organizations must be combined, it is fundamental that each one of them knows, and may have worked, with the collaborative resources. However, training in the IPD culture can be done from within, although a willingness to integrate and collaborate is a necessary starting point. It is better to dispense from the beginning of people who have not stayed in this form of work, than to try it against their will.

This is one of the basic points which needs the dissemination of the methodology in Spain, now, when we find an incipient knowledge of it must be incremented its teaching, so that from the knowing of its basis is where IPD application can come from, later the contracts and their development will come, but without previous culture this will not be achieved.

To form a good team, you must set clear and specific objectives, not of a general type such as: "We will be the best" or "We will achieve success", which have no effect, but determined and fixed along the whole process. A great help for this, establishing the construction as a set of processes, is the use of Building Information Modelling (BIM). The objectives must be aligned and be common to all, that is the great difference with the traditional method in which the confrontation between the actors of the construction takes place from the beginning of the project, and even more from the work itself.

All the members of the team must be recognized and self-realized, so that the tasks must be assigned, and everyone will feel responsible for their own and feel obliged to do things well, in this way, delegating is easy, because we will know that all will be involved in the same way, each one with its mission³.

Regarding the number of people who must compose an IPD work team, "the most effective teams are neither small (below 4 or 5 people) nor very large (above a dozen people). A good rule is to maintain them between five and nine members" (Robbins, 2011). If a task is too large for the team to be efficient it should be divided into subtasks. "Members of large teams have problems to coordinate one with another, specially under pressure." (Robbins, 2011). Nevertheless, organization of IPD teams vary considerably with different size and complexity of the building to be constructed.

"The biggest three mistakes made by the people, when they are going to compose a team. are the following:

- 1.- It is assumed that "the more members the better" and therefore too many people are put on the team.
- 2.- It is assumed that people who are like others will work better together, and therefore too homogeneous teams are composed.
- 3.- It is assumed that everyone knows how to work as a team, and consequently no attention is paid to the interpersonal skills of potential members." (Hackman, 2002).

In the United States, where the IPD methodology has been applied with greater extension and success, it is related that, by working together in the same physical space, what they call "big room", there is a greater sense of common responsibility and coordination among all team members.

Another aspect to consider is that interdisciplinarity components with different degrees of experience and points of view must be mixed, the personalities of the members which make up the team must also be considered, although often the latter is more an art than a science. "The better designed a team is, the greater is the internal collective motivation" (Hackman, 2011). "The teams composed by people of design, engineering, production, sales and marketing" (Deming, 1982), were part of the essential improvement recommendations proposed by W. Edwards Deming to the Western company.

The stability of the team is a factor that contributes to its effectiveness. "Teams that remain stable have more chances of success than those which have to fight permanently with new members and the departure of veterans." (Hackman, 2011). In those companies that have experience in IPD teams in the United States, always is added to the team someone who has previously worked with the methodology and who can contribute with "lessons learned" to others, an IPD facilitator, he/she will be who deliver part of the work of the IPD preparation and training in the methodology to which we have referred earlier.

The professor of social and organizational psychology at Harvard University (USA) PhD. J. Richard Hackman (deceased in 2013), whom we have cited several times, has been one of the greatest experts and who most deeply has written about the creation, management and development of work teams in Companies in general. Reviewing his writings, we see how much they have in common with the recommended techniques for the Collaborative Methods discussed in this article:

³ "England expects that every man will do his duty", Admiral Nelson message to his fleet before Trafalgar Battle, 1805.



"It's not how a leader's management style determines how well a team progresses, but how well a leader designs and supports a team, so that its members can manage themselves." (Hackman, 2002)

The five conditions that PhD. Hackman identifies in the teams which achieve success are:

- "Be a real team.
- Have a convincing address.
- Have a structure that enables people.
- Developed in a context of mutual support.
- Have the monitoring of experts." (Hackman, 2008)

Likewise, according to PhD. Hackman, what can be done to make work teams function well is:

- "Strengthen the essential socialization processes in collective work.
- Build a common goal, with the appropriate union of skills, strategies and coordination of tasks.
- Help team members solve problems and find emerging opportunities.
- Capture individual experiences and translate them into shared knowledge." (Hackman, 2008)

As a summary, we can say that a good preparation of an IPD equipment requires:

- Early incorporation to the project.
- Define clear, concrete and ambitious objectives.
- Involve all members.
- Establish indicators of the progress of the tasks.
- In addition to the final objectives propose intermediate challenges.
- Communicate and give feedback on the progress of the project.
- Feel all responsible members together.
- Analyse the critical points.
- Detect unforeseen risks and risks in general together.
- Avoid downtime, no one must be stopped at any time.
- Integrate all the people.
- Promote the team's versatility.
- Work based on continuous improvement.
- Generate new ideas, creative collaboration.
- Share knowledge for the improvement of the whole.
- Encourage empathy among team members.
- Foster confidence and self-leadership.
- Work on a team basis between 5 and 10 people, at most.
- If necessary by the size of a task, divide it into subtasks to fit it to that ideal team size

3. Communication, A Powerful Weapon

"The "core team" IPD has to clearly communicate the values and objectives of the project to all participants in it and continue to reinforce these objectives and values through repetition and recognition during the development of the project" (Fischer, Aschcraft, Reed and Khanzode, 2017). The teams require communication, clarity and consistency, and: "To communicate well it is necessary to listen before" (Covey, 2006).

The coordination must be increased by means of the regular and complete transfer to all the components of all the information available about the project, not only by computer means, with common servers, but even with notes or posters placed in places of public view of all, and of course being reflected in the BIM model, which will grow as the project progresses.

This information should cover all aspects of the project, including the economic aspects. Collaborative work cannot be requested if information is withheld from the team members. IPD is based, among other things, on mutual loyalty, which is embodied in communication and information, is what is called "open books". "Confidence and transparency must prevail, if this does not exist there will be no progression of improvement in the team" (Ashcraft, 2011).

"The effectiveness of the team requires clear communication and the ability to disagree without damaging personal relationships, although mild levels of conflict related to tasks and processes increase productivity. But this skill requires strong doses of empathy" (Fischer, Aschcraft, Reed and Khanzode, 2017). It is achieved by training the team in these functions from the beginning, both in terms of communication and conflict resolution.



"Good planning requires good information: The information systems that support team development are those that mix reliable data on the situation at all times, with predictions that suggest how those requirements will change in the future" (Hackman, 2002).

It is not only important to give good and complete information of the present to the team, but also to anticipate the tasks that will be necessary to develop in future stages, and even evaluate how the performance has been in the past and compare it with the objectives planned.

For the resolution of conflicts between the members of the team, it is also essential to apply the communication, individual culprits should never be sought, since the overall culture must prevail always, it is very discouraging for any of its members, and for the team, that someone be held accountable individually, whether it is a success or a failure.

Regarding the resolution of conflicts related to discrepancies between the members of the team, on how to solve a problem that has been raised in the project, a good method to reach consensus, which is in line with the Lean Culture and was also created by Toyota within the Toyota Production System or TPS, for the resolution of this type of conflict, is the called A3 Report, because this sheet size is used to reflect it. In Figure 2 we can see the succession of actions that will be reflected writing in it:

Background	Future State & Countermeasures
- Why do we need to work on this? - Context - Importance	- Actions being taken to address the issue (what, who, when) - Quick fixes (Containment actions) - To Be process map
Current State	Impact
- Problem statement/definition - As Is process map - Scale of the problem (data)	- Results achieved - Trend graph (before/after)
Objective	Follow-up
- Target level of performance - Desired outcome	- Actions still required (what, who, when) - Learning points to share
Root Cause Analysis	
- Fishbone diagram - 5 Whys - Data (Pareto, Scatter diagram)	

Figure 2: A3 report on conflict resolution

In the first place, the problem is clearly defined, then the current situation is described, in third place, the causes of the root of the problem are analysed, then the situation where you want to arrive is defined, the one that constitutes the objective, a plan of action is established in a next step to achieve it, and then a follow-up of the same, to finally verify the results, repeating cyclically this process in case the desired objective is not achieved as a result. It is a very practical and effective way to reach consensus when there are discrepancies about the solution to a problem.

Communication among team members must take place in a climate of trust and transparency, "members of effective teams trust each other, as well as their leaders. Interpersonal trust among team members facilitates cooperation, reduces the need to control each one's progress and extends the belief that nobody is going to take advantage of others effort." (Robbins, 2011).

Transparency is another essential component in IPD equipment, for this we must banish the idea that who wins a dispute is the one who is capable of deceiving the other, in an environment of these characteristics is where the production process usually occurs in Spanish construction sector, that reason is why it is not wanted to facilitate all the information to the intervening ones in the development of a project, it is to be able to take



advantage in a certain moment of the information that each one owns. IPD is the opposite, it is information shared in the search for a true team spirit based on trust and transparency, communication and empathy.

"The research says that in face-to-face communication attitudes and feelings are only 7% of what it is communicated and 38% is due to how it has been communicated, but 55% is body language" (Covey, 2006).

That is one of the reasons to look for work in "big room", for establishing that direct face-to-face relationship between the various members of the team, this produces a quality of communication that cannot be substituted by telematic means, even if it is shared. Keep in mind that the teams are made by people and we must use all the springs of interpersonal communication to achieve good coordination.

To focus on a concrete example of what we have discussed previously, we took the appointment of Cristina Ayats book: "Lean Diseño y Construcción. Un cambionecesario", which says about the communication in the Cathedral Hill Hospital project, San Francisco (USA), made with IPD methodology:

"From everything I've seen and learned until then, I concluded that the main problem in applying lean in construction was coordination, and that this should be worked through communication.

- It must be fluid, Clara pointed out, so that the message reaches all the members of the team. Each one of them must be able to transmit the changes made, in order that the team can coordinate with their most recent model. Otherwise, that coordination will be wasteful.

Then he went on to explain different ideas that were discussed in the Cathedral Hill Hospital project to transmit the information and that, finally, were standardized:

- Modifications at a structural and architectural level were communicated through weekly comparative archives, where what was eliminated was marked in red and what was moved in blue. These changes were transmitted through an e-mail in which the alterations produced since the last update of the virtual model were enumerated.
- The architects commented on the recent modifications of the virtual model in a joint meeting of 5 minutes.
- To transmit the team what structural elements were ready for its manufacture (and therefore could not be touched), the metal structure subcontractor passed a model where he distinguished, in green, what was already prepared to be built; in yellow, the areas where they were working; and, in red, those in which the team could modify the detail without impacting them.
- Every meeting had a person in charge, an objective and ended with a series of obligations, each with its responsible person and date of completion.
- Any action that needed a plan departed from the main meeting after having assigned the person in charge and assistants, so that they could meet later to resolve it. Without responsibility, these works would not have been carried out. "(Ayats, 2015).

We have found it interesting to quote this example, in which it can be seen very well how to standardize the way of communicating into the team for the good performance of the project.



Figure 3: Cathedral Hill Hospital, San Francisco (USA)

4. The IPD Contract, Expression of the Team:

To achieve the objectives of a good team collaborative work, it is essential that all parties feel comfortable with the agreed contractual conditions, so we will briefly analyse this type of contracts, which present very peculiar characteristics and whose adequate adjustment is going to determine to a large extent the success of the work, and therefore of the project.

Indeed, in the beginning of the application in real projects of the methodology in USA, about the year 2.007, this was a major problem, the idea was underway, but the rules of the game of this new way of working had to be translated into a paper, and after the experience developed by the Sutter Health Company, a pioneer in the application of the methodology, with the first Integrated Form of Agreement (IFOA) written by the lawyer Will Lichtig, the first complete IPD contract was prepared, which came to light with the collaboration of numerous institutions: The American Institute of Architects (AIA), the Lean Construction Institute (LCI), the Associated General Contractors of America (AGC) and the Sutter Health company, this document, which continues to serve as the basis for IPD contracts, is known as ConsensusDoc 300.

After, the AIA has published its own IPD contract, based on the previous, including a law firm in California: Hanson Bridget LLP, through one of its partners, a construction specialist, and specifically in this type of contracts: Howard W Ashcraft, who has developed the subject with great diffusion in academic and business forums.

These three are basically the most used contracts in USA for IPD: The ConsensusDoc 300, the AIA and the Hanson Bridget LLP. In Spain, in parallel with the knowledge of this way of working, it also opens a good possibility of developing IPD contracts adapted to our legislation, for those law firms that want to join this current.

The Collaborative Methodology approaches the constructive fact in a totally different way to the traditional one in our country, the contracts that must be written to carry it out, must put a different focus on the rights and obligations of the interveners.

It is often said that in any contract the first thing is negotiation and then the drafting, but in the case that concerns us, it is necessary to start from some basic principles without which the contract would not be IPD, but something else, for this reason it is very important, as we said before, that the participants support the methodology and believe in it, that they accept these basic conditions of entry, and that based on them they build the contract with the specific characteristics of the project to be developed.

Recall the conditions that the definition of Integrated Project Delivery (IPD) of the AIA established in 2014:



"It is a method of delivering a project that integrates people, systems, business structures and practices, in a process that collaboratively puts to work the talents and visions of all participants to reduce losses and optimize efficiency through all phases of design, manufacturing and construction.

The Integrated Project Delivery Method contains, at least all the following elements:

- 1.- Continuous involvement of the owner, as well as key designers and builders.
- 2.- Business interests aligned through a shared risk / benefit system, including financial gains for risk, which depend on the results of the project.
- 3.- Control of the joint project by the owner, as well as key designers and constructors.
- 4.- Common contract between all the parties or with conditions of mandatory and specific participation.
- 5.- Responsibility shared by the owner, the designers and builders "(AIA, 2014).

These are the minimum conditions that an IPD contract must contain, from here the specificities of each case begin.

As well as to enhance the aspects of organization, development and communication in the team, we have said that many times someone who, with knowledge and experience in the field, acts as a facilitator by joining online wills of what IPD really is, could also in what refers to the drafting of the contract achieve much relevance by approaching criteria and improving relations.

Bear in mind that, when the IPD contract is drawn up, everything is estimated, what is going to be projected and what is going to be built is not yet fully known, and therefore the degree of uncertainty is important. One of the defects attributed to the Collaborative Methods is that for this reason you can only start a project with your own funds, since financial organizations do not want to work with uncertainties, they want to know as much as possible what they are going to finance. Once the starting point of the project has been reached, with the project defined, this can change, but not before.

"The general objectives of an IPD contract are:

- Remove impediments, stimulate communication, collaboration and creativity.
- Promote the early participation of key actors in the project.
- Distribute risks and rewards based on the results of the project.
- Exercise control of the project jointly.
- Reduce the exposure to responsibilities of the participants.
- Develop and validate the objectives jointly. "(Ashcraft, 2011)

To these objectives the AIA adds one more:

- " Decision-making in a collaborative manner. "(AIA, 2014)

Which is a generalization as to the form of these contracts, so Howard W. Ashcraft has not considered it, however, it does seem an interesting approach, since it covers the whole process, not just the control and the objectives.

The aspects that Howard W. Ashcraft (2011) considered as conflictive in the negotiation of these contracts are those related to the specificities of each project, in particular:

- "Project dimensions.
- Scope of the project.
- Form in which the project will be managed and how the decision making will be adopted.
- Compensations.
- Setting of Objectives.
- Contingencies and their adjustment to the objectives.



- Allowed costs and benefits.
- Measurement of the progress of the project.
- Risk management "

For example, the ConsensusDoc 300 favours decision making by consensus, and in case of a tie, the ruling opinion is that of property, but there are other models that prefer not to give that power to the property so as not to ballast the management of the project.

As for the setting of objectives, a technique that is usually associated with IPD contracts is to establish a prior Target Cost or Target Value Design (TVD). It consists of subjecting the design to that Target Cost and not deviating from it throughout the entire development of the project, for this purpose it uses a continuous evaluation of alternatives and implications that can influence the budget from the design, it is helped permanently by the BIM methodology, which makes it possible to optimize this work. It is about delivering the highest possible value to the client within a prefixed maximum cost throughout the development of the project.

About the allowed costs and benefits, a base budget of necessary costs for all the actors is usually established (by each one of them), also a margin for possible contingencies that could arise, although using the TVD control so that this margin is minimum, and an adequate benefit for all the participants, depending on the achievement or not of the objectives of the project. In an IPD project the efficiency is rewarded and the inefficiency is punished.

Given that IPD is a method based on collaboration and trust between team members, those consultants who work for the component technicians of the "core team", and subcontractors of the construction company chosen, should also be integrated in this way of working and should do it collaboratively with the other parts of the team, so that the application of the methodology is complete.

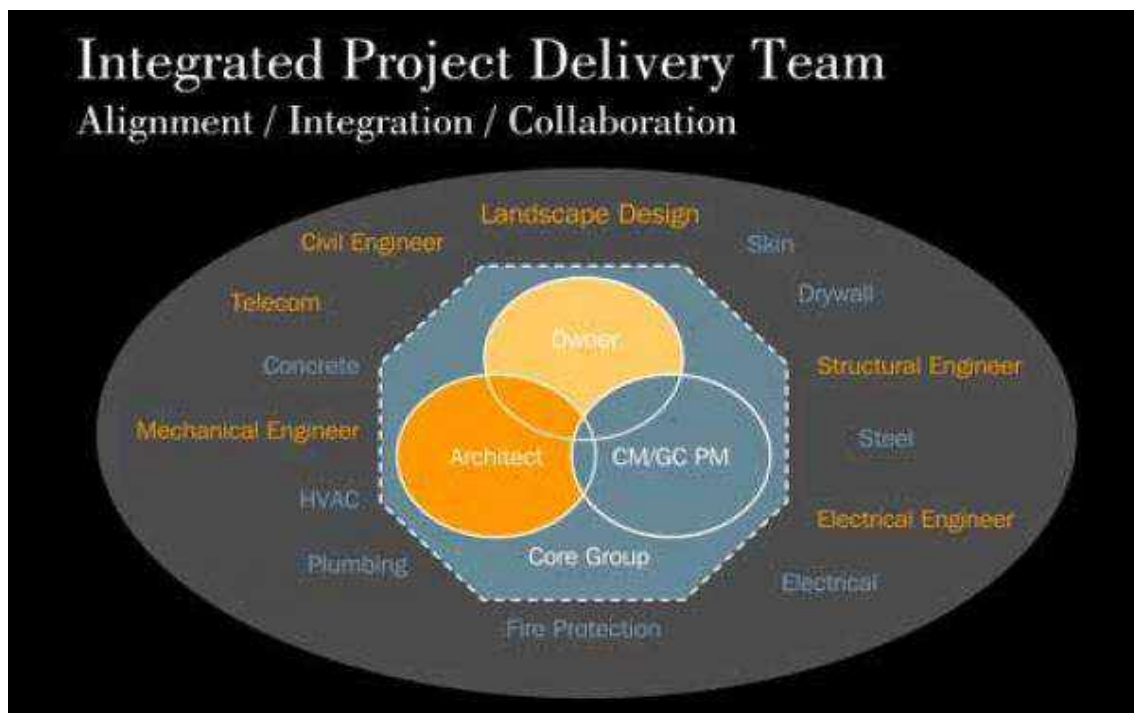


Figure 4: IPD scheme (DPR Construction Inc., 2009)

Obviously IPD brings new conflicts or manages traditional conflicts in construction in another way, it is not a panacea, to be successful in negotiating an IPD agreement, all team members must understand it from the beginning perfectly from a theoretical point of view as well practical.

"Researchers from the University of British Columbia, University of Washington and Scan Consulting, led by Renée Cheng, have recently completed an in-depth study of 10 Lean IPD projects (Cheng, et.al., 2016). The researchers tried to determine if construction was improved with IPD, arriving at the conclusion, based on their own research, and on the one made by others, that the Lean IPD methodology produces better results in the



delivery of projects, achieving a cost, and a deadline for delivery below those of the market, and that the projects studied responded to this result. Although the study was limited in the number of IPD projects examined, it offers the most detailed examination of IPD projects, done to date." (Fischer, Aschcraft, Reed and Khanzode, 2017).

In the United Kingdom many years ago, various researchers proposed formulas for improvement in the British construction process, through teamwork, in lines like what we have been defining as Collaborative Methods or IPD. The Latham Report of the year 1994, already recommended these techniques, which were developed with greater depth and approximation to the formulas applied in USA in the Egan Report of 1998. Based on these reports, PhD. David Mosey drafted the first collaborative contract that was made public in that country: The PPC2000, which greatly influenced the ConsensusDoc 300, and this considering that at the time it was written, BIM did not have the development and implementation that it has today, and none could think of the advantages that its use would bring for the application of these techniques.

In Australia and in the Nordic Countries, such as Finland, Denmark and Norway, they are also working based on Collaborative Methods and drafting contracts adapted to the legislation and customs of each of these Countries but based on the basic principles that we have outlined above. The collaborative techniques in construction offer much better results than the traditional methods and hence the increase of its implantation throughout the world. In Spain, in the same way that progress is being made in the adoption of BIM, we must work on the knowledge and application of IPD to improve our results in the construction industry.

5. Conclusions

- IPD is based on a good functioning of the team.
- This good functioning, in turn, is based on communication, clarity and consistency.
- It is essential that the members of the IPD team believe in the methodology and have the will to integrate and collaborate.
- The early incorporation of the members of the "core team" is essential for the future development of the project.
- It is convenient to incorporate to the team, from the beginning, an IPD facilitator who motivates and contributes to achieving its objectives, also keeping it aligned with the methodology and with good preparation in the same.
- In an IPD team, trust and transparency must prevail.
- An IPD team must have clear and concrete objectives.
- A great help is to work with BIM, which allows the best information for all the members of the team and considers the construction as a set of processes.
- It is important the stability of the team over time, as well as the face-to-face work in "big room".
- Communication and information among team members must be clear, permanent and complete, using an "open books" system.
- Good planning requires good information.
- The contract that binds all parties is essential to develop a true IPD.
- All parties must feel comfortable with the agreed contractual conditions. The IPD facilitator has a great job to do in this field, both at the beginning and throughout the project.

All these principles must be applied in IPD teams, with the particularities that construction has and are the basis for the methodology to work properly, the teams are made by people and only with an adequate involvement of all its members can the project achieve its target.

"We make people before we make cars"
Fujio Chó
(President of Toyota Motor Corporation 1999-2005)

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HOW TO CREATE AND MANAGE A TEAM TO APPLY COLLABORATIVE METHODS IN CONSTRUCTION (IPD) IN SPAIN

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Summary

"Teamwork is the ability to work together towards a common vision. The ability to direct individual achievements towards organizational objectives. It is the fuel that allows ordinary people to achieve uncommon results. "Andrew Carnegie.¹

The Collaborative Methods² in Construction (Integrated Project Delivery or IPD) are based precisely on a good functioning of the team. IPD is built around it. The formalization of these techniques is still incipient in Spain, very little by little there are beginning some works by applying them, it is necessary that we expand our knowledge to improve the efficiency and productivity of the construction sector in our country, and that its successful application spread as it is already doing in others. Construction is an inefficient industry in Spain because it is not developed with collaboration, if we manage to introduce this collaborative methodology, our results will improve.

Key Words: Team, Collaborative Methods, Integrated Project Delivery, IPD

1. INTRODUCTION:

Without a team IPD would not work. In the Collaborative Methodology "the management of the team is not a work of supervision but of leadership" (Deming, 1982), and in that sense it is very important to know how to implement it and exercise it without impositions. We will develop in this article the way to carry out

¹ American businessman and philanthropist native from Scotland, UK (1835-1919)

² Along this text we will use alternatively the synonym expressions: Collaborative Methods, Integrated Project Delivery or IPD indistinctively.

a collaborative work that motivates the team and contributes to achieving its objectives.

According to the latest IPD definition of the American Institute of Architects (AIA, 2014) a collaborative team must be composed at least by: The property, the technicians and the builder, however, as the work develops and grows, other stakeholders are going to be part of it, as we see represented in Figure 1, and therefore the management of its components will be more complicated.

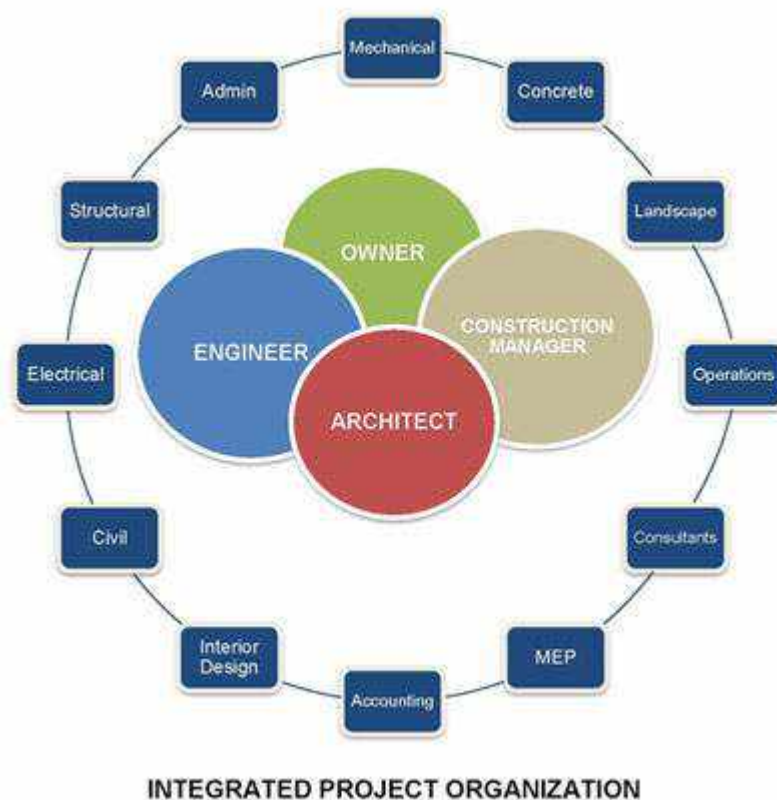


Figure 1: Integral Project Delivery as the collective effort of a coordinated team for the development of the project (SSA Engineers, Prahadevi, Mumbai, 2009)

We will study how good preparation is necessary for an effective team management. To maintain the motivation and objective between the ones of the project, communication and information are essential, all the components of the team must know the achievements and failures which occur in the development of the assigned tasks, as well as act proactively based on the same. The use of Building Information Modelling (BIM) tools is an important support to achieve it. How to give that information and implement an efficient communication is also another objective included in the article.

Finally, another aspect of vital importance for the good development of the IPD team, the sharing of content, which is essential for a true IPD methodology, sharing duties and profits is a point of support for the whole team to feel united, to feel that has a single shared objective, that all members are aligned, and that the participation of each one of them depends on the objectives of the project. This vital aspect is also analysed, based on the experiences which have already been applied in the United States and other countries, as well as the results obtained in them.

2. THE PREPARATION OF THE TEAM.

The early incorporation of key participants is one of the more important basis for the IPD project success, this is managed by committees with members representing these key participants, as minimum: Property, technicians and contractor, is what is called as "core team" or leading team. His main responsibilities are (Ashcraft, 2011):

- "Establishment of the Objectives of the Project.
- Provision and allocation of resources.
- Financial supervision.
- Select the members of the functional teams.
- Tutoring of team members.
- Administration of contracts (work orders, corrections, etc.).
- Conflict resolution "

For the success of the IPD team, its components must really believe in the methodology, and support its development, it is impossible to carry out the purposes outlined above starting from an ignorance of what it really means to work collaboratively, from the renounce to "false individualism, the selfish and self-centred one, and assuming the true individualism, the one contributing to the group" (Hayek, 2009), and that of complementarity work among the members that should be sought with teamwork.

Since the constitution of an IPD team people from different cultures and coming from different organizations must be combined, it is fundamental that each one of them knows, and may have worked, with the collaborative resources. However, training in the IPD culture can be done from within, although a willingness to integrate and collaborate is a necessary starting point. It is better to dispense from the beginning of people who have not stayed in this form of work, than to try it against their will.

This is one of the basic points which needs the dissemination of the methodology in Spain, now, when we find an incipient knowledge of it, must be incremented its teaching, so that from the knowing of its basis is where IPD application can come

from, later the contracts and their development will come, but without previous culture this will not be achieved.

To form a good team, you must set clear and specific objectives, not of a general type such as: "We will be the best" or "We will achieve success", which have no effect, but determined and fixed along the whole process. A great help for this, establishing the construction as a set of processes, is the use of Building Information Modelling (BIM). The objectives must be aligned and be common to all, that is the great difference with the traditional method in which the confrontation between the actors of the construction takes place from the beginning of the project, and even more from the work itself.

All the members of the team must be recognized and self-realized, so that the tasks must be assigned and everyone will feel responsible for their own and feel obliged to do things well, in this way, delegating is easy, because we will know that all will be involved in the same way, each one with its mission³.

Regarding the number of people who must compose an IPD work team, "the most effective teams are neither small (below 4 or 5 people) nor very large (above a dozen people). A good rule is to maintain them between five and nine members" (Robbins, 2011). If a task is too large for the team to be efficient it should be divided into subtasks. "Members of large teams have problems to coordinate one with another, specially under pressure." (Robbins, 2011). Nevertheless, organization of IPD teams vary considerably with different size and complexity of the building to be constructed.

"The biggest three mistakes made by the people, when they are going to compose a team. are the following:

- 1.- It is assumed that "the more members the better" and therefore too many people are put on the team.
- 2.- It is assumed that people who are like others will work better together, and therefore too homogeneous teams are composed.
- 3.- It is assumed that everyone knows how to work as a team, and consequently no attention is paid to the interpersonal skills of potential members. "(Hackman, 2002).

In the United States, where the IPD methodology has been applied with greater extension and success, it is related that, by working together in the same physical space, what they call "big room", there is a greater sense of common responsibility and coordination among all team members.

Another aspect to consider is that interdisciplinarity components with different degrees of experience and points of view must be mixed, the personalities of the

³ "England expects that every man will do his duty", Admiral Nelson message to his fleet before Trafalgar Battle, 1805.

members which make up the team must also be considered, although often the latter is more an art than a science. "The better designed a team is, the greater is the internal collective motivation" (Hackman, 2011). "The teams composed by people of design, engineering, production, sales and marketing" (Deming, 1982), were part of the essential improvement recommendations proposed by W. Edwards Deming to the Western company.

The stability of the team is a factor that contributes to its effectiveness. "Teams that remain stable have more chances of success than those which have to fight permanently with new members and the departure of veterans." (Hackman, 2011). In those companies that have experience in IPD teams in the United States, always is added to the team someone who has previously worked with the methodology and who can contribute with "lessons learned" to others, an IPD facilitator, he/she will be who deliver part of the work of the IPD preparation and training in the methodology to which we have referred earlier.

The professor of social and organizational psychology at Harvard University (USA) PhD. J. Richard Hackman (deceased in 2013), whom we have cited several times, has been one of the greatest experts and who most deeply has written about the creation, management and development of work teams in Companies in general. Reviewing his writings, we see how much they have in common with the recommended techniques for the Collaborative Methods discussed in this article:

"It's not how a leader's management style determines how well a team progresses, but how well a leader designs and supports a team, so that its members can manage themselves." (Hackman, 2002)

The five conditions that PhD. Hackman identifies in the teams which achieve success are:

- "Be a real team.
- Have a convincing address.
- Have a structure that enables people.
- Developed in a context of mutual support.
- Have the monitoring of experts. "(Hackman, 2008)

Likewise, according to PhD. Hackman, what can be done to make work teams function well is:

- "Strengthen the essential socialization processes in collective work.
- Build a common goal, with the appropriate union of skills, strategies and coordination of tasks.
- Help team members solve problems and find emerging opportunities.

- Capture individual experiences and translate them into shared knowledge." (Hackman, 2008)

As a summary, we can say that a good preparation of an IPD equipment requires:

- Early incorporation to the project.
- Define clear, concrete and ambitious objectives.
- Involve all members.
- Establish indicators of the progress of the tasks.
- In addition to the final objectives propose intermediate challenges.
- Communicate and give feedback on the progress of the project.
- Feel all responsible members together.
- Analyse the critical points.
- Detect unforeseen risks and risks in general together.
- Avoid downtime, no one must be stopped at any time.
- Integrate all the people.
- Promote the team's versatility.
- Work based on continuous improvement.
- Generate new ideas, creative collaboration.
- Share knowledge for the improvement of the whole.
- Encourage empathy among team members.
- Foster confidence and self-leadership.
- Work on a team basis between 5 and 10 people, at most.
- If necessary by the size of a task, divide it into subtasks to fit it to that ideal team size

3. COMMUNICATION, A POWERFUL WEAPON

"The "core team" IPD has to clearly communicate the values and objectives of the project to all participants in it and continue to reinforce these objectives and values through repetition and recognition during the development of the project" (Fischer, Aschcraft, Reed and Khanzode, 2017). The teams require communication, clarity and consistency, and: "To communicate well it is necessary to listen before" (Covey, 2006).

The coordination must be increased by means of the regular and complete transfer to all the components of all the information available about the project, not only by computer means, with common servers, but even with notes or posters placed in places of public view of all, and of course being reflected in the BIM model, which will grow as the project progresses.

This information should cover all aspects of the project, including the economic aspects. Collaborative work cannot be requested if information is withheld from the team members. IPD is based, among other things, on mutual loyalty, which is embodied in communication and information, is what is called "open books". "Confidence and transparency must prevail, if this does not exist there will be no progression of improvement in the team" (Ashcraft, 2011).

"The effectiveness of the team requires clear communication and the ability to disagree without damaging personal relationships, although mild levels of conflict related to tasks and processes increase productivity. But this skill requires strong doses of empathy" (Fischer, Ashcraft, Reed and Khanzode, 2017). It is achieved by training the team in these functions from the beginning, both in terms of communication and conflict resolution.

"Good planning requires good information: The information systems that support team development are those that mix reliable data on the situation at all times, with predictions that suggest how those requirements will change in the future" (Hackman, 2002).

It is not only important to give good and complete information of the present to the team, but also to anticipate the tasks that will be necessary to develop in future stages, and even evaluate how the performance has been in the past and compare it with the objectives planned.

For the resolution of conflicts between the members of the team, it is also essential to apply the communication, individual culprits should never be sought, since the overall culture must prevail always, it is very discouraging for any of its members, and for the team, that someone be held accountable individually, whether it is a success or a failure.

Regarding the resolution of conflicts related to discrepancies between the members of the team, on how to solve a problem that has been raised in the project, a good method to reach consensus, which is in line with the Lean Culture and was also created by Toyota within the Toyota Production System or TPS, for the resolution of this type of conflict, is the called A3 Report, because this sheet size is used to reflect it. In Figure 2 we can see the succession of actions that will be reflected writing in it:

Background	Future State & Countermeasures
- Why do we need to work on this? - Context - Importance	- Actions being taken to address the issue (what, who, when) - Quick fixes (Containment actions) - To Be process map
Current State	Impact
- Problem statement/definition - As Is process map - Scale of the problem (data)	- Results achieved - Trend graph (before/after)
Objective	Follow-up
- Target level of performance - Desired outcome	- Actions still required (what, who, when) - Learning points to share
Root Cause Analysis	
- Fishbone diagram - 5 Whys - Data (Pareto, Scatter diagram)	

Figure 2: A3 report on conflict resolution

In the first place, the problem is clearly defined, then the current situation is described, in third place, the causes of the root of the problem are analysed, then the situation where you want to arrive is defined, the one that constitutes the objective, a plan of action is established in a next step to achieve it, and then a follow-up of the same, to finally verify the results, repeating cyclically this process in case the desired objective is not achieved as a result. It is a very practical and effective way to reach consensus when there are discrepancies about the solution to a problem.

Communication among team members must take place in a climate of trust and transparency, "members of effective teams trust each other, as well as their leaders. Interpersonal trust among team members facilitates cooperation, reduces the need to control each one's progress and extends the belief that nobody is going to take advantage of others effort." (Robbins, 2011).

Transparency is another essential component in IPD equipment, for this we must banish the idea that who wins a dispute is the one who is capable of deceiving the other, in an environment of these characteristics is where the production process usually occurs in Spanish construction sector, that reason is why it is not wanted to facilitate all the information to the intervening ones in the development of a project, it is to be able to take advantage in a certain moment of the information that each one owns. IPD is the opposite, it is information shared in the search for a true team spirit based on trust and transparency, communication and empathy.

"The research says that in face-to-face communication attitudes and feelings are only 7% of what it is communicated and 38% is due to how it has been communicated, but 55% is body language" (Covey, 2006)

That is one of the reasons to look for work in "big room", for establishing that direct face-to-face relationship between the various members of the team, this produces a quality of communication that cannot be substituted by telematic means, even if it is shared. Keep in mind that the teams are made by people and we must use all the springs of interpersonal communication to achieve good coordination.

To focus on a concrete example of what we have discussed previously, we took the appointment of Cristina Ayats book: "Lean Diseño y Construcción. Un cambio necesario", which says about the communication in the Cathedral Hill Hospital project, San Francisco (USA), made with IPD methodology:

"From everything I've seen and learned until then, I concluded that the main problem in applying lean in construction was coordination, and that this should be worked through communication.

- It must be fluid, Clara pointed out, so that the message reaches all the members of the team. Each one of them must be able to transmit the changes made, in order that the team can coordinate with their most recent model. Otherwise, that coordination will be wasteful.

Then he went on to explain different ideas that were discussed in the Cathedral Hill Hospital project to transmit the information and that, finally, were standardized:

- Modifications at a structural and architectural level were communicated through weekly comparative archives, where what was eliminated was marked in red and what was moved in blue. These changes were transmitted through an e-mail in which the alterations produced since the last update of the virtual model were enumerated.

- The architects commented on the recent modifications of the virtual model in a joint meeting of 5 minutes.

- To transmit the team what structural elements were ready for its manufacture (and therefore could not be touched), the metal structure subcontractor passed a model where he distinguished, in green, what was already prepared to be built; in yellow, the areas where they were working; and, in red, those in which the team could modify the detail without impacting them.

- Every meeting had a person in charge, an objective and ended with a series of obligations, each with its responsible person and date of completion.

- Any action that needed a plan departed from the main meeting after having assigned the person in charge and assistants, so that they could meet later to

resolve it. Without responsibility, these works would not have been carried out. "(Ayats, 2015).

We have found it interesting to quote this example, in which it can be seen very well how to standardize the way of communicating into the team for the good performance of the project.



Figure 3: Cathedral Hill Hospital, San Francisco (USA)

4. THE IPD CONTRACT, EXPRESSION OF THE TEAM:

To achieve the objectives of a good team collaborative work, it is essential that all parties feel comfortable with the agreed contractual conditions, so we will briefly analyse this type of contracts, which present very peculiar characteristics and whose adequate adjustment is going to determine to a large extent the success of the work, and therefore of the project.

Indeed, in the beginning of the application in real projects of the methodology in USA, about the year 2.007, this was a major problem, the idea was underway, but the rules of the game of this new way of working had to be translated into a paper, and after the experience developed by the Sutter Health Company, a pioneer in the application of the methodology, with the first Integrated Form of Agreement (IFOA) written by the lawyer Will Llichtig, the first complete IPD contract was prepared, which came to light with the collaboration of numerous

institutions: The American Institute of Architects (AIA), the Lean Construction Institute (LCI), the Associated General Contractors of America (AGC) and the Sutter Health company, this document, which continues to serve as the basis for IPD contracts, is known as ConsensusDoc 300.

After, the AIA has published its own IPD contract, based on the previous, including a law firm in California: Hanson Bridget LLP, through one of its partners, a construction specialist, and specifically in this type of contracts: Howard W Ashcraft, who has developed the subject with great diffusion in academic and business forums.

These three are basically the most used contracts in USA for IPD: The ConsensusDoc 300, the AIA and the Hanson Bridget LLP. In Spain, in parallel with the knowledge of this way of working, it also opens a good possibility of developing IPD contracts adapted to our legislation, for those law firms that want to join this current.

The Collaborative Methodology approaches the constructive fact in a totally different way to the traditional one in our country, the contracts that must be written to carry it out, must put a different focus on the rights and obligations of the interveners.

It is often said that in any contract the first thing is negotiation and then the drafting, but in the case that concerns us, it is necessary to start from some basic principles without which the contract would not be IPD, but something else, for this reason it is very important, as we said before, that the participants support the methodology and believe in it, that they accept these basic conditions of entry, and that based on them they build the contract with the specific characteristics of the project to be developed.

Recall the conditions that the definition of Integrated Project Delivery (IPD) of the AIA established in 2014:

"It is a method of delivering a project that integrates people, systems, business structures and practices, in a process that collaboratively puts to work the talents and visions of all participants to reduce losses and optimize efficiency through all phases of design, manufacturing and construction.

The Integrated Project Delivery Method contains, at least all the following elements:

- 1.- Continuous involvement of the owner, as well as key designers and builders.
- 2.- Business interests aligned through a shared risk / benefit system, including financial gains for risk, which depend on the results of the project.
- 3.- Control of the joint project by the owner, as well as key designers and constructors.

4.- Common contract between all the parties or with conditions of mandatory and specific participation.

5.- Responsibility shared by the owner, the designers and builders "(AIA, 2014).

These are the minimum conditions that an IPD contract must contain, from here the specificities of each case begin.

As well as to enhance the aspects of organization, development and communication in the team, we have said that many times someone who, with knowledge and experience in the field, acts as a facilitator by joining online wills of what IPD really is, could also in what refers to the drafting of the contract achieve much relevance by approaching criteria and improving relations.

Bear in mind that, when the IPD contract is drawn up, everything is estimated, what is going to be projected and what is going to be built is not yet fully known, and therefore the degree of uncertainty is important. One of the defects attributed to the Collaborative Methods is that for this reason you can only start a project with your own funds, since financial organizations do not want to work with uncertainties, they want to know as much as possible what they are going to finance. Once the starting point of the project has been reached, with the project defined, this can change, but not before.

"The general objectives of an IPD contract are:

- Remove impediments, stimulate communication, collaboration and creativity.
- Promote the early participation of key actors in the project.
- Distribute risks and rewards based on the results of the project.
- Exercise control of the project jointly.
- Reduce the exposure to responsibilities of the participants.
- Develop and validate the objectives jointly. "(Ashcraft, 2011)

To these objectives the AIA adds one more:

- " Decision-making in a collaborative manner. "(AIA, 2014)

Which is a generalization as to the form of these contracts, so Howard W. Ashcraft has not considered it, however, it does seem an interesting approach, since it covers the whole process, not just the control and the objectives.

The aspects that Howard W. Ashcraft (2011) considered as conflictive in the negotiation of these contracts are those related to the specificities of each project, in particular:

- "Project dimensions.
- Scope of the project.
- Form in which the project will be managed and how the decision making will be adopted.
- Compensations.
- Setting of Objectives.
- Contingencies and their adjustment to the objectives.
- Allowed costs and benefits.
- Measurement of the progress of the project.
- Risk management "

For example, the ConsensusDoc 300 favours decision making by consensus, and in case of a tie, the ruling opinion is that of property, but there are other models that prefer not to give that power to the property so as not to ballast the management of the project.

As for the setting of objectives, a technique that is usually associated with IPD contracts is to establish a prior Target Cost or Target Value Design (TVD). It consists of subjecting the design to that Target Cost and not deviating from it throughout the entire development of the project, for this purpose it uses a continuous evaluation of alternatives and implications that can influence the budget from the design, it is helped permanently by the BIM methodology, which makes it possible to optimize this work. It is about delivering the highest possible value to the client within a prefixed maximum cost throughout the development of the project.

About the allowed costs and benefits, a base budget of necessary costs for all the actors is usually established (by each one of them), also a margin for possible contingencies that could arise, although using the TVD control so that this margin is minimum, and an adequate benefit for all the participants, depending on the

achievement or not of the objectives of the project. In an IPD project the efficiency is rewarded and the inefficiency is punished.

Given that IPD is a method based on collaboration and trust between team members, those consultants who work for the component technicians of the "core team", and subcontractors of the construction company chosen, should also be integrated in this way of working and should do it collaboratively with the other parts of the team, so that the application of the methodology is complete.

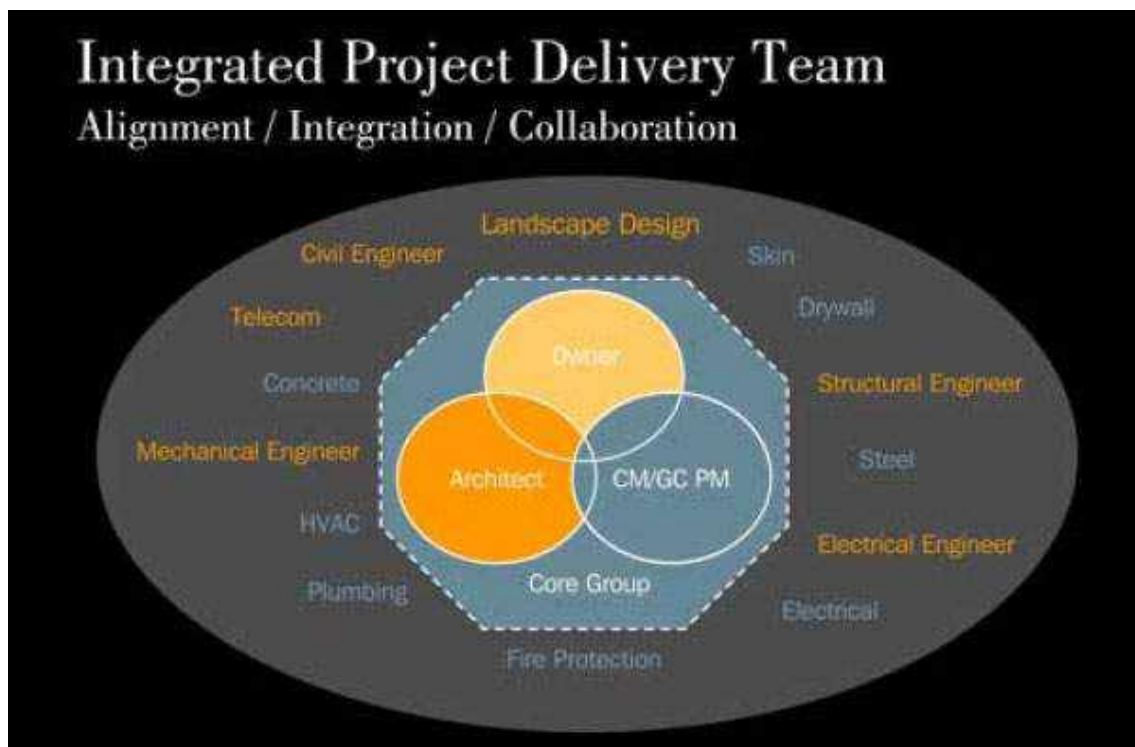


Figure 4: IPD scheme (DPR Construction Inc., 2009)

Obviously IPD brings new conflicts or manages traditional conflicts in construction in another way, it is not a panacea, to be successful in negotiating an IPD agreement, all team members must understand it from the beginning perfectly from a theoretical point of view as well practical.

"Researchers from the University of British Columbia, University of Washington and Scan Consulting, led by Renée Cheng, have recently completed an in-depth study of 10 Lean IPD projects (Cheng, et.al., 2016). The researchers tried to determine if construction was improved with IPD, arriving at the conclusion, based on their own research, and on the one made by others, that the Lean IPD

methodology produces better results in the delivery of projects, achieving a cost, and a deadline for delivery below those of the market, and that the projects studied responded to this result. Although the study was limited in the number of IPD projects examined, it offers the most detailed examination of IPD projects, done to date." (Fischer, Aschcraft, Reed and Khanzode, 2017).

In the United Kingdom many years ago, various researchers proposed formulas for improvement in the British construction process, through teamwork, in lines like what we have been defining as Collaborative Methods or IPD. The Latham Report of the year 1.994, already recommended these techniques, which were developed with greater depth and approximation to the formulas applied in USA in the Egan Report of 1998. Based on these reports, PhD. David Mosey drafted the first collaborative contract that was made public in that country: The PPC2000, which greatly influenced the ConsensusDoc 300, and this considering that at the time it was written, BIM did not have the development and implementation that it has today, and none could think of the advantages that its use would bring for the application of these techniques.

In Australia and in the Nordic Countries, such as Finland, Denmark and Norway, they are also working based on Collaborative Methods and drafting contracts adapted to the legislation and customs of each of these Countries but based on the basic principles that we have outlined above. The collaborative techniques in construction offer much better results than the traditional methods and hence the increase of its implantation throughout the world. In Spain, in the same way that progress is being made in the adoption of BIM, we must work on the knowledge and application of IPD to improve our results in the construction industry.

5. CONCLUSIONS

- IPD is based on a good functioning of the team.
- This good functioning, in turn, is based on communication, clarity and consistency.
- It is essential that the members of the IPD team believe in the methodology and have the will to integrate and collaborate.
- The early incorporation of the members of the "core team" is essential for the future development of the project.

- It is convenient to incorporate to the team, from the beginning, an IPD facilitator who motivates and contributes to achieving its objectives, also keeping it aligned with the methodology and with good preparation in the same.
- In an IPD team, trust and transparency must prevail.
- An IPD team must have clear and concrete objectives.
- A great help is to work with BIM, which allows the best information for all the members of the team and considers the construction as a set of processes.
- It is important the stability of the team over time, as well as the face-to-face work in "big room".
- Communication and information among team members must be clear, permanent and complete, using an "open books" system.
- Good planning requires good information.
- The contract that binds all parties is essential to develop a true IPD.
- All parties must feel comfortable with the agreed contractual conditions. The IPD facilitator has a great job to do in this field, both at the beginning and throughout the project.

All these principles must be applied in IPD teams, with the particularities that construction has and are the basis for the methodology to work properly, the teams are made by people and only with an adequate involvement of all its members can the project achieve its target.

"We make people before we make cars"

Fujio Chó

(President of Toyota Motor Corporation 1999-2005)

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Como crear y gestionar un equipo para aplicar Métodos Colaborativos (IPD) en construcción en España

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Palabras Clave: Equipos, Métodos Colaborativos, Integrated Project Delivery, IPD

Si bien por el momento en España la teoría respecto a IPD se encuentra en fase de conocimiento inicial y está poco formalizada en la práctica, como ocurre con todas las técnicas Lean Construction, es importante profundizar en ella para lograr cada día una mayor aplicabilidad en la construcción española. Los Métodos Colaborativos (IPD) se desarrollan en torno a un equipo. El objetivo de este artículo es analizar cómo debe crearse y gestionarse ese equipo para lograr el éxito aplicando la metodología.

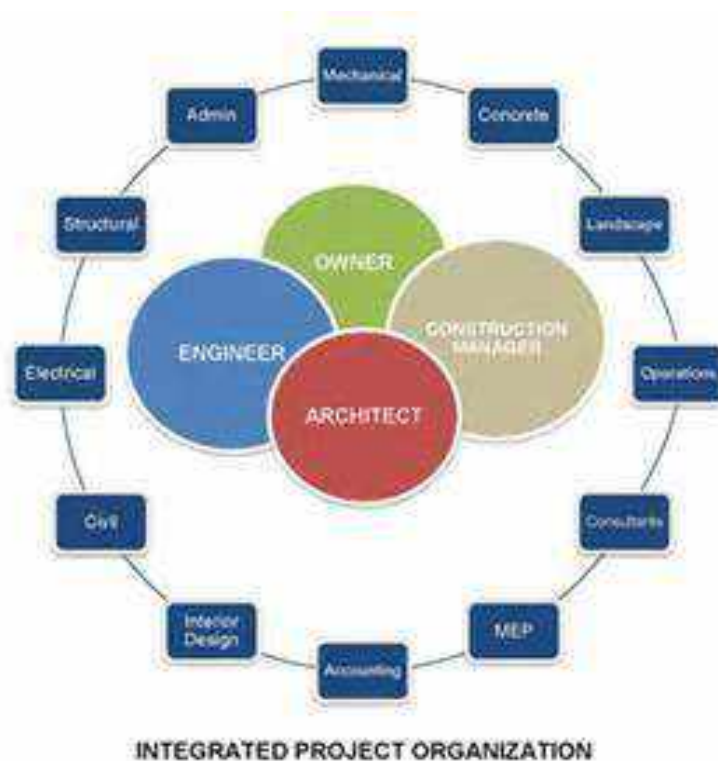


Figura 1: Integrated Project Delivery como el esfuerzo colectivo de un equipo coordinado para el desarrollo del proyecto

Sin equipo, IPD no funcionaría, es necesaria la comunicación, la claridad y la consistencia de este. En la Metodología Colaborativa la gestión del equipo no es un trabajo de supervisión sino de liderazgo, y en ese sentido es muy importante saber cómo implantarlo y ejercerlo sin imposiciones. Desarrollaremos en este artículo la forma de llevar a cabo un liderazgo colaborativo que motive al equipo y contribuya a alcanzar los objetivos de este.

Según la última definición de IPD del American Institute of Architects (AIA, 2014) un equipo colaborativo debe estar compuesto al menos por: La propiedad, los técnicos y la constructora, no obstante, a medida que el trabajo vaya desarrollándose y creciendo, otros interesados (stakeholders) van a ir formando parte de este, como vemos representado en la Figura 1, y por tanto la gestión de sus componentes se va a complicar. Estudiaremos en este artículo cómo la buena preparación es necesaria para hacer una gestión eficaz del equipo y cómo es algo que no ocurre por arte de magia, sino que requiere técnicas específicas.

Para mantener al equipo motivado y alineado con los objetivos del proyecto es fundamental la comunicación y la información, todos los componentes deben conocer los logros y fallos que se den en el desarrollo de las tareas asignadas, así como actuar proactivamente en base a los mismos. La utilización de herramientas BIM será un apoyo importante para lograrlo. Cómo entregar esa información y cómo implementar una comunicación eficaz será otro objetivo a contemplar en nuestro artículo.

Finalmente, otro aspecto de vital importancia para el buen desarrollo del equipo IPD es el contrato que vincula a todas las partes, algo esencial para que se trate de una verdadera metodología IPD, compartir responsabilidades, pérdidas y ganancias es un punto de apoyo para que todo el equipo se sienta unido, sienta que tiene un único objetivo compartido, que todos sus miembros están alineados y que de la participación de todos y cada uno de ellos depende alcanzar los objetivos del proyecto. Este vital aspecto también será analizado en el artículo que proponemos, partiendo de las experiencias que ya han sido aplicadas en Estados Unidos y de los resultados obtenidos.

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CÓMO CREAR Y GESTIONAR UN EQUIPO PARA APLICAR MÉTODOS COLABORATIVOS EN CONSTRUCCIÓN (IPD) EN ESPAÑA

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Resumen

“El trabajo en equipo es la habilidad para trabajar juntos hacia una visión común. La habilidad de dirigir logros individuales hacia objetivos organizacionales. Es el combustible que permite a la gente común conseguir resultados poco comunes.”

Andrew Carnegie.¹

Los Métodos Colaborativos² en Construcción (Integrated Project Delivery o IPD) se basan precisamente en un buen funcionamiento del equipo. IPD se construye en torno al mismo. La formalización de estas técnicas es aún incipiente en España, muy poco a poco empiezan a ejecutarse algunas obras aplicándolas, es necesario que amplíemos nuestro conocimiento de ellas para mejorar la eficiencia y productividad del sector de la construcción en nuestro país y que su aplicación con éxito se extienda como ya lo está haciendo en otros. La construcción es una industria ineficaz en España porque no se colabora, si logramos introducir esta metodología colaborativa, mejorarán nuestros resultados.

Palabras Clave: Equipo, Métodos Colaborativos, Integrated Project Delivery, IPD

1. INTRODUCCIÓN

Sin equipo IPD no funcionaría. En la Metodología Colaborativa “la gestión del equipo no es un trabajo de supervisión sino de liderazgo” (Deming, 1982), y en ese sentido es muy importante saber cómo implantarlo y ejercerlo sin imposiciones. Desarrollaremos en este artículo la forma de llevar a cabo un trabajo colaborativo que motive al equipo y contribuya a alcanzar sus objetivos.

Según la última definición de IPD del American Institute of Architects (AIA, 2014) un equipo colaborativo debe estar compuesto al menos por: La propiedad, los técnicos y la constructora, no obstante, a medida que el trabajo vaya desarrollándose y creciendo, otros interesados (stakeholders) van a ir formando

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² A lo largo del texto utilizaremos las expresiones sinónimas: Métodos Colaborativos, Integrated Project Delivery o IPD indistintamente.

parte de este, como vemos representado en la Figura 1 y por tanto la gestión de sus componentes se va a complicar.

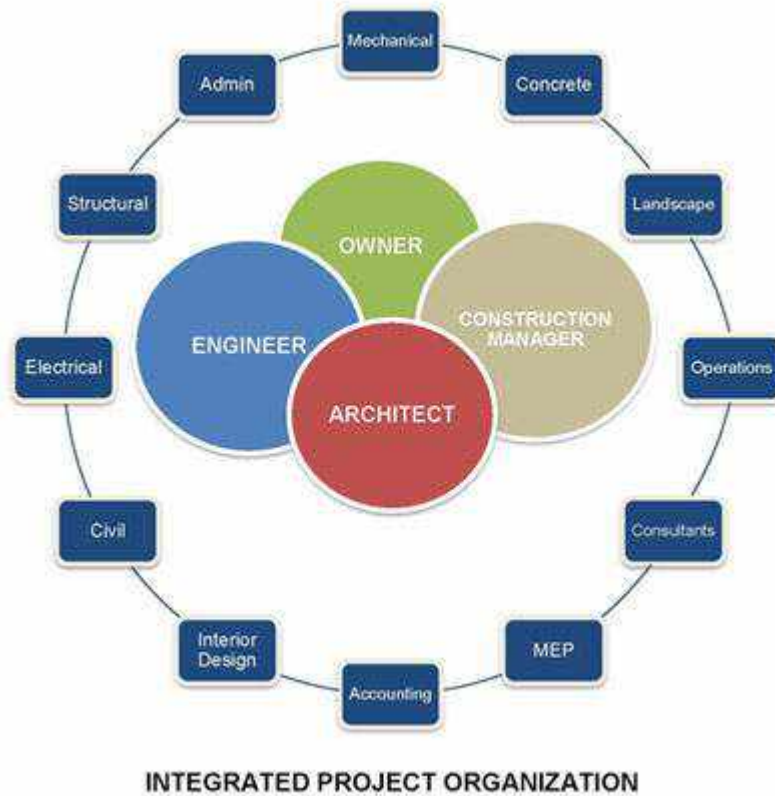


Figura 1: Integrated Project Delivery como el esfuerzo colectivo de un equipo coordinado para el desarrollo del proyecto (SSA Engineers, Prahadevi, Mumbai, 2009)

Estudiaremos cómo la buena preparación es necesaria para hacer una gestión eficaz del equipo. Para mantenerlo motivado y alineado con los objetivos del proyecto es fundamental la comunicación y la información, todos los componentes deben conocer los logros y fallos que se dan en el desarrollo de las tareas asignadas, así como actuar proactivamente en base a los mismos. La utilización de herramientas BIM será un apoyo importante para lograrlo. Cómo entregar esa información e implementar una comunicación eficaz será así mismo un objetivo que contemplar en el artículo.

Finalmente, otro aspecto de vital importancia para el buen desarrollo del equipo IPD es el contrato que vincula a todas las partes, algo esencial para que se trate de una verdadera metodología IPD, compartir responsabilidades, pérdidas y ganancias es un punto de apoyo para que todo el equipo se sienta unido, sienta que tiene un único objetivo compartido, que todos sus miembros están alineados, y que de la participación de todos y cada uno de ellos depende alcanzar los objetivos del proyecto. Este vital aspecto también será analizado, partiendo de las experiencias que ya han sido aplicadas en Estados Unidos y otros países, así como de los resultados obtenidos en las mismas.

2. LA PREPARACIÓN DEL EQUIPO.

La incorporación temprana al proyecto de los participantes clave es una de las bases más importantes para el éxito del proyecto IPD, éste es gestionado por comités con miembros que representan a estos participantes clave, como mínimo: La propiedad, los técnicos y el contratista, que es lo que se denomina como “core team” o equipo líder. Sus responsabilidades principales son (Ashcraft, 2011):

- “Establecimiento de los Objetivos del Proyecto.
- Provisión y localización de los recursos.
- Supervisión financiera.
- Seleccionar a los miembros de los Equipos funcionales.
- Tutoría de los miembros del equipo.
- Administración de contratos (órdenes de trabajo, correcciones etc.).
- Resolución de conflictos”.

Para el éxito del equipo IPD sus componentes deben creer realmente en la metodología, y apoyar el desarrollo de ésta, no pueden llevarse a cabo los fines antes reseñados partiendo de un desconocimiento de lo que significa realmente trabajar de forma colaborativa, de las renuncias al “individualismo falso, el egoísta y egocentrista, asumiendo el individualismo verdadero, el que colabora y aporta al grupo” (Hayek, 2009) así como la complementariedad entre sus miembros que se debe buscar con el trabajo en equipo.

Dado que para la formación de un equipo IPD se han de combinar personas procedentes de organizaciones diferentes, es fundamental que cada una de ellas conozca, y a ser posible haya trabajado, con Métodos Colaborativos. No obstante, el entrenamiento en la cultura IPD se puede hacer desde dentro, si bien partiendo de una voluntad de integración y colaboración. Es mejor prescindir desde el principio de aquellas personas que no se sientan cómodas con esta forma de trabajar, que intentar convencerlas en contra de su voluntad.

Este es uno de los puntos básicos que hace necesaria la difusión de la metodología en España, en el momento en que nos encontramos de incipiente conocimiento de ésta, debe incrementarse su enseñanza, ya que del conocimiento de la cultura IPD es de donde puede venir su aplicación, posteriormente vendrán los contratos y su desarrollo, pero sin cultura previa esto no se logrará.

Para formar un buen equipo se deben fijar unos objetivos claros y concretos, no de tipo general como: Vamos a ser los mejores o Vamos a conseguir el éxito, que no tienen ningún efecto, sino determinados y fijos a lo largo del proceso. Una gran ayuda en este sentido, para considerar la construcción como un conjunto de procesos, es la utilización de Building Information Modeling (BIM). Los

objetivos tienen que estar alineados y ser comunes a todos, esa es la gran diferencia con el método tradicional en el que el enfrentamiento entre los actores de la construcción se produce desde el principio del proyecto y aún más de la obra.

Todos los miembros del equipo tienen que verse reconocidos y autorrealizados, para ello se deben asignar las tareas de modo que cada uno se sienta responsable de lo suyo y por tanto se sienta obligado a hacer las cosas bien, de este modo delegar será fácil, porque sabremos que todos estaremos implicados de la misma forma, cada uno con su cometido³.

En cuanto al número de personas que deben componer un equipo de trabajo IPD, “los equipos más efectivos no son ni muy pequeños (por debajo de 4 ó 5 personas) ni muy grandes (por encima de la docena de personas). Una buena regla es mantenerlos entre cinco y nueve miembros” (Robbins, 2011). Si una tarea es demasiado grande para que el equipo sea eficiente debe ser dividida en subtareas. “Los miembros de equipos grandes tienen problemas para coordinarse unos con otros, especialmente bajo presión.” (Robbins 2011). No obstante, la organización de los equipos IPD varía considerablemente en base al tamaño y la complejidad técnica del edificio a desarrollar.

“Las tres mayores equivocaciones que comenten las personas cuando van a componer un equipo son las siguientes:

- 1.- Se asume que “cuantos más miembros mejor” y por tanto se pone demasiada gente en el equipo.
- 2.- Se asume que las personas que son similares a otras trabajarán mejor juntas, y por tanto se componen equipos demasiado homogéneos.
- 3.- Se asume que todo el mundo sabe cómo trabajar en equipo, y en consecuencia no se presta atención a las habilidades interpersonales de los posibles miembros.” (Hackman, 2002).

En Estados Unidos, donde la metodología IPD ha sido aplicada con mayor extensión y éxito, se refiere que, mediante el trabajo conjunto en un mismo espacio físico, lo que denominan “big room”, se produce una mayor sensación de responsabilidad común y de coordinación entre todos los miembros del equipo.

Otro aspecto que considerar es la interdisciplinaridad, deben mezclarse componentes con diferentes grados de experiencia y puntos de vista, las personalidades de los miembros que componen el equipo también han de ser tenidas en cuenta, si bien muchas veces esto último es más un arte que una

³ “England expects that every man will do his duty” (“Inglaterra espera que cada hombre haga su trabajo”), mensaje del Almirante Nelson a su flota antes de la Batalla de Trafalgar, 1805.

ciencia. “Cuanto mejor diseñado está un equipo es mayor la motivación interna colectiva” (Hackman, 2011). “Los equipos compuestos por personas de diseño, ingeniería, producción, ventas y marketing” (Deming, 1982), fueron parte de las recomendaciones de mejora esenciales propuestas por W. Edwards Deming a la compañía Western.

La estabilidad del equipo es un factor que contribuye a su eficacia. “Los equipos que permanecen estables tienen más posibilidades de éxito que aquellos que han de luchar de forma permanente con nuevos miembros y la salida de los veteranos.” (Hackman, 2011). En aquellas empresas que tienen experiencia en equipos IPD en Estados Unidos, siempre se incorpora al mismo a alguien que haya trabajado anteriormente con la metodología y que pueda aportar “lecciones aprendidas” a los demás, un facilitador IPD, esa es parte de la labor de preparación y entrenamiento en la metodología a la que antes nos hemos referido.

El profesor de psicología social y organizacional de la Universidad de Harvard (EE. UU.) Dr. J. Richard Hackman (fallecido en el año 2013), al que hemos citado varias veces, ha sido uno de los mayores expertos y que más profundamente ha escrito sobre la creación, gestión y desarrollo de equipos de trabajo en empresas en general, y repasando sus escritos, vemos cuánto tienen en común las técnicas que recomienda con los Métodos Colaborativos de los que tratamos en este artículo.

“No es cómo el estilo de gestión de un líder determina lo bien que progresa un equipo de trabajo, sino lo bien que un líder diseña y apoya a un equipo, de modo que sus miembros puedan gestionarse a sí mismos”. (Hackman, 2002)

Las cinco condiciones que el Dr. Hackman identifica en los equipos que alcanzan el éxito son:

- “Ser un auténtico equipo.
- Tener una dirección convincente.
- Tener una estructura que habilita a las personas.
- Desarrollarse en un contexto de apoyo mutuo.
- Tener la monitorización de expertos.” (Hackman, 2008)

Así mismo, según el Dr. Hackman, lo que se puede hacer para que los equipos de trabajo funcionen bien es:

- “Potenciar los procesos de socialización esenciales en el trabajo colectivo.
- Construir un objetivo común, con la apropiada unión de habilidades, estrategias y coordinación de tareas.
- Ayudar a los miembros del equipo a solucionar los problemas y encontrar oportunidades emergentes.

- Capturar las experiencias individuales y traducirlas en un conocimiento compartido.” (Hackman, 2008)

Como resumen podemos decir que una buena preparación de un equipo IPD requiere:

- Incorporación temprana al proyecto.
- Definir objetivos claros, concretos y ambiciosos.
- Hacer participar a todos los miembros.
- Establecer indicadores del progreso de las tareas.
- Además de los objetivos finales proponerse retos intermedios.
- Comunicar y dar retroalimentación del progreso del proyecto.
- Sentirnos todos los miembros responsables en conjunto.
- Analizar los puntos críticos en conjunto.
- Detectar los imprevistos y riesgos en conjunto.
- Evitar tiempos muertos, que nadie esté parado en ningún momento.
- Integrar a todas las personas.
- Fomentar la polivalencia del equipo.
- Trabajar en base a la mejora continua.
- Generar nuevas ideas, que la colaboración sea creativa.
- Compartir el conocimiento para la mejora del conjunto.
- Fomentar la empatía entre los componentes del equipo.
- Fomentar la confianza y el autoliderazgo.
- Trabajar en base a equipos entre 5 y 10 personas, como máximo.
- En caso necesario por la amplitud de una tarea, dividirla en subtareas para ajustarla a ese tamaño ideal de equipo

3. LA COMUNICACIÓN, UN ARMA PODEROSA:

El “core team” IPD tiene que comunicar claramente los valores y objetivos del proyecto a todos los participantes en el equipo y continuar reforzando estos objetivos y valores mediante la repetición y el reconocimiento durante el desarrollo del proyecto” (Fischer, Aschcraft, Reed y Khanzode, 2017). Los equipos requieren comunicación, claridad y consistencia, y:” Para comunicar bien hay que escuchar antes” (Covey, 2006).

La coordinación debe ser incrementada mediante el traslado regular y completo a todos los componentes de toda la información disponible sobre el proyecto, no solo por medios informáticos, con servidores comunes, sino incluso con notas o carteles colocados en lugares de paso a la vista de todos, y por supuesto siendo plasmada en el modelo BIM, que irá creciendo a medida que el proyecto progrese.

Esta información debe abarcar todos los aspectos del proyecto, incluyendo los económicos, no se puede pedir apoyo al trabajo colaborativo si se sustrae

información a los miembros del equipo. IPD se basa entre otras cosas en la lealtad mutua, que se plasma en la comunicación e información, es lo que se denomina en inglés la fórmula “open books”, o libros abiertos. “Tiene que primar la confianza y la transparencia, si esto no existe no habrá progresión de mejora en el equipo” (Ashcraft, 2011).

“La efectividad del equipo requiere una comunicación clara y la habilidad de disentir sin dañar las relaciones personales, si bien leves niveles de conflicto relativos a las tareas y procesos incrementan la productividad. Pero esta habilidad requiere fuertes dosis de empatía” (Fischer, Ashcraft, Reed y Khanzode, 2017). Esto se logra entrenando al equipo en estas funciones desde el principio, tanto en materia de comunicación como de resolución de conflictos.

“La buena planificación requiere buena información: Aquellos sistemas de información que apoyan al desarrollo del equipo son los que mezclan datos fiables sobre la situación en cada momento, con predicciones que sugieren como van a cambiar esos requerimientos en el futuro” (Hackman, 2002).

Es decir que no solo es importante dar buena y completa información de la actualidad al equipo, sino también adelantarse a las tareas que va a ser necesario desarrollar en etapas venideras, e incluso evaluar cómo ha sido el desempeño en el pasado y compararlo con los objetivos previstos.

Para la resolución de conflictos entre los miembros del equipo también es esencial aplicar la comunicación, no se deben buscar nunca culpables individuales, ya que la cultura de conjunto debe primar en todo momento, resulta muy desincentivador para cualquiera de sus miembros, y para el equipo, que se responsabilice a alguien individualmente, bien sea de un éxito o un fracaso.

En cuanto a la resolución de conflictos relativos a discrepancias entre los miembros del equipo sobre cómo resolver un problema que se ha planteado en el proyecto, un buen método para alcanzar el consenso, que está en la línea de la Cultura Lean y que también fue creado por Toyota dentro del Toyota Production System o TPS, para la resolución de este tipo de conflictos, es el denominado Informe o Reporte A3, debido a que se utiliza este tamaño de hoja para reflejarlo. En la Figura 2 podemos ver la sucesión de acciones que quedarán plasmadas por escrito en el mismo:

Reporte A3

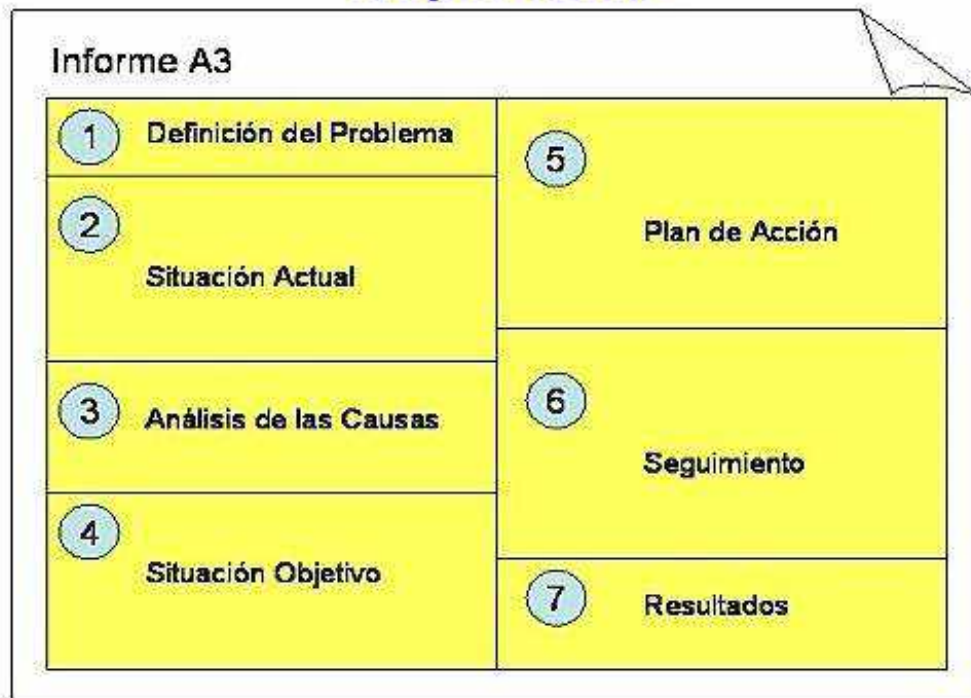


Figura 2: Reporte A3 de resolución de conflictos

En primer lugar se define claramente cuál es el problema, a continuación se describe cuál es la situación actual en la que se encuentra, en tercer lugar se analizan las causas de la raíz del mismo, a continuación se define cuál es la situación a la que se quiere llegar, cuál es el objetivo, se establece en un siguiente paso un plan de acción para lograrlo y a continuación un seguimiento del mismo, para verificar finalmente los resultados, repitiéndose cíclicamente este proceso en caso de que no se logre el objetivo que se desea como resultado. Es una forma muy práctica y eficaz de alcanzar consensos cuando hay discrepancias sobre la solución a un problema.

La comunicación entre los miembros del equipo debe desarrollarse en un clima de confianza y de transparencia, “los miembros de los equipos eficaces confían unos en los otros, así como en sus líderes. La confianza interpersonal entre los miembros del equipo facilita la cooperación, reduce la necesidad de controlar el progreso de cada uno y extiende la creencia de que nadie se va a aprovechar del esfuerzo de los demás” (Robbins, 2011).

La transparencia es otro componente esencial en los equipos IPD, para ello hay que desterrar la idea de que quien gana una controversia es aquel que es capaz de engañar al otro, en un ambiente de esas características es en el que se da habitualmente el proceso productivo de la construcción en España, por eso no se quiere facilitar toda la información a los intervinientes en el desarrollo de un

proyecto, para poder tomar ventaja en un momento determinado de la información que cada uno posee. IPD es todo lo contrario, es información compartida en la búsqueda de un verdadero espíritu de equipo basado en la confianza y en la transparencia, en la comunicación y en la empatía.

“La investigación dice que en la comunicación cara a cara las actitudes y sentimientos son solo el 7 % de lo que se comunica y el 38 % se debe a cómo se ha comunicado, pero el 55 % es lenguaje corporal” (Covey, 2006)

Ese es uno de los motivos de buscar el trabajo en “big room”, ya que establecer esa relación directa cara a cara entre los diversos miembros del equipo, produce una calidad de comunicación que no puede sustituirse con medios telemáticos, aunque se comparta. Tengamos en cuenta que los equipos los componen personas y debemos utilizar todos los resortes de la comunicación interpersonal al objeto de lograr una buena coordinación.

Para centrarnos en un ejemplo concreto de lo que hemos comentado anteriormente, tomamos la cita del libro de Cristina Ayats: “Lean Diseño y Construcción. Un cambio necesario”, que dice sobre la comunicación en el proyecto del Cathedral Hill Hospital en San Francisco (EE. UU.), realizado con metodología IPD:

“Por todo lo visto y aprendido hasta entonces, deduje que el principal problema de aplicar lean en construcción era la coordinación, y que esta debería trabajarse a través de la comunicación.

- Debe ser fluida -señaló Clara-, para que el mensaje llegue a todos los miembros del equipo. Cada uno de ellos debe poder transmitir los cambios realizados, con el fin de que el equipo pueda coordinarse con su modelo más reciente. De lo contrario, esa coordinación será desperdicio.

Entonces pasó a explicarme diferentes ideas que barajaban en el proyecto del Cathedral Hill Hospital para transmitir la información y que, finalmente, se estandarizaron:

- Las modificaciones a nivel estructural y arquitectónico se comunicaban a través de archivos comparativos semanales, donde se marcaba en rojo lo que se eliminaba y en azul lo que se movía. Estos cambios se transmitían a través de un e-mail en el que se enumeraban las alteraciones producidas desde la última actualización del modelo virtual.
- Los arquitectos comentaban las recientes modificaciones del modelo virtual en una reunión conjunta de 5 minutos.
- Para que el equipo supiera qué elementos estructurales estaban listos para su fabricación (y que por tanto no se podían tocar), la subcontrata de estructura metálica pasaba un modelo donde distinguía, en verde, lo que ya estaba preparado para ser construido; en amarillo, las zonas donde

estaban trabajando; y, en rojo, aquellas en las que el equipo podía modificar el detalle sin impactarles.

- Toda reunión tenía un responsable, un objetivo y finalizaba con una serie de obligaciones, cada una con su responsable y fecha de realización.
- Toda actuación que necesitase un plan se apartaba de la reunión principal tras haber asignado responsable y asistentes, para que estos pudieran reunirse más tarde a resolverlo. Sin responsable, estos trabajos no se hubiesen realizado.” (Ayats, 2015).

Nos ha parecido interesante citar este ejemplo, en el que se ve muy bien como estandarizar la forma de comunicar en el equipo es esencial para el progreso del proyecto.



Figura 3: Cathedral Hill Hospital en San Francisco (EE.UU.)

4. EL CONTRATO IPD, EXPRESIÓN DEL EQUIPO:

Para poder conseguir los objetivos de un buen trabajo colaborativo en equipo, es esencial que todas las partes se sientan cómodas con las condiciones contractuales pactadas, por eso vamos a analizar brevemente este tipo de contratos, que presentan unas características muy peculiares y cuyo adecuado ajuste va a determinar en buena medida el éxito del trabajo, y por ende del proyecto.

En efecto, en los comienzos de la aplicación en proyectos reales de la metodología en EE. UU., sobre el año 2.007, este fue un problema importante, la idea estaba en marcha, pero había que plasmar en un papel las reglas del juego de esta nueva forma de trabajar, y tras la experiencia desarrollada por la Compañía Sutter Health, pionera en la aplicación de la metodología, con el primer contrato Integrated Form of Agreement (IFOA) redactado por el abogado Will Lichtig, se preparó el primer contrato completo de IPD, que vio la luz con la colaboración de numerosas Instituciones: El American Institute of Architects (AIA), el Lean Construction Institute (LCI), la Associated General Contractors of America (AGC) y la compañía Sutter Health, este documento, que continúa sirviendo como base de los contratos IPD, es conocido como ConsensusDoc 300.

Posteriormente al AIA ha publicado su propio contrato IPD, basado en el anterior, incluso un despacho de abogados de California: Hanson Bridget LLP, a través de uno de sus socios, especialista en construcción, y en concreto en este tipo de contratos: Howard W. Ashcraft, ha desarrollado la materia con gran difusión en foros académicos y empresariales.

Estos tres son básicamente los contratos más utilizados en EE. UU. para IPD: El ConsensusDoc 300, el del AIA y el de Hanson Bridget LLP. En España en paralelo al conocimiento de esta forma de trabajar también se abre una buena posibilidad de desarrollo de contratos IPD adaptados a nuestra legislación, para aquellos despachos de abogados que se quieran incorporar a esta corriente.

Del mismo modo que la Metodología Colaborativa se aproxima al hecho constructivo de una forma totalmente diferente a la tradicional en nuestro país, los contratos que hay que redactar para llevarla a cabo, han de tener un enfoque distinto sobre los derechos y obligaciones de los intervinientes.

Suele decirse que en todo contrato lo primero es la negociación y después la redacción, pero en el caso que nos ocupa, es necesario partir de unos principios básicos sin los cuales el contrato no sería IPD, sino otra cosa, por ello es muy importante, como dijimos antes, que los intervinientes apoyen la metodología y crean en ella, que acepten esas condiciones básicas de entrada, y que a partir de las mismas construyan el contrato con las características específicas del proyecto a desarrollar.

Recordemos las condiciones que la definición de Integrated Project Delivery (IPD) del AIA establece en el año 2014:

“Es un método de entrega de un proyecto que integra a las personas, los sistemas, las estructuras de negocio y las prácticas, en un proceso que de forma colaborativa pone a trabajar los talentos y visiones de todos los participantes

para reducir las pérdidas y optimizar la eficiencia a través de todas las fases de diseño, fabricación y construcción.

El Método Integrated Project Delivery contiene, como mínimo todos los siguientes elementos:

- 1.- Implicación continua del propietario, así como de los diseñadores y constructores clave.
- 2.- Intereses de negocio alineados a través de un sistema compartido de riesgo/beneficio, incluyendo ganancias financieras por riesgo, que dependan de los resultados del proyecto.
- 3.- Control del proyecto conjunto del propietario, así como de los diseñadores y constructores clave.
- 4.- Contrato común entre todas las partes o con condiciones de participación obligatorias y específicas.
- 5.- Responsabilidad compartida por el propietario y los diseñadores y constructores” (AIA, 2014).

Estas son las condiciones mínimas que tiene que contener un contrato IPD, a partir de aquí empiezan las especificidades de cada caso.

Al igual que para potenciar los aspectos de organización, desarrollo y comunicación en el equipo hemos dicho que muchas veces se incorpora al mismo a alguien que, con conocimientos y experiencia en la materia, actúa como facilitador aunando voluntades en línea de lo que es realmente IPD, en lo que se refiere a la redacción del contrato esta figura puede alcanzar mucha relevancia aproximando criterios y mejorando las relaciones.

Tengamos en cuenta que, cuando se redacta el contrato IPD, todo es estimado, lo que se va a proyectar y se va a construir aún no se sabe de forma completa y por tanto el grado de incertidumbre es importante. Uno de los defectos que se le achacan a los Métodos Colaborativos es que por este motivo solo se puede arrancar así un proyecto con fondos propios, ya que las organizaciones financieras no quieren trabajar con incertidumbres, quieren conocer lo más posible aquello que van a financiar, una vez llegado el punto de comienzo de obra, con el proyecto definido, esto puede cambiar, pero no antes.

“Los objetivos generales de un contrato IPD son:

- Retirar los impedimentos, estimular la comunicación, la colaboración y la creatividad.
- Impulsar la participación temprana de los actores clave en el proyecto.
- Repartir los riesgos y las recompensas basado en los resultados del proyecto.

- Ejercer el control del proyecto de forma conjunta.
- Reducir la exposición a responsabilidades de los participantes.
- Desarrollar y validar los objetivos de forma conjunta.” (Ashcraft, 2011)

A estos objetivos el AIA añade uno más:

- “Toma de decisiones de forma colaborativa.” (AIA, 2014)

Lo cual es una generalización en cuanto a la forma de estos contratos, por lo que Howard W. Ashcraft no lo ha considerado, no obstante, sí que parece un enfoque interesante, ya que abarca la totalidad del proceso, no solo al control y los objetivos.

Los aspectos que Howard W. Ashcraft (2011) considera como conflictivos en la negociación de estos contratos son aquellos relativos a las especificidades de cada proyecto, en concreto:

- “Dimensiones del proyecto.
- Alcance del proyecto.
- Forma en la que se va a gestionar el proyecto y como se hará la toma de decisiones.
- Compensaciones.
- Fijación de Objetivos.
- Contingencias y su ajuste a los objetivos.
- Costes permitidos y beneficios.
- Medición del progreso del proyecto.
- Gestión de riesgos”

Por ejemplo, el ConsensusDoc 300 favorece la toma de decisiones por consenso, y en caso de empate que la opinión dirimente sea la de la propiedad, pero hay otros modelos que prefieren no dar ese poder a la propiedad para no lastrar la gestión del proyecto.

En cuanto a la fijación de objetivos, una técnica que suele venir asociada a los contratos IPD es establecer con carácter previo un Coste Objetivo o hacer Diseño de Coste Objetivo, en inglés: Target Value Design (TVD). Consiste en someter el diseño a ese Coste Objetivo y no desviarse del mismo a lo largo de todo el desarrollo del proyecto, para ello utiliza una continua evaluación de alternativas e implicaciones que pueden influenciar al presupuesto a partir del diseño y se ayuda de forma permanente de la metodología BIM, que permite optimizar esta labor. Se trata de entregar el mayor valor posible al cliente dentro de un coste máximo prefijado e inamovible a lo largo del desarrollo del proyecto.

Por lo que atañe a los costes permitidos y beneficios, suele establecerse un presupuesto base de costes necesarios para todos los actores (cada uno el suyo), un margen para posibles imprevistos que pudieran surgir, si bien utilizando el control TVD para que este margen sea mínimo y unos beneficios adecuados

para todos los intervinientes, en función de la consecución o no de los objetivos del proyecto. En un proyecto IPD se busca recompensar la eficiencia y castigar la ineficiencia.

Dado que IPD es un método basado en la colaboración y la confianza entre los miembros del equipo, aquellos consultores que trabajen para los técnicos componentes del “core team”, y subcontratistas de la empresa constructora que se elijan, también deberían integrarse en esta forma de trabajar y hacerlo de forma colaborativa con las otras partes del equipo, para que la aplicación de la metodología sea completa.



Figura 4: Esquema de IPD (Pons, 2014)

Obviamente IPD trae nuevos conflictos o gestiona los conflictos tradicionales en la construcción de otra manera, no es una panacea, para poder tener éxito al negociar un acuerdo IPD, todos los miembros del equipo tienen que entenderlo desde el principio perfectamente desde un punto de vista tanto teórico como práctico.

“Investigadores de la Universidad de British Columbia, Universidad de Washington y Scan Consulting, liderados por Renée Cheng, han completado recientemente un estudio en profundidad de 10 proyectos Lean IPD (Cheng, et.al., 2016). Los investigadores intentaban determinar si se mejoraba con el IPD, llegando a la conclusión, basados en su propia investigación, y en la hecha por otros, que la metodología Lean IPD produce mejores resultados en la entrega de proyectos logrando un costo y un plazo de entrega por debajo de los del mercado

y que los proyectos estudiados respondían a este resultado. Aunque el estudio fue limitado en el número de proyectos IPD examinados, ofrece el examen más detallado de proyectos IPD, hecho hasta la fecha.” (Fischer, Aschcraft, Reed y Khanzode, 2017).

En el Reino Unido hace muchos años que diversos investigadores propusieron fórmulas de mejora en el proceso constructivo británico, mediante el trabajo en equipo, en líneas similares a lo que hemos estado definiendo como Métodos Colaborativos o IPD. El Informe Latham del año 1.994, ya preconizaba estas técnicas, que fueron desarrolladas con mayor profundidad y aproximación a las fórmulas aplicadas en EE. UU. en el Informe Egan de 1.998. En base a estos Informes el Dr. David Mosey redactó el primer contrato colaborativo que se hizo público en ese país: El PPC2000, que influyó mucho en el ConsensusDoc 300, y eso considerando que en la época en que fue redactado, BIM no tenía el desarrollo e implantación que tiene hoy en día, y no se podía pensar en las ventajas que su utilización iba a traer para la aplicación de estas técnicas.

En Australia y en los países nórdicos, como Finlandia, Dinamarca y Noruega están trabajando también en base a Métodos Colaborativos y redactan contratos adaptados a la legislación y a las costumbres de cada uno de estos países, pero partiendo de los principios básicos que antes hemos enunciado. Las técnicas colaborativas en construcción ofrecen mucho mejores resultados que los métodos tradicionales y de ahí el incremento de su implantación en todo el mundo. En España del mismo modo que se está avanzando en la adopción de BIM, se debe trabajar en el conocimiento y aplicación de IPD para mejorar nuestros resultados en la industria de la construcción.

5. CONCLUSIONES

- IPD se basa en un buen funcionamiento del equipo.
- Este buen funcionamiento, a su vez, se basa en La comunicación, la claridad y la consistencia.
- Es fundamental que los miembros del equipo IPD crean en la metodología y tengan voluntad de integración y de colaboración.
- La incorporación temprana de los miembros del “core team” es esencial para el desarrollo futuro del proyecto.
- Es conveniente incorporar al equipo, desde el principio, a un facilitador IPD que lo motive y contribuya a alcanzar sus objetivos, también que lo mantenga alineado con la metodología y con buena preparación en la misma.
- En un equipo IPD tiene que primar la confianza y la transparencia.
- Un equipo IPD tiene que tener unos objetivos claros y concretos.

- Un gran ayuda es trabajar con BIM, que permite la mejor información para todos los miembros del equipo y considerar la construcción como un conjunto de procesos.
- Es importante la estabilidad del equipo en el tiempo, así como el trabajo cara a cara en “big room”.
- La comunicación y la información entre los miembros del equipo tiene que ser clara, permanente y completa, utilizando un sistema “open books”.
- La buena planificación requiere buena información.
- El contrato que vincula a todas las partes es esencial para desarrollar un verdadero IPD.
- Todas las partes tienen que sentirse cómodas con las condiciones contractuales pactadas. El facilitador IPD tiene una gran labor que hacer en este campo, tanto al principio del proyecto como a lo largo del mismo

Todos estos principios tienen que ser aplicados en los equipos IPD, con las particularidades que tiene la construcción y son la base de que la metodología funcione correctamente, los equipos los constituyen las personas y solo con una implicación adecuada de todos sus miembros puede salir adelante el proyecto.

“We make people before we make cars”

“Hacemos personas antes de hacer coches”

Fujio Chó

(Presidente de Toyota Motor Corporation 1999-2005)

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Madrid 19 de Febrero de 2018



CÓMO CREAR Y GESTIONAR UN EQUIPO PARA APLICAR MÉTODOS COLABORATIVOS EN CONSTRUCCIÓN (IPD) EN ESPAÑA

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Madrid 8 de Marzo de 2018

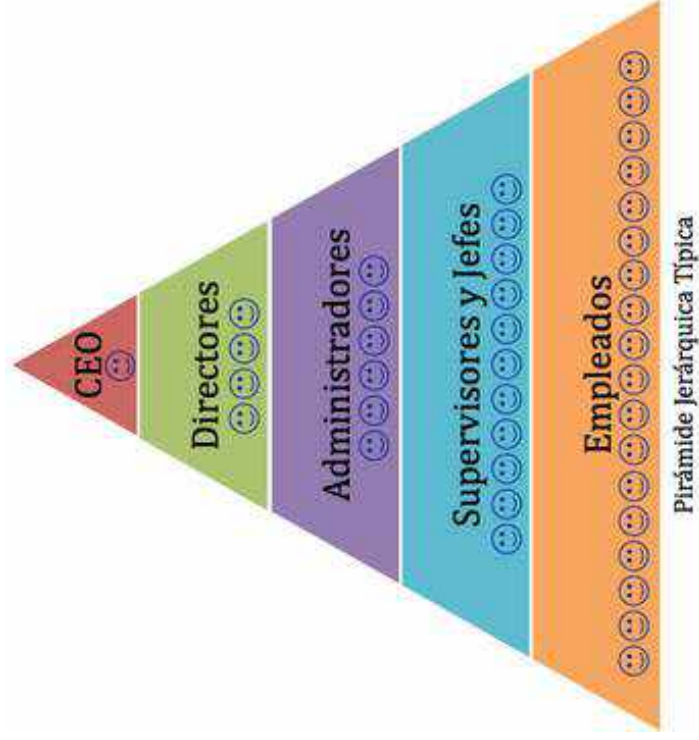


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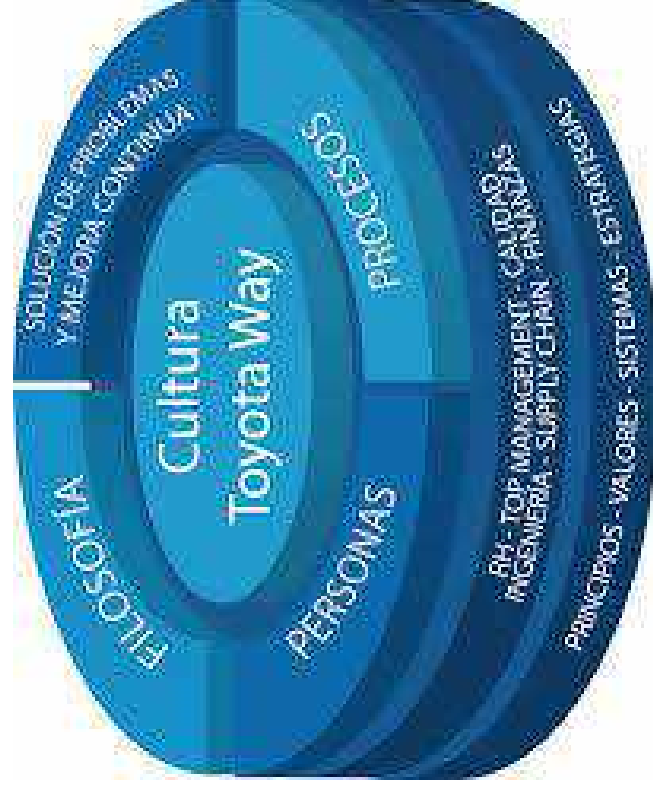
- 1.- INTRODUCCIÓN A MÉTODOS COLABORATIVOS, INTEGRATED PROJECT DELIVERY (IPD).
- 2.- ¿QUÉ SIGNIFICAN Y EN QUÉ CONSISTEN LOS EQUIPOS IPD?
- 3.- LA PREPARACIÓN DEL EQUIPO.
- 4.- LA COMUNICACIÓN, UN ARMA PODEROSA.
- 5.- EL CONTRATO IPD, EXPRESIÓN DEL EQUIPO.
- 6.- CONCLUSIONES.

LA GESTIÓN

MÉTODO TRADICIONAL



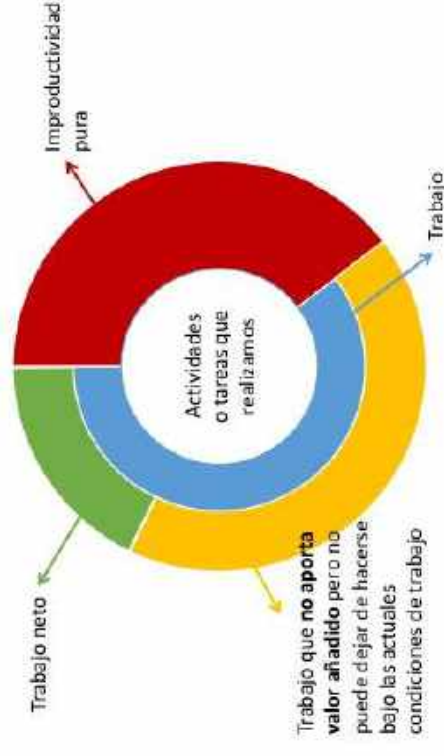
THE TOYOTA WAY



1.- INTRODUCCIÓN A MÉTODOS COLABORATIVOS, INTEGRATED PROJECT DELIVERY (IPD)

LEAN CONSTRUCTION

EL CÍRCULO DE LA IMPRODUCTIVIDAD



El Círculo de la Improductividad. Fuente: Introducción a Lean Construction, Juan Felipe Pons, Fundación Laboral de la Construcción, 2014

1.- INTRODUCCIÓN A MÉTODOS COLABORATIVOS, INTEGRATED PROJECT DELIVERY (IPD)

LA CONSTRUCCIÓN EN LA ACTUALIDAD EN ESPAÑA

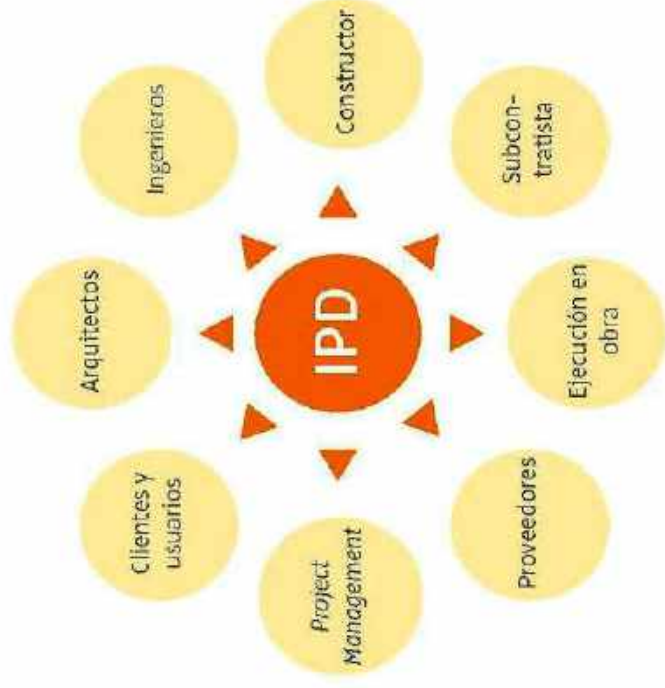
- Proyecto- Concurso-Construcción un foco interminable de conflictos.
- Establecimiento de remuneraciones y responsabilidades enfrentadas entre los diversos agentes intervinientes.
- Inadecuación de la Legislación en materia de construcción permitiendo solamente actuar de este modo.
- Obsolescencia en los métodos de trabajo en construcción que redundan en la ineficacia del proceso constructivo.
- Ineficacia es despilfarro.



LA ALTERNATIVA: MÉTODOS COLABORATIVOS

- La Construcción como un esfuerzo colaborativo de los agentes intervinientes con una meta única.
- Remuneraciones y responsabilidades compartidas entre todos.
- Necesaria adecuación de la Legislación en materia de Construcción abriéndose a nuevas posibilidades.
- Puesta al día de los métodos de trabajo en Construcción que redundará en una mayor eficacia del proceso constructivo.
- Eficacia es ahorro.

INTEGRATED PROJECT DELIVERY



Esquema de IPD. Fuente: Introducción a Lean Construction, Juan Felipe Pons, Fundación Laboral de la Construcción, 2014

1.- INTRODUCCIÓN A MÉTODOS COLABORATIVOS, INTEGRATED PROJECT DELIVERY (IPD)

3^{er} CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN



DEFINICIÓN

El AMERICAN INSTITUTE OF ARCHITECTS (AIA) ha actualizado en 2014 su definición de IPD respecto a la publicada en 2007:

“ Es un método de entrega de un proyecto que integra a las personas, los sistemas, las estructuras de negocio y las prácticas, en un proceso que de forma colaborativa pone a trabajar los talentos y visiones de todos los participantes para reducir las pérdidas y optimizar la eficiencia a través de todas las fases de diseño, fabricación y construcción.

El Método Integrated Project Delivery contiene, como mínimo todos los siguientes elementos:

- 1.- Implicación continua del propietario, así como de los diseñadores y constructores clave.*
- 2.- Intereses de negocio alineados a través de un sistema compartido de riesgo/beneficio, incluyendo ganancias financieras por riesgo, que dependen de los resultados del proyecto.*
- 3.- Control del proyecto conjunto del propietario así como de los diseñadores y constructores clave.*
- 4.- Contrato común entre todas las partes o con condiciones de participación obligatorias y específicas.*
- 5.- Responsabilidad compartida por el propietario y los diseñadores y constructores clave”*

1.- INTRODUCCIÓN A MÉTODOS COLABORATIVOS, INTEGRATED PROJECT DELIVERY (IPD)



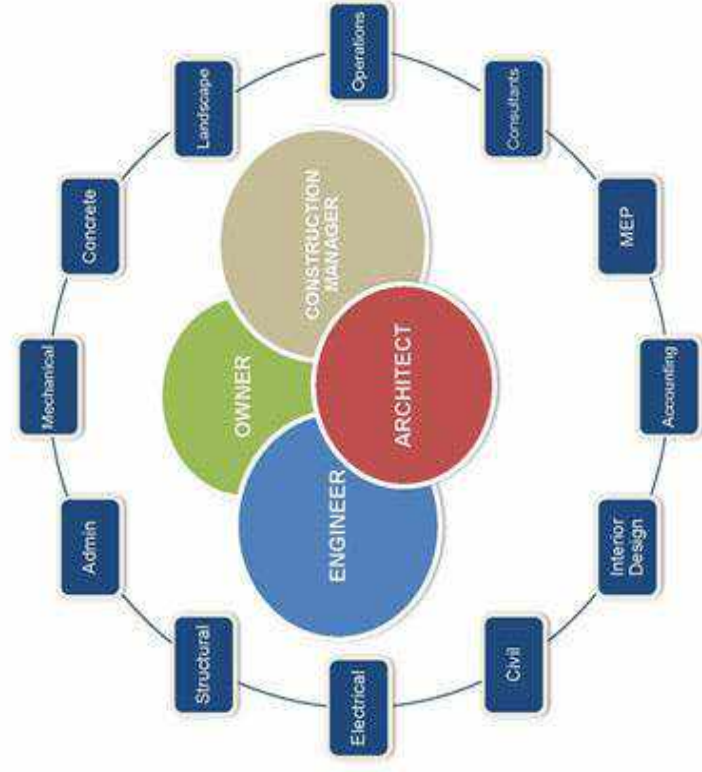
“El trabajo en equipo es la habilidad para trabajar juntos hacia una visión común. La habilidad de dirigir logros individuales hacia objetivos organizacionales. Es el combustible que permite a la gente común conseguir resultados poco comunes.”

Andrew Carnegie

-Industrial, empresario y filántropo estadounidense oriundo de Escocia, Reino Unido (1835-1919)-

2.- ¿QUE SIGNIFICAN Y EN QUE CONSISTEN LOS EQUIPOS IPD?

3^{er} CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN



INTEGRATED PROJECT ORGANIZATION

Integrated Project Delivery como el esfuerzo colectivo de un equipo coordinado para el desarrollo del proyecto (SSA Engineers, Prahadevi, Mumbai, 2009)

2.- ¿QUÉ SIGNIFICAN Y EN QUÉ CONSISTEN LOS EQUIPOS IPD

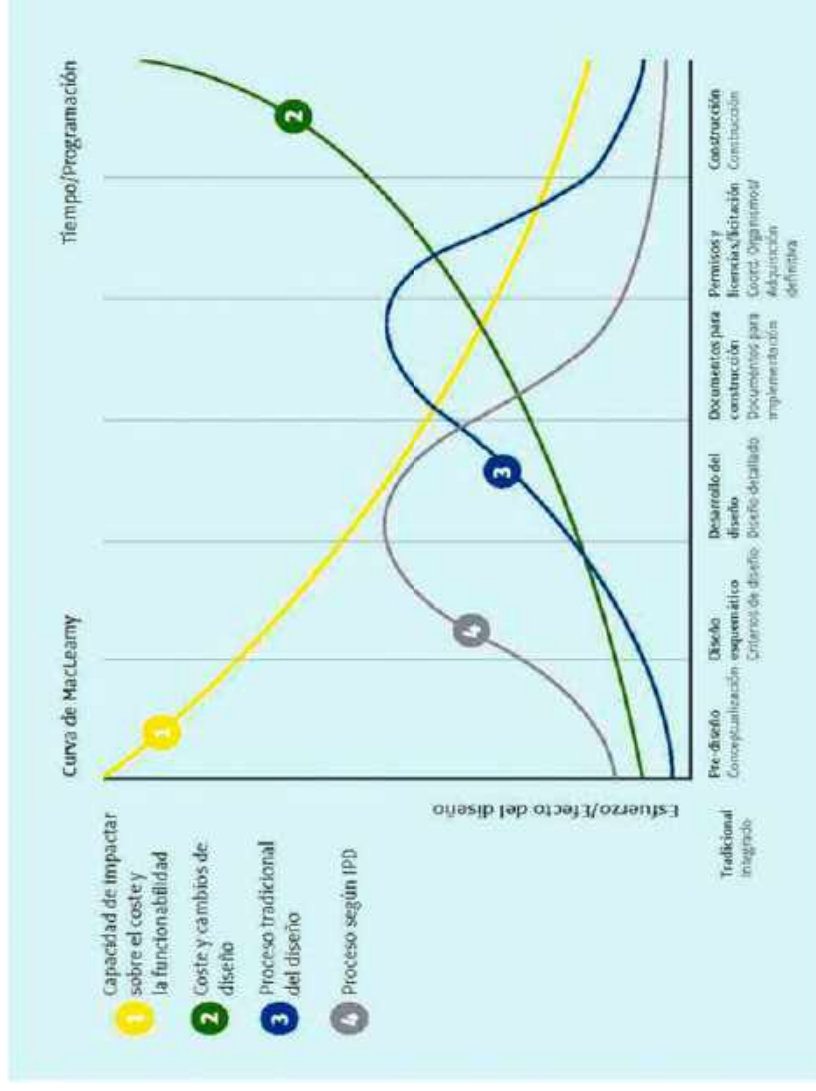
PRINCIPIOS BÁSICOS

- Sin equipo IPD no funcionaría.
- “La gestión no es un trabajo de supervisión sino de liderazgo”.
Deming W. Edwards, 1982
- La buena preparación es necesaria para una gestión eficaz del equipo.
- Para el éxito de un equipo IPD, sus componentes deben creer realmente en la metodología.
- La información y la comunicación son fundamentales para mantener motivado al equipo.
- El equipo debe permanecer en todo momento alineado con los objetivos del proyecto.

3er CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN



INCORPORACIÓN TEMPRANA



Curva de MacLeamy. Adaptado de "Integrated Project Delivery: A Guide" (AIA, 2007). Fuente: *Introducción a Lean Construction*, Juan Felipe Pons, Fundación Laboral de la Construcción, 2014

3.- LA PREPARACIÓN DEL EQUIPO



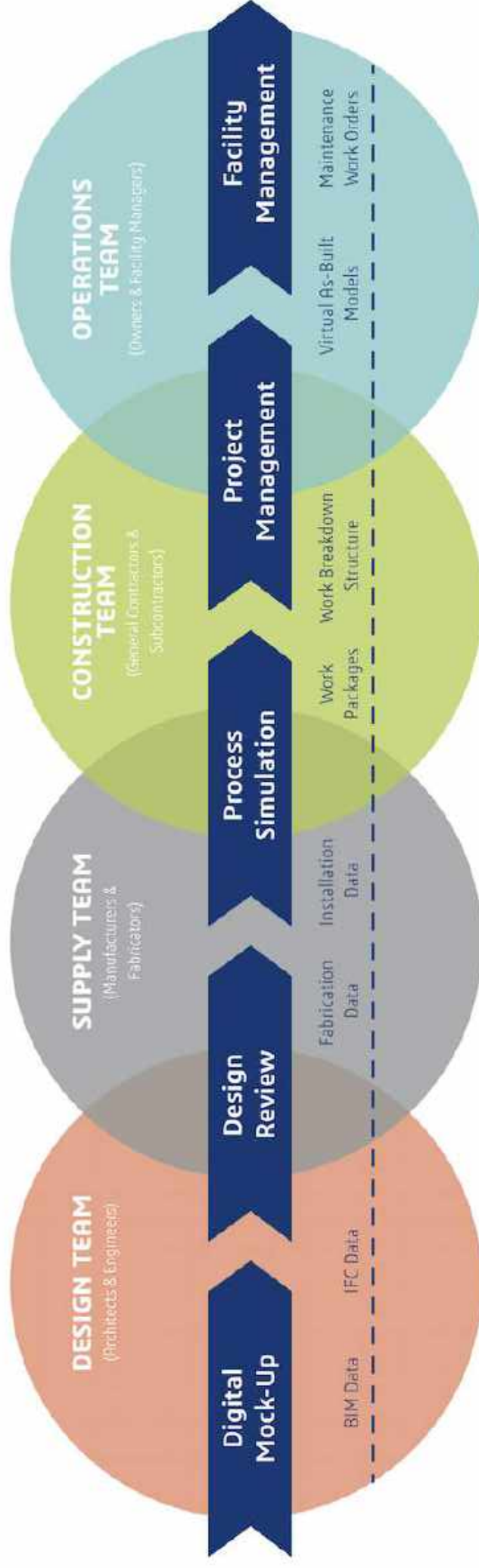
FUNCIONES PRINCIPALES DEL “CORE TEAM”

- “Establecimiento de los Objetivos del Proyecto.
- Provisión y localización de los recursos.
- Supervisión financiera.
- Seleccionar a los miembros de los Equipos funcionales.
- Tutoría de los miembros del equipo.
- Administración de contratos (órdenes de trabajo, correcciones etc.).
- Resolución de conflictos.”

3^{er} CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN



LA AYUDA DE BUILDING INFORMATION MODELING (BIM)



© DASSAULT SYSTÈMES S.A.

Building Information Modelling (BIM) Benefits, Dassault Systèmes, 2014

3.- LA PREPARACIÓN DEL EQUIPO

APRENDER DE NUESTRAS DERROTAS: LA BATALLA DE TRAFALGAR



“Inglaterra espera que cada hombre haga su trabajo” Almirante Nelson a su flota antes de la Batalla de Trafalgar, Cádiz, España, 1805

3.- LA PREPARACIÓN DEL EQUIPO

UN EQUIPO NO PRODUCE RESULTADOS EXTRAORDINARIOS POR MAGIA



I have no question that when you
have a team, the possibility exists
that it will generate magic,
producing something extraordinary
But don't count on it.

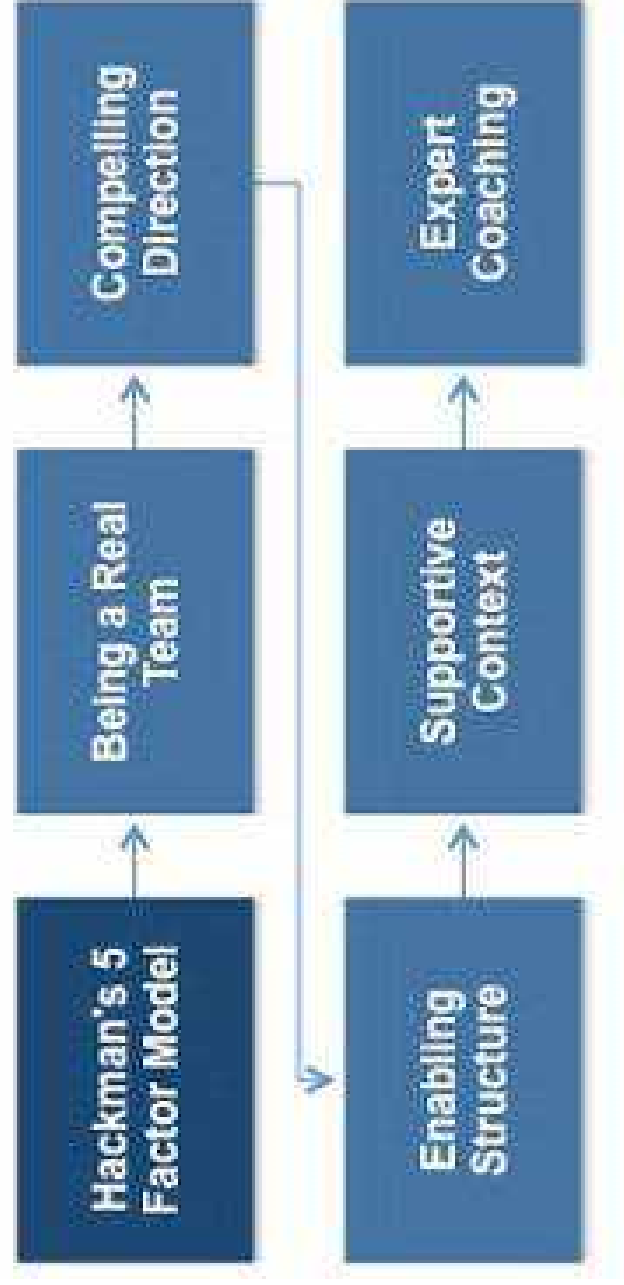
— *J. Richard Hackman* —

AZQUOTES

Hackman J. Richard, 2002

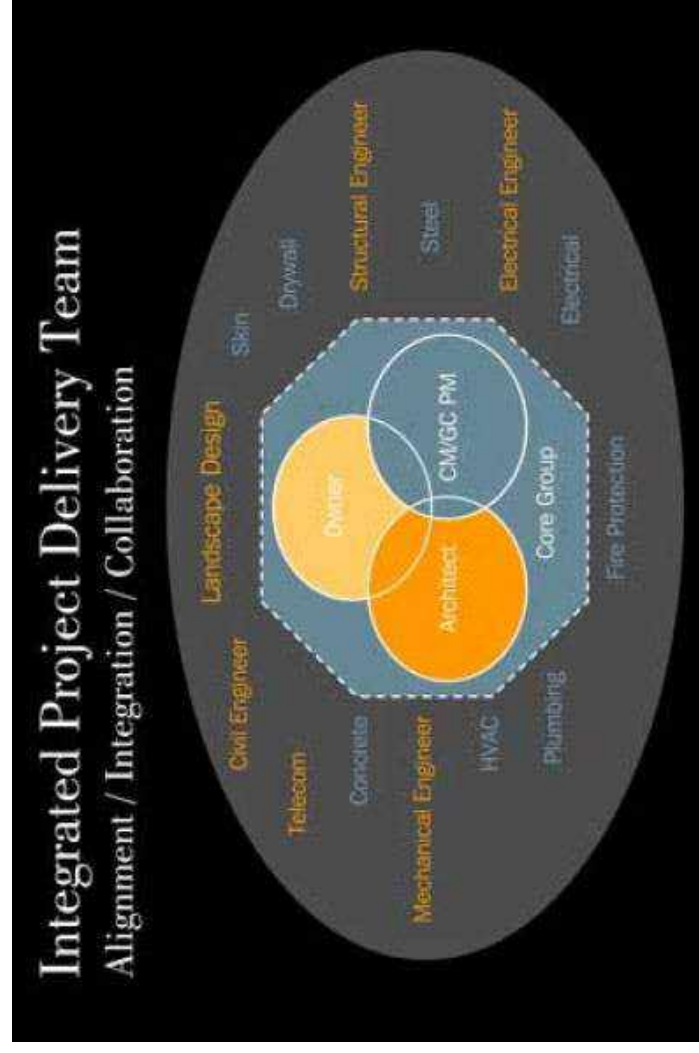
3.- LA PREPARACIÓN DEL EQUIPO

LAS CONDICIONES DE UN VERDADERO EQUIPO



Hackman J. Richard, 2008

EL EQUIPO IPD: ALINEADO, INTEGRADO, COLABORATIVO



Tracy Carbasho, TRADELINE, 2008

3.- LA PREPARACIÓN DEL EQUIPO



LA COMUNICACIÓN COMO INCREMENTO DE LA COORDINACIÓN DEL EQUIPO

- Traslado regular y completo de TODA la información del proyecto disponible a TODOS los miembros del equipo.
- Utilizando para ello tantos medios informáticos como notas o carteles en lugares comunes de paso.
- La comunicación debe realizarse en un clima de confianza y transparencia entre los miembros del equipo
- Abandonar la reserva de información para poder “engañar” al otro, tan característica en España.
- Trabajar en “Big Room”.

RESOLUCIÓN DE CONFLICTOS EN EL EQUIPO: REPORTE A3

Reporte A3

Informe A3	
1 Definición del Problema	5 Plan de Acción
2 Situación Actual	6 Seguimiento
3 Análisis de las Causas	7 Resultados
4 Situación Objetivo	

Reporte A3

4.- LA COMUNICACIÓN, UN ARMA PODEROSA

**3^{er} CONGRESO INTERNACIONAL DE INNOVACIÓN
TECNOLÓGICA EN EDIFICACIÓN**



TRABAJO EN BIG ROOM, LA COMUNICACIÓN DE TODA LA INFORMACIÓN



Mike Purdy, 2009

4.- LA COMUNICACIÓN, UN ARMA PODEROSA

**3^{er} CONGRESO INTERNACIONAL DE INNOVACIÓN
TECNOLÓGICA EN EDIFICACIÓN**



EJEMPLO DE EDIFICIO DESARROLLADO CON IPD



Cathedral Hill Hospital, San Francisco, EE.UU., 2012

4.- LA COMUNICACIÓN, UN ARMA PODEROSA



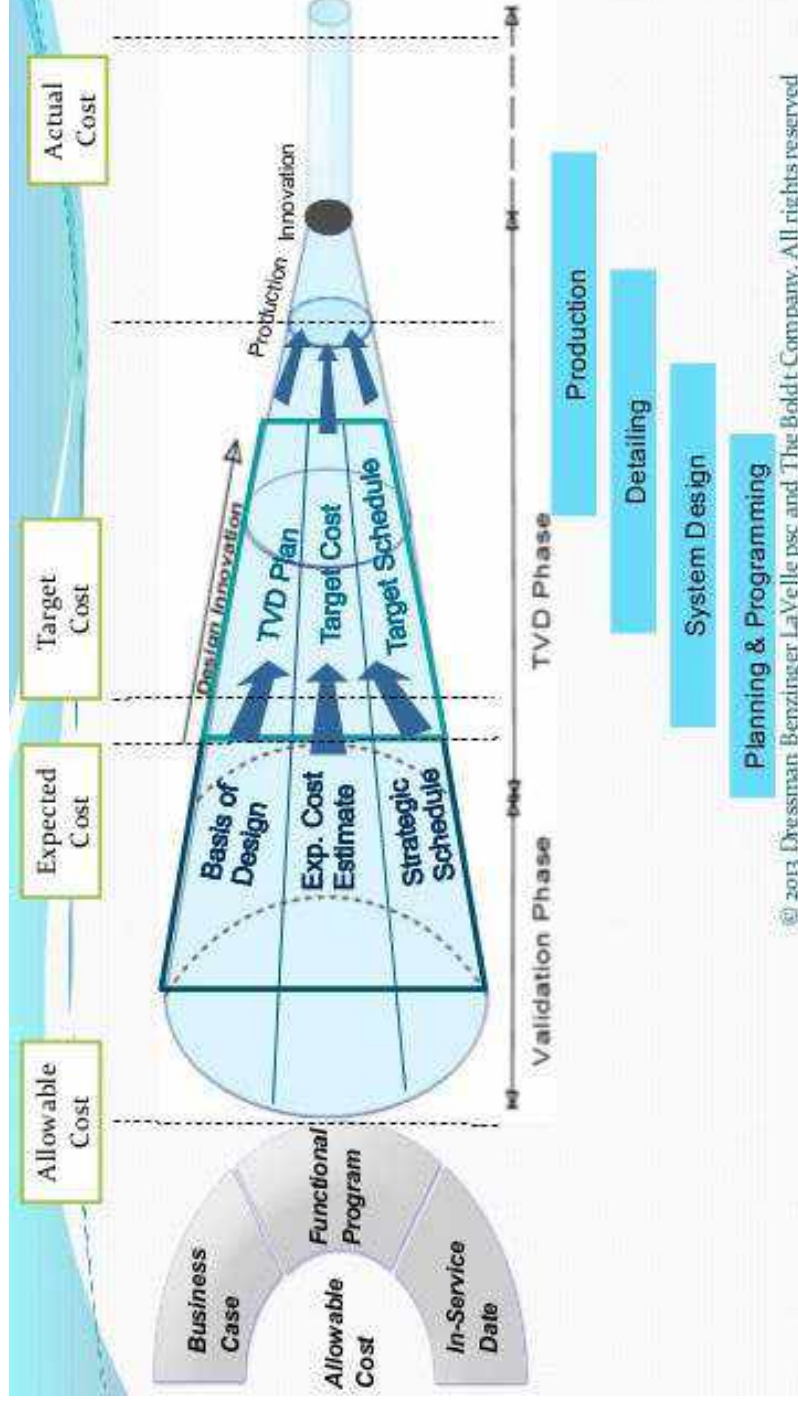
OBJETIVOS GENERALES DE UN CONTRATO IPD

- “Retirar los impedimentos, estimular la comunicación, la colaboración y la creatividad.
- Impulsar la participación temprana de los actores clave en el proyecto.
- Repartir los riesgos y las recompensas basado en los resultados del proyecto.
- Ejercer el control del proyecto de forma conjunta.
- Reducir la exposición a responsabilidades de los participantes.
- Desarrollar y validar los objetivos de forma conjunta.”
- “Toma de decisiones de forma colaborativa.”

Ashcraft H.W., 2011

AIA, 2014

FIJACIÓN DE OBJETIVOS DEL PROYECTO: TARGET VALUE DESIGN



Dressman Benzinger LaVelle psc y The Boldt Company, 2013

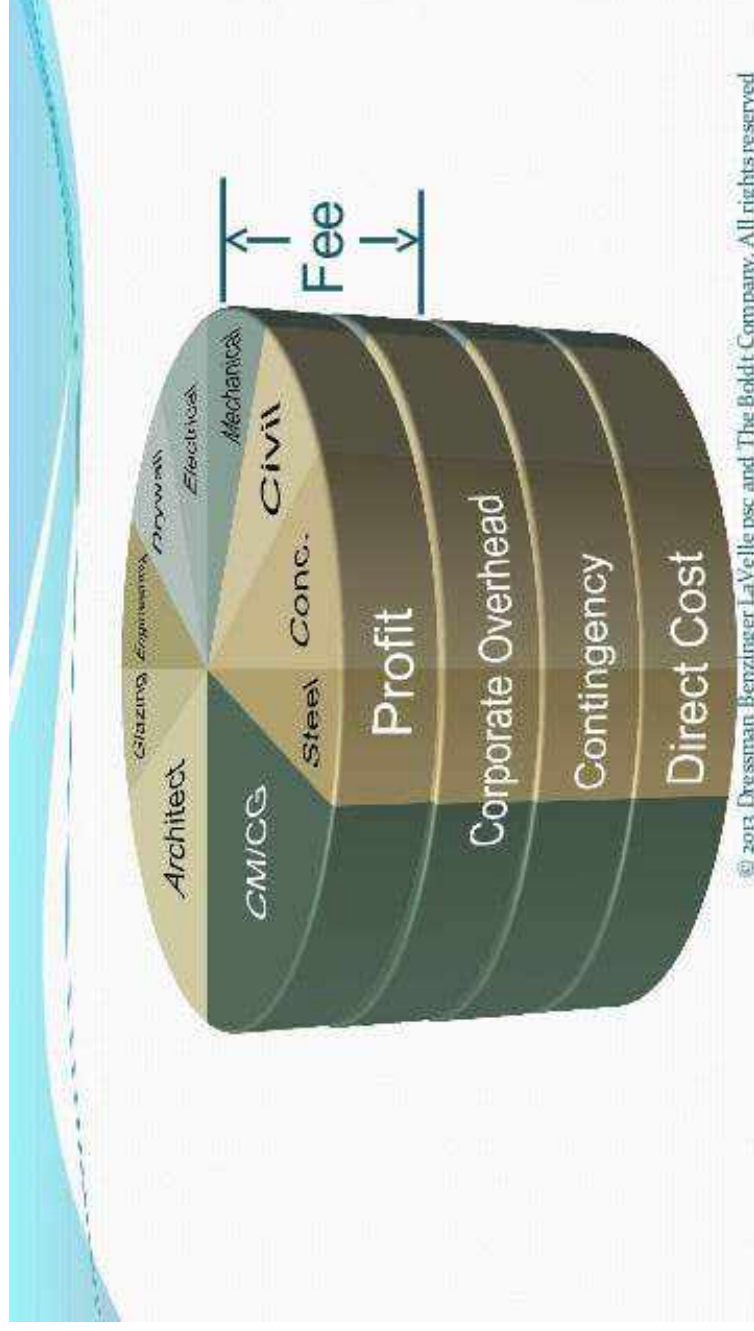
5.- EL CONTRATO IPD, EXPRESIÓN DEL EQUIPO



EVOLUCIÓN DE LOS CONTRATOS IPD

- Primer contrato Integrated Form of Agreement (IFOA).
Will Lichtig para Sutter Health, 2007.
- ConsensusDoc 300.
Sutter Health, Lean Construction Institute (LCI), American Institute of Architects (AIA) y Associated General Contractors (AGC), 2008.
- Hanson Bridgett LLP.
Howard W. Ashcraft, 2012
- IPD An updated working definition.
American Institute of Architects, California Council, 2016

ESQUEMA DE UN CONTRATO IPD



Dressman Benzinger LaVelle psc y The Boldt Company, 2013

5.- EL CONTRATO IPD, EXPRESIÓN DEL EQUIPO



CONCLUSIONES 1

- IPD se basa en un buen funcionamiento del equipo.
- Este buen funcionamiento, a su vez, se basa en La comunicación, la claridad y la consistencia.
- Es fundamental que los miembros del equipo IPD crean en la metodología y tengan voluntad de integración y de colaboración.
- La incorporación temprana de los miembros del “core team” es esencial para el desarrollo futuro del proyecto.



CONCLUSIONES 2

- Es conveniente incorporar al equipo, desde el principio, a un facilitador IPD que lo motive y contribuya a alcanzar sus objetivos, también que lo mantenga alineado con la metodología y con buena preparación en la misma.
- En un equipo IPD tiene que primar la confianza y la transparencia.
- Un equipo IPD tiene que tener unos objetivos claros y concretos.
- Un gran ayuda es trabajar con BIM, que permite la mejor información para todos los miembros del equipo y considerar la construcción como un conjunto de procesos.
- Es importante la estabilidad del equipo en el tiempo, así como el trabajo cara a cara en “big room”.



CONCLUSIONES 3

- La comunicación y la información entre los miembros del equipo tiene que ser clara, permanente y completa, utilizando un sistema “open books”.
- La buena planificación requiere buena información.
- El contrato que vincula a todas las partes es esencial para desarrollar un verdadero IPD.
- Todas las partes tienen que sentirse cómodas con las condiciones contractuales pactadas. El facilitador IPD tiene una gran labor que hacer en este campo, tanto al principio del proyecto como a lo largo del mismo.



CONCLUSIONES 5

Los equipos los constituyen las personas y solo con una implicación adecuada de todos sus miembros puede salir adelante el proyecto.

“Hacemos personas antes de hacer coches”

Fujio Chó

-Presidente de Toyota Motor Corporation, 1999-2005-



MUCHAS GRACIAS

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³Eugenio Pellicer 3^{er}Autor;

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SUPERIOR DE INGENIEROS DE CAMINOS, CANALES Y PUERTOS,
UNIVERSITAT POLITÈCNICA DE VALÈNCIA.*

Madrid 8 de Marzo de 2018



III Congreso Internacional
de Innovación Tecnológica
en Edificación - CITE2018

CERTIFICADO OTORGADO A:

D. Miguel Ángel Álvarez Pérez

por su participación como PONENTE con la comunicación:
HOW TO CREATE AND MANAGE A TEAM TO APPLY COLLABORATIVE
METHODS IN CONSTRUCTION (IPD) IN SPAIN

III CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN
(III International Conference on Technological Innovation in Building)
CITE2018

celebrado en la Escuela Técnica Superior de Edificación de la Universidad Politécnica de Madrid,
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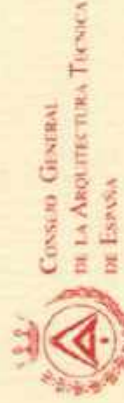
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Madrid, a 11 de septiembre de 2018

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Madrid 11th of September, 2018

*D^a. Asunción Gómez Pérez, Vicerrectora de Investigación, Innovación y Doctorado de la Universidad Politécnica de Madrid,
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Fuente: Miguel-Angel Alvarez-Perez

**Project Management Institute: Newtown Square, PA,
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2007 hasta 2008 | Project Management Professional (PMP)

Fuente: Miguel-Angel Alvarez-Perez

**Universidad Politécnica de Madrid: Madrid,
Comunidad de Madrid, España**

1968 hasta 1974 | Master Architect & Urban Planner (Escuela Técnica Superior de Arquitectura)

Fuente: Miguel-Angel Alvarez-Perez

Empleo (1)

**ag arquitectura sa: Madrid, Comunidad de Madrid,
España**

1989 hasta 2018 | CEO & Founder

Fuente: Miguel-Angel Alvarez-Perez

Obras (1 of 1)

Target value design a different way of approaching the constructive process in Spain

Journal of Modern Project Management

2018 | journal-article

DOI: 10.19255/JMPM01505

EID: 2-s2.0-85040999222

Fuente: Scopus to ORCID

Reviewer Recommendation and Comments for Manuscript Number TJCM-2019-0089

Procurement and its influence on construction risk and success in the UK: subcontractors’ perspective

Original Submission

Miguel-Angel Alvarez-Perez, Ms.Architect & Urban Planner **Reviewer 2**

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Recommendation: **Minor Revision**

Custom Review Question(s)

Would you be willing to review a revision of this manuscript?

Response

Yes

Reviewer Blind Comments to Author:

- 1.- Really does the author think, with all the examples that he introduces, and the vast experience that exist in the matter, the approach of collaborative methodologies is still immature?
- 2.- Why if the study refers to the UK the author uses data from China and Malaysia?
- 3.- From 15 June and 1 July it seems to be very few days for a such extended study.
- 4.- It is very strange to put at the same level client satisfaction, which is a global concept, than health and security for example, and others like this. I think that should be better to classify them differently.
- 5.- Health and Safety was already treated before, why this repetition?
- 6.- It is very interesting the author comment that projects with Target Cost increase collaboration, May be treated in a bigger extension?
- 7.- It is very interesting that all the participants must consider collaboration as a key factor to improve construction process. Could it be treated with bigger extension?
- 8.- Meng,2012, is a good cite about collaboration!
- 9.- The author explains the results of the interviews, but we don ’t know neither the questions nor the answers of people interviewed. It should be interesting to know more about this.

Reviewer Confidential Comments to Editor:

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9.2.4.- Curso 2018-2019:



9.4.- Curso 2018-2019:

9.4.1 Publicaciones

15-06-2019

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Título “Una Mejora en la Planificación de la Construcción en España: El Sistema del Último Planificador (Last Planner System ®)”.

Coautores: Manuel Soler Severino y Eugenio Pellicer Armiñana.

9.4.2 Congresos

6,7,8-03-2019

Asisto como ponente al IV Congreso de Innovación Tecnológica en la Edificación, CITE 2019, celebrado en la ETSEM, UPM. Título de la Ponencia: “An Improvement in Construction Planning: Last Planner System”

Coautores: Manuel Soler Severino y Eugenio Pellicer Armiñana.

18-12-2018

Asisto en Valladolid al Congreso BIMTECNIA 2018 “BIM en Negativo” como asistente. Celebrado en el Centro de Congresos de Valladolid. Título de la ponencia: “El IPD de la Sede de la Fundación Laboral de la Construcción”.

28-02-2019

Asisto como ponente a la Mesa Redonda del Capítulo de Madrid del Project Management Institute. Título de la ponencia: “Aplicación de Metodologías Ágiles en el Sector de la Construcción”.

18-07-2019

Asisto como ponente a la Presentación en la Reunión Mensual de Socios del Capítulo de Madrid del Project Management Institute. Título de la ponencia: “Los Métodos de Trabajo Colaborativos en los Proyectos de Construcción (Integrated Project Delivery)”.

9.4.3 Actividades de la UPM

29-01-2019



Asisto como alumno a una clase recibida en el Ciclo de Apoyo al Doctorado y la Investigación 2018-2019 de la Subdirección de Investigación y Doctorado de la ETSAM (UPM). Título: “Investigar y publicar, Revistas Académicas, Bases de Datos e Índices de Impacto”. Profesor: Álvaro Sevilla Buitrago.

08-09-10-05-2019

Asisto y presento Ponencia en el Simposium de la UPM “Cuéntanos tu Tesis”

9.4.4 Índices de Calidad

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An improvement in construction planning: Last Planner System ®

Una mejora en la planificación de la construcción: el sistema del último planificador

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For approximately five years, the Last Planner System ® has been used more and more in Spain, due to the improvement that its use produces in the productivity of the construction, reaching, with its use, better results in the achievement of the objectives of: Cost, time and quality of the projects. But still it is necessary its knowledge and diffusion so the application of this System will be normal in all our works. It was Professors Glenn Ballard and Greg Howell of the University of Berkeley in California, United States, who in the early 90s of the last Century investigated a form of planning of the work that, within the Lean Construction philosophy, were more appropriate with the special characteristics of the construction process. Lean Construction contributes with numerous associate techniques to improve the constructive process, and one of them is Last Planner System ®. In this paper we will do a quick revision of the state of art related with Planification Methodologies which have been used in construction during last and present centuries, to conclude that Last Planner System ® represents a considerable improvement in relation with previous Systems. It is an opinion and reveal paper to promote the knowledge and use of this System in Spanish Construction with greatest interest.

Planning; Last Planner System ®.

Desde hace aproximadamente cinco años, se está utilizando cada vez más en España el Sistema del Último Planificador (Last Planner System ®), debido a la mejora que su utilización produce en la productividad de la construcción, alcanzándose, con su uso, mejores resultados en la consecución de los objetivos de: Coste, plazo y calidad de los proyectos. Pero aún es necesario su conocimiento y difusión para que la aplicación de este Sistema se extienda a todas nuestras obras. Fueron los Profesores Glenn Ballard y Greg Howell de la Universidad de Berkeley en California, Estados Unidos, quienes a principios de los años 90 del pasado Siglo investigaron sobre una forma de planificación de obra que, dentro de la filosofía Lean Construction, fuera más acorde con las especiales características del proceso constructivo. La Construcción sin Pérdidas (Lean Construction) aporta numerosas técnicas asociadas para mejorar el proceso constructivo, y una de ellas es el Sistema del Último Planificador. En este artículo haremos una rápida revisión del estado del arte en cuanto a Métodos de Planificación que se han usado en construcción en el pasado Siglo y en el presente, para concluir que el Sistema del Último Planificador representa una mejora considerable con respecto a los anteriores Sistemas. Se trata de un artículo de opinión y divulgación para fomentar el conocimiento y uso de este Sistema en la construcción española con mayor intensidad.

Planificación; Sistema del Último Planificador; Last Planner System ®.

1. EL NACIMIENTO DE LAST PLANNER SYSTEM ®

Tras los estudios, antes mencionados de los Profesores Glenn Ballard y Greg Howell de la Universidad de Berkeley en California, Estados Unidos, en los años 90 del pasado Siglo, y de su conocimiento del Profesor Lauri Koskela, de la Universidad de Helsinki, Finlandia, estos trabajos se formalizaron en artículos científicos dentro del Lean Construction Institute, que fundaron conjuntamente.

1. THE BIRTH OF LAST PLANNER SYSTEM ®

After the studies by Professors Glenn Ballard and Greg Howell of the University of California at Berkeley, United States in the 90s of the last Century, and their knowledge of Professor Lauri Koskela, of the University of Helsinki, Finland, these works were formalized in scientific articles within the Lean Construction Institute, which they founded together.

En el año 2000, el Profesor Glenn Ballard presentó su Tesis Doctoral en la Universidad de Birmingham (Reino Unido), titulada: "The Last Planner System of Production Control" (El Sistema del Último Planificador de Control de la Producción), en la que da forma definitiva a la metodología, con muchos puntos en común con el Ciclo de Deming: Plan, Do, Check, Act (PDCA) o Planificar, Hacer, Comprobar y Actuar. (Figura 1).

"La planificación de la Producción en general consiste en:

- Establecer metas y objetivos
- Estimar los recursos necesarios para alcanzar las metas.
- Establecer un plan para alcanzar las metas de forma eficiente y a tiempo.
- Prever las etapas de producción.
- Prever los problemas que pueden surgir en el proceso.
- Aplicar medidas correctivas.
- ¿Qué, cuando, cuánto y cómo producir?"

(Ponz Tienda, 2017)

La planificación en construcción siempre se había llevado a cabo, hasta la aparición del Last Planner System (LPS)®, básicamente siguiendo el Diagrama de Gantt, y más desde la aparición y uso de los Programas Informáticos Microsoft Project y Primavera, y aún hoy se sigue haciendo de esta forma en la mayoría de los casos, pero Last Planner System® venía a establecer una forma nueva y más eficaz de planificación en la construcción.

In 2000, Professor Glenn Ballard presented his Doctoral Thesis at the University of Birmingham (United Kingdom), entitled: "The Last Planner System of Production Control" [1], in which he gives definitive form to the methodology. That has many points in common with the Deming Cycle: Plan, Do, Check, Act (PDCA) [2], (Figure 1).

"Production planning in general consists of:

- Set goals and objectives
- Estimate the resources necessary to achieve the goals.
- Establish a plan to achieve the goals efficiently and on time.
- Forecast the stages of production.
- Anticipate the problems that may arise in the process.
- Apply corrective measures.
- What, when, how much and how to produce? "

(Ponz Tienda, J.L., 2017)

Planning in construction had always been carried out until the appearance of the Last Planner System (LPS)® basically following the Gantt Chart, and even more since the appearance and use of Microsoft Project and Primavera Computer Programs, even today it continues to be this way in most cases, but Last Planner System® came to establish a new and more efficient way of planning in construction.

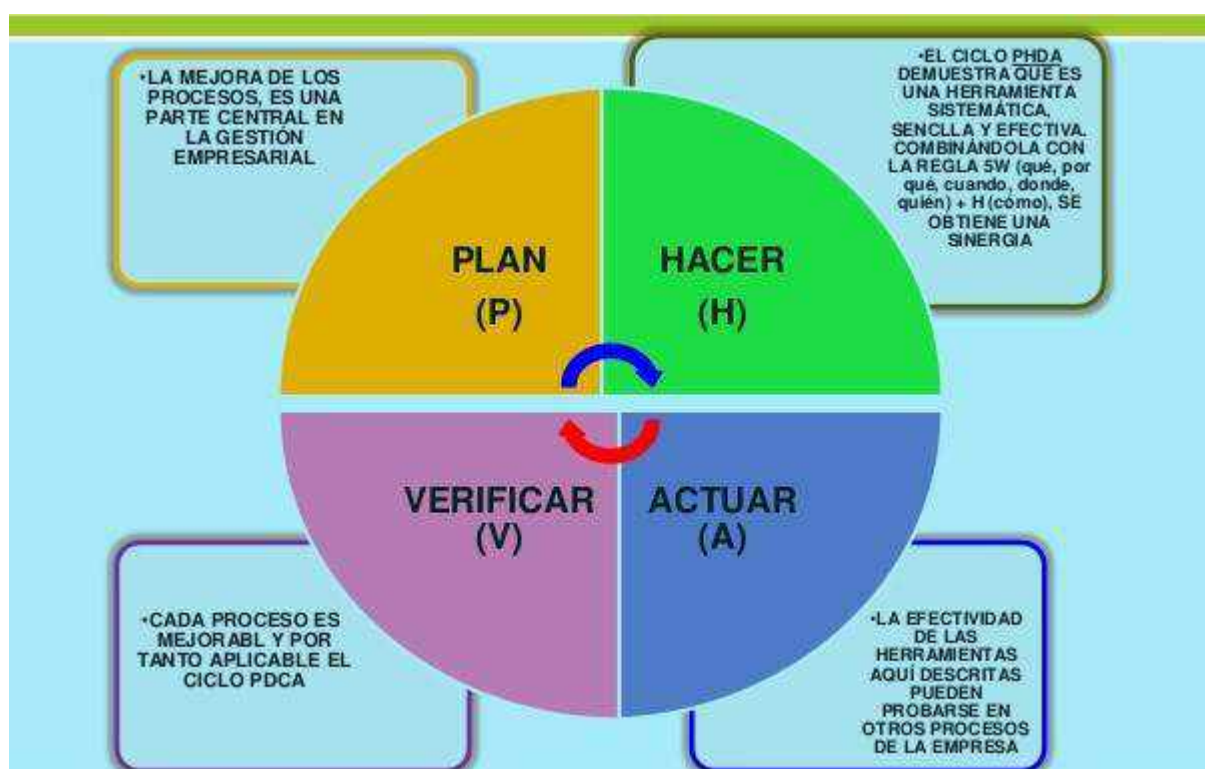


Fig. 1: Ciclo de Deming, Fuente Milagros Espinosa, Universidad Yacambú, 2013

2. EL DIAGRAMA DE GANTT

El Diagrama de Gantt en construcción presenta varios problemas:

- No pone de manifiesto la interdependencia de varias actividades.
- Es difícil definir exactamente el trabajo que debe realizarse en un instante preciso.
- Es difícil determinar el progreso de un proyecto cuando una barra representa un largo periodo de tiempo. No tiene relación con la situación física de los trabajos en la obra.
- El hecho de que existan actividades programadas en tiempos solapados o simultáneos no indica necesariamente que estén relacionadas o sean interdependientes.
- El Diagrama se complica mucho y hace muy difícil su aprehensión cuando las tareas comienzan a dividirse en subtarefas.
- Normalmente se redacta sin la participación de las subcontratas o trabajadores que van a ejecutar los trabajos, por lo que es más un deseo, que algo que represente realmente como se va a desarrollar la obra.

Los profesionales con experiencia en gestionar procesos de obra son conscientes de que el Diagrama de Gantt, teniendo en cuenta la variabilidad que hay en el proceso constructivo, tiene que estar en una constante reprogramación y adaptación a medida que avanzan los trabajos, y que esto, con las urgencias que siempre hay por terminar, suele derivar en su abandono.



Fig.2: Diagrama de Gantt de una Obra. Fuente Konstruir.com, 2008

3. EL MÉTODO DE LÍNEAS DE BALANCE

Existen otros métodos de planificación de la construcción, que resuelven algunos de los problemas del Diagrama de Gantt, por ejemplo, el denominado de Líneas de Balance, (LdB) que fueron utilizadas por primera vez en Estados Unidos en los años 30 del Siglo pasado y en particular, con buenos resultados, en la construcción del Empire State Building, que en plena depresión económica tras el Crack de la Bolsa de 1929, fue construido en 11 meses, inaugurado en 1931, y

2. THE GANTT CHART

The Gantt Diagram under construction presents several problems:

- It does not reveal the interdependence of several activities.
- It is difficult to define exactly the work that must be done at a precise moment.
- It is difficult to determine the progress of a project when a bar represents a long period of time. It has no relation with the physical situation of the tasks in the work.
- The fact that there are activities scheduled in overlapping or simultaneous times does not necessarily indicate that they are related or interdependent.
- The Diagram becomes very complicated and makes it very difficult to grasp when the tasks begin to be divided into subtasks.
- Normally it is written without the participation of the companies or workers that are going to execute the works, so it is more a wish, than something that really represents how the work will be developed.

Those who have site management experience, know well that the Gantt Diagram (Figure 2), considering the variability that there is in the construction process, must be in constant reprogramming and adaptation as the work progresses, and that this, with the urgencies that always there is to advance, usually derives in its abandonment.

3. THE LINES OF BALANCE METHOD

There are other methods of construction planning, which solve some of the problems of the Gantt Chart, for example, the so-called Lines of Balance, (LoB) that were used for the first time in the United States in the 30s of the last century and in particular, with good results, in the construction of the Empire State Building [9], which in a full economic depression after the Crack of the Stock Exchange of 1929, was built in 11 months, inaugurated in 1931, and has a constructed area of 250,000

tiene una superficie construida de 250.000 m². en 102 plantas (Willis, 2012).

Las LdB son un método de planificación de la construcción que introduce un factor fundamental a la hora de controlar la obra, y conocer su estado en cada momento, que es el emplazamiento de la tarea [2]. Según el Diagrama de Gantt, dentro del Plano Cartesiano, estamos acostumbrados a que las abscisas sean los tiempos y las ordenadas las tareas, el desarrollo de estas se representa mediante barras horizontales.

En el método de LdB el eje de las abscisas sigue siendo el tiempo, pero el eje de las ordenadas representa el emplazamiento, con lo que las tareas y su evolución se representan mediante líneas inclinadas, que al observarlas sí que nos dan información sobre en qué punto se encuentra la obra y su grado de desarrollo, así como su velocidad de ejecución. Cuando las líneas tienen mayor inclinación la actividad va más lenta y al revés (Figura 3).

m². in 102 plants (Willis, 2012).

The LoB is a construction planning method that introduces a fundamental factor when controlling the work, and knowing its status always, which is the site of the task [2].

According to the Gantt Diagram, within the Cartesian Plane, we are accustomed to the abscissa being the times and the ordinates tasks, the development of these is represented by horizontal bars.

In the LoB method the abscissa axis is still the time, but the axis of the ordinates represents the location, with which the tasks and their evolution are represented by inclined lines, by observing them do give us information about at what point is the work and its degree of development, as well as its speed of execution. When the lines have greater inclination, the activity goes slower and vice versa (Figure 3).

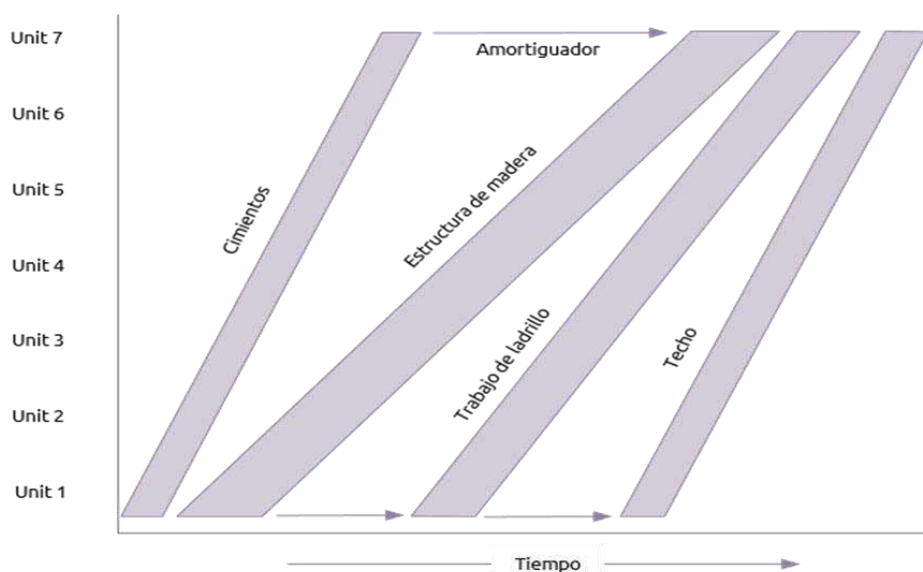


Fig.3: Diagrama de Líneas de Balance (Fuente: Blog Praxis Framework Limited, 2015) / Lines of Diagram (Source: Blog Praxis Framework Limited, 2015)

Es un sistema de planificación lineal que permite ordenar las actividades para que sean ejecutadas de forma continua, incluso aunque el trabajo de cada una de ellas se esté desarrollando en diferentes zonas de la obra, como por ejemplo distintas plantas.

Teniendo en cuenta el principio de eliminar la variabilidad en la producción del Toyota Production System (TPS), recordemos: "Es mejor producir como la tortuga que como la liebre" (Ohno, 1995), trasladado a las Líneas de Balance, lo ideal es que estas vayan en paralelo, ya que esto significaría que todas las subcontratas están trabajando al mismo ritmo, y por tanto estaríamos eliminando la variabilidad [7].

4. EL MÉTODO PERT

Otros métodos utilizados son los probabilísticos, como el Método PERT (Program Evaluation and Review Technique),

It is a linear planning system that allows ordering the activities so that they are executed continuously, even though the work of each of them is being developed in different areas of the work, such as different plants.

Bearing in mind the principle of eliminating the variability in the production of the Toyota Production System (TPS), remember: "It is better to produce like the turtle than the hare" (Ohno, 1995), transferred to the Lines of Balance, the ideal is that they go in parallel, since this would mean that all subcontractors are working at the same pace, and therefore we would be eliminating the variability [7].

4. THE PERT METHOD

Other methods used are probabilistic, such as the PERT Method (Program Evaluation and Review Technique), created by the United States Navy in 1957 for the POLARIS program.

creado por la Armada de Estados Unidos en el año 1957 para el programa POLARIS.

PERT se vale de datos estadísticos para conducirnos a datos probables, la información que nos da está en función de probabilidades y se basa en el conocimiento de situaciones similares anteriores y sus resultados.

Estima la duración de las actividades partiendo de tres escenarios: Optimo, más probable y pésimo, y a partir de esto deduce la desviación típica, considera los riesgos de esta desviación y los clasifica en aceptables o no, estudia las actividades en función de si son precedentes, sucesorias o ficticias y finalmente obtiene un Camino Crítico de duración total, con un grado de probabilidad de que ocurra (Figura 4).

Se centra especialmente en el tiempo y es posible que para mejorar la duración de una actividad tenga que emplear recursos excesivos y poco rentables, algo que parte de la aceptación o no de los riesgos de cumplimiento del plazo. Por tanto, es un método estocástico, es decir admite una cierta aleatoriedad en su cálculo.

PERT uses statistical data to lead us to probable data, the information it gives us is based on probabilities and on the knowledge of previous similar situations and their results.

Estimates the duration of the activities based on three scenarios: Optimal, most likely and lousy, and from this deducts the standard deviation, considers the risks of this deviation and classifies them as acceptable or not, studies the activities according to whether they are precedents, successions or fictitious and finally gets a critical path of a total duration, with a degree of probability that it happens (Figure 4).

It focuses especially on time and it is possible that to improve the duration of an activity it must use excessive and unprofitable resources, something that starts from the acceptance or not of the risks of compliance with the term.

Therefore, it is a stochastic method, it admits a certain randomness in its calculation.

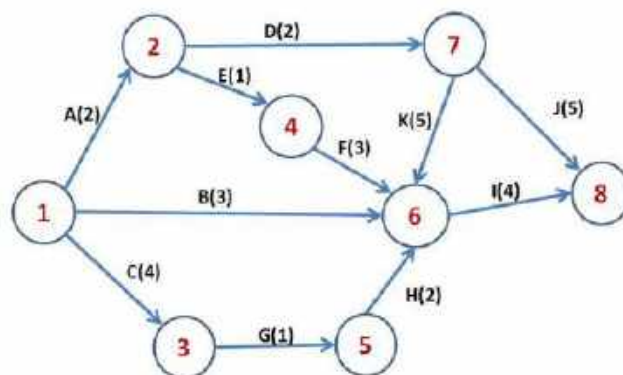


Fig.4: Diagrama PERT (Fuente: Blog Sinnaps, 2018) / PERT diagram (Source: Blog Sinnaps, 2018)

Teniendo en cuenta las especiales características de la construcción: Cada obra es diferente, cada edificio se erige en una situación determinada, en la ejecución intervienen trabajadores procedentes de distintas subcontratas, le influyen muchos factores impredecibles como por ejemplo la climatología, etc.

Un método estocástico como el PERT no es adecuado para nuestro sector, por la dificultad de poder encontrar estadísticas suficientes, con estimaciones fiables de duración de las actividades y por la variabilidad que determina la asunción de riesgos y de recursos, en consecuencia, su utilización en construcción es limitada.

5. EL MÉTODO DE LA CADENA CRÍTICA

El Método de la Cadena Crítica o CPM (Critical Path Method) es una evolución del PERT más adecuada para la planificación en construcción. Como su propio nombre indica también busca el Camino Crítico, pero asumiendo que en una obra puede haber varios, para elegir el más conveniente, y a diferencia

Considering the special characteristics of the construction industry: Each work is different, each building is erected in a specific situation, in the intervention are involved workers from different companies (subcontractors), it is influenced by many unpredictable factors such as weather, etc.

A stochastic method like PERT is not adapted for our sector, by the difficulty of being able to find enough statistics, with reliable estimations of duration of the activities and by the variability that determines the assumption of risks and resources, consequently, its use in construction is limited.

5. THE CRITICAL PATH METHOD

The Critical Path Method or CPM is an evolution of the PERT most suitable for planning in construction. As its name indicates, it also searches for the Critical Path, but if there may be several in a work, to choose the most convenient one, and unlike the PERT does not part from statistics but data with a reasonable degree of accuracy, both in terms of times as to the allocation of resources for activities (Figure 5).

del PERT no parte de estadísticas sino de datos con un grado razonable de precisión, tanto en cuanto a los tiempos como a la asignación de recursos para las actividades (Figura 5).

Por tanto, se orienta a las actividades y no a los tiempos, fue creado también en Estados Unidos en el año 1957, paralelamente al PERT, aunque en este caso fueron empresas privadas: Dupont y Remington Rand, las que encargaron el diseño a expertos, la intención era controlar los costos más que el plazo de la producción, y por ello se diseñó de forma más exigente en esa materia.

Therefore, it is oriented to activities and not to time, it was also created in the United States in 1957, parallel to the PERT, although in this case were private companies: Dupont and Remington Rand, which commissioned the design to experts, the intention was to control the costs more than the term of production, and for that reason it was designed in a more demanding way in that matter.

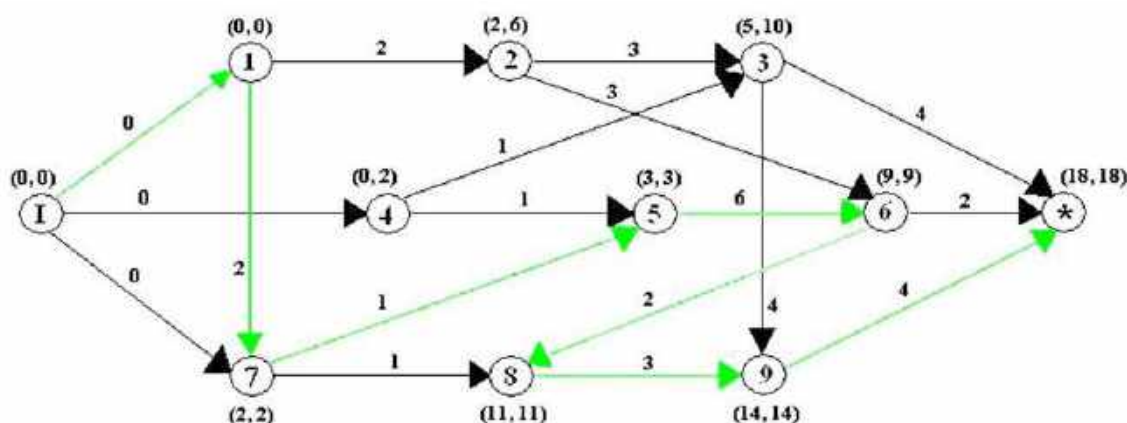


Fig. 5: Diagrama CPM (Fuente: Escuela de Organización Industrial, 2013) / CPM diagram (Source: Escuela de Organización Industrial, 2013)

Al utilizar datos determinísticos, nos conduce a resultados ciertos, no probables como el PERT, en consecuencia, es un método no estocástico y por tanto aplicable a la construcción. No obstante, su uso en esta materia también es limitado.

When using deterministic data, it leads us to certain results, not probable as the PERT, consequently, it is a non-stochastic method and applicable to the construction. However, its use in this matter is limited.

6. EL SISTEMA DEL ÚLTIMO PLANIFICADOR

No obstante, los métodos clásicos de planificación de obras descritos anteriormente son inadecuados para las necesidades actuales, y se producen anomalías en su uso.

"¿Por qué se producen estas anomalías?:

- Se diseñaron hace 70 años con la tecnología de hace 70 años.
- Los algoritmos de cálculo de los grafos están muy relajados.
- No consideran situaciones reales de los proyectos.
- No consideran un enfoque sistémico del proyecto.
- No consideran que los proyectos son sistemas productivos.
- No consideran que los proyectos los hacen personas"

(Ponz Tienda, 2017)

"Hacen falta métodos de análisis de las matemáticas, adaptados para encajar Sistemas que contienen Seres Humanos"

(Goldratt, Eliyahu M. 1997)

6. THE LAST PLANNER SYSTEM®

However, the classical work planning methods described above are inadequate for current needs and anomalies in their use occur.

"Why do these anomalies occur?

- They were designed 70 years ago with the technology of 70 years ago.
- The graph calculation algorithms are very relaxed.
- They do not consider real situations of the projects.
- They do not consider a systemic approach to the project.
- They do not consider that the projects are productive systems.
- They do not consider that the projects are made by people "

(Ponz Tienda, J.L., 2017)

"Mathematical analysis methods are needed, adapted to fit Systems containing Human Beings"

(Goldratt, E.M. 1997)

Last Planner System (LPS)®, o el Sistema del Último Planificador, da respuesta a muchos de los problemas que plantean los métodos que hemos descrito anteriormente.

Partiendo de la frase reproducida del Profesor Eliyahu M. Goldratt, LPS deja de pensar en las actividades y se enfoca en las personas. Básicamente parte de afrontar tres cuestiones fundamentales para planificar una obra con éxito:

1.- Variabilidad:

Este principio, consustancial a las obras de construcción, lo afronta mediante la planificación colaborativa, implicando a todos los contratistas y subcontratistas, así como técnicos y demás interesados a participar y aportar su criterio a la hora de elaborar el plan de obra.

2.- Flujo-Transformación:

Identifica las tareas que generan flujo para llegar a la transformación. Mientras las metodologías analizadas anteriormente eran todas del tipo "push" es decir que se planificaba desde el principio hacia el final, veremos que LPS es una planificación tipo "pull", que es coincidente con los principios del TPS, se planifica desde el final hacia el principio.

3.- El principio: Debe, puede, se hará:

Este es otro de los pilares en los que se fundamenta el LPS, en el compromiso de las personas, que son quienes van a realizar el trabajo y que a su vez son los que están planificando, es decir ellos mismos se están comprometiendo con el equipo, a la vez que se hace el plan de obra.

4.- Análisis de Restricciones:

LPS estudia detenidamente cuáles son las limitaciones que existen para poder alcanzar los objetivos (falta de materiales, falta de definición del diseño, falta de mano de obra, etc.) y procede a ejecutar las acciones necesarias para eliminarlas, para que el plan siga adelante. Recordemos, que eliminar el desperdicio es una de las metas fundamentales de Lean Construction.

En base a los principios antes mencionados, el Sistema del Último Planificador se estructura mediante varios escalones:

- La Pull Session:

Es la primera reunión del equipo en la que se hace la planificación con los interesados. Es importante que cuando se haga estén presentes todos los implicados en la obra. Sobre un gran tablero en blanco se sitúan en el eje de abscisas los tiempos, y en otro tablero aparte también en blanco se van a reflejar las restricciones.

Cada una de las actividades de obra que vayan a intervenir tendrá un paquete de post-it o tarjetas adhesivas de diferente color y en cada hoja su responsable apuntará la tarea a la que se refiere, las actividades previas que

Last Planner System (LPS)®, responds to many of the problems posed by the methods described above [4].

Based on the phrase reproduced by Professor Eliyahu M. Goldratt, LPS stops thinking about activities and focuses on people. Basically, part of addressing three fundamental issues to plan a successful work:

1.- Variability:

This principle, inherent to construction works, is addressed through collaborative planning, involving all contractors and subcontractors, as well as technicians and other interested parties, to participate and contribute their criteria when preparing the work plan.

2.- Flow-Transformation:

It identifies the tasks that generate flow to reach the transformation. While the methodologies analysed above were all the "push" type, that it was planned from the beginning towards the end, we will see that LPS is a "pull" type planning, which coincides with the principles of the TPS, it is planned from the end towards the beginning.

3.- The principle: Must, can, will be done:

This is another of the pillars on which the LPS is based, on the commitment of the people, who are the ones who are going to carry out the work and who in turn are the ones who are planning, that is, they are committing themselves with the team, at the same time that the work plan is made.

4.- Analysis of Restrictions:

LPS studies carefully what are the limitations that exist to be able to reach the objectives (lack of materials, lack of definition of the design, lack of manpower, etc.) and proceeds to execute the necessary actions to eliminate them, so that the plan can continue.

Let's remember, that eliminating waste is one of the fundamental goals of Lean Construction.

Based on these principles, the Last Planner System® is structured by several steps:

- The Pull Session:

It is the first meeting of the team in which the planning is done with the interested parties. It is important that all those involved in the work are present when it is done.

On a large white board if you place the times on the abscissa axis, and on another separate board also in white the restrictions will be reflected.

Each one of the work activities that will take part will have a post-it packs or different colour adhesive cards and on each sheet the person in charge will write down the task to which it refers, the previous activities that it needs, the possible duration, and the resources he will use.

necesita, la duración posible, y los recursos que empleará.

Comienza a situarse sobre el tablero en blanco la tarjeta de la última de las tareas previstas, en el extremo derecho de este, que coincidirá con la fecha en la que se quiere terminar la obra. A continuación, se situará a la izquierda de esa tarea la anterior, previendo los tiempos necesarios para ejecutarla, y de este modo se continuará hacia la izquierda, hasta que se llegue a la fecha de comienzo de obra (Figura 6).

Si todo saliera perfectamente habríamos llegado a la fecha exacta, pero, como es lógico, eso no ocurre normalmente (lo habitual es que resulte un plazo mayor). Durante todo el proceso los asistentes pueden opinar sobre si los tiempos que cada uno ha aportado son correctos o no.

Una vez se tiene cerrado el cronograma, se vierte en un programa de planificación como Microsoft Project o Primavera, y se obtiene el Plan Maestro o Master Plan. Este es el momento de ajustarlo para que encaje en las fechas previstas de comienzo y final, así como establecer los hitos o milestones en los que se divide la obra, lo que se hará nuevamente con la intervención de todos, revisando los tiempos. Si una tarea tiene una duración que parece excesiva, se analizará aplicando la técnica de los 5 Porqué, para eliminar pérdidas, mejorando los plazos [7].

Si durante la disposición de las tarjetas que representan las actividades surgen restricciones que dificultarían o impedirían la ejecución de alguna de ellas, se apuntan en el tablero de restricciones, sabiendo que tienen que estar resueltas antes de que se comience a ejecutar la tarea en cuestión, también se apunta quién es el responsable de liberar cada una de ellas.

De esta forma al final tendremos una planificación que ha sido realizada entre todos, y en la que todos se han comprometido, unos con otros, a trabajar dentro de unos márgenes que se han autoimpuesto.

Esta reunión puede tener una duración máxima aproximada de unas dos horas para una obra de tipo medio. Repetimos que es muy importante la asistencia de todos los interesados, y especialmente del Jefe de Obra y de la Dirección Facultativa, para que nadie pueda decir que se han tomado decisiones sin contar con él y que por tanto no se siente obligado por las mismas. La implicación del equipo es necesaria para que funcione adecuadamente. Es conveniente que la sesión sea monitorizada por un facilitador experto en la aplicación de LPS.

- El Look-Ahead:

Tras esta primera sesión, el sistema se revisará periódicamente, en principio al menos en dos escalones: La denominada Planificación Inmediata o Look-Ahead, que será como hacer un zoom del Plan Maestro, normalmente para un

Start to place on the blank board the card of the last of the planned tasks, on the far right of this, which will coincide with the date on which you want to finish the work (Figure 6), then it will be placed to the left of that task the previous, foreseeing the necessary times to execute it, and in this way it will continue to the left, until the start date of the work is reached [6].

If everything went perfectly, we would have arrived at the exact date of the beginning, but of course this does not happen normally (usually it is a longer period), throughout the process attendees can comment on whether the times that each has contributed are correct or do not.

Once the schedule is closed, it is poured into a planning program such as Microsoft Project or Primavera, and the Master Plan is obtained, this is the time to adjust it to fit in the expected start and end dates, as well how to establish the milestones in which the work is divided, which will be done again with the intervention of all, reviewing the times.

If a task has a duration that seems excessive, it will be analysed applying the technique of the 5 Why, to eliminate losses by improving the deadlines [7].

If during the disposition of the cards that represent the activities arise restrictions that would hinder or impede the execution of any of them, they are indicated on the board of restrictions, knowing that they have to be resolved before the task in question begins to be executed, it also points out who is responsible for releasing each of them.

In this way at the end we will have a planning that has been carried out among all, and in which all have committed with each other to work within margins that have been self-imposed.

This meeting can have a maximum duration of approximately two hours for a medium-sized work, we repeat that it is very important the assistance of all stakeholders, and especially the Project Manager, so that no one can say that they have made decisions without him and that therefore he does not feel bound by them. The involvement of the team is necessary for it to function properly. It is convenient that the session be monitored by an expert facilitator in the LPS application.

- The Look-Ahead:

After this first session, the system will be revised periodically, in principle at least in two steps: The so-called Immediate Planning or Look-Ahead, which will be like zooming in on the Master Plan, normally for a period of about six months, or for the term between two work milestones, with an approximate duration of one and a half hours.

And the so-called Weekly Planning, this will be done every week and will last approximately one hour. The purpose of



Fig.6: Pull Session (Fuente: Blog Lean Construction Blog, 2017) / Pull Session (Source: Blog Lean Construction Blog, 2017)

plazo de unos seis meses, o bien para el plazo entre dos hitos de obra, con una duración aproximada de una hora y media. Y la denominada Planificación Semanal, esta se hará todas las semanas y durará aproximadamente una hora. El objeto de ambas será controlar el grado de ejecución de lo planificado y/o realizar los ajustes necesarios.

- Las Reuniones Semanales:

Las revisiones son la aplicación directa del principio del Kaizen, la mejora continua, a lo que nos hemos referido como el principio: Debe, Puede, Se hará.

Las preguntas son:

- ♦ ¿Qué pasó y por qué?
- ♦ ¿Qué se debe hacer?
- ♦ ¿Qué se puede hacer?
- ♦ ¿Qué se hará?

A partir de las respuestas a estas preguntas se establecen los compromisos, las promesas que un industrial hace frente a sus compañeros y que pueden condicionar el trabajo de otros. Se ha comprobado en la práctica que esta forma de proceder funciona, y que nadie quiere llegar a la siguiente reunión sin haber hecho su parte del trabajo. [10].

Estas reuniones semanales a su vez se complementan con breves reuniones diarias al comenzar la jornada, para repasar cuales son los cometidos del día, se suelen denominar Reuniones de Pie o Daily Huddle y no deben durar más de unos quince minutos, se trata de enfocar las tareas inmediatas y descubrir si hay alguna restricción nueva o que ha sido bien establecida en la reunión semanal.

Los resultados y el progreso se miden mediante varias herramientas, de las que destacamos el PPC (Porcentaje de Promesas Cumplidas o Porcentaje del Plan Completado), indicador que mide el grado de compromiso del equipo, y el CNC (Causas de No Cumplimiento), en este caso se analizan los motivos del incumplimiento y se incorporan a las restricciones a eliminar, si es que no lo hubieran estado antes:

both will be to control the degree of execution of the planned and / or make the necessary adjustments.

- The Weekly Meetings:

The revisions are the direct application of the Kaizen principle, continuous improvement, to what we have referred to as the principle: Must, Can, Will be done.

The questions are:

- ♦ What happened and why?
- ♦ What should be done?
- ♦ What can be done?
- ♦ What will be done?

From the answers to these questions are established the commitments, the promises that an industrialist makes in front of his colleagues and that can condition the work of others. It has been proven in practice that this way of proceeding really works, and that nobody wants to get to the next meeting without having done their part of the work [10].

These weekly meetings are complemented by brief daily meetings at the beginning of the day, to review the tasks of the day, are usually called Standing Meetings or Daily Huddle and should not last more than fifteen minutes, it is about focusing the Immediate tasks and find out if there are any new restrictions or that have been well established in the weekly meeting.

The results and progress are measured by several tools, of which we highlight the PPC (Percentage of Promises Fulfilled or Percentage of the Completed Plan), indicator that measures the degree of commitment of the team, and the CNC (Causes of Non-Compliance), in this case, the reasons for the breach are analysed and incorporated into the restrictions to be eliminated, if they had not been before:

PPC = Number of Promises Met Programmed / Number of Promises Scheduled for a given period (for example, a week).

$PPC = \text{N}^\circ \text{ de Promesas Cumplidas Programadas} / \text{N}^\circ \text{ de Promesas Programadas para un periodo dado (por ejemplo, una semana).}$

7. CONCLUSIONES

LPS cómo podemos ver es una Planificación Colaborativa, de la que deriva un compromiso colectivo.

Es fundamental para su aplicación que el equipo entienda que forma parte de un sistema y que el incumplimiento de un compromiso afecta a los demás intervinientes.

El equipo debe entender cuál es el proceso, e involucrarse en él para la mejora del desempeño de cada uno de sus miembros.

La forma de actuar con LPS resuelve, como ningún otro de los Métodos de Planificación mencionados anteriormente, la variabilidad que se da en la construcción, al hacer un seguimiento permanente del desarrollo de la obra, y en consecuencia al adaptarse en cada momento a las circunstancias que se puedan producir, para alcanzar los objetivos establecidos en el punto de partida. El compromiso debe entenderse, por cada miembro del equipo, como algo cuyo cumplimiento no solo beneficia a otros intervinientes sino también a sí mismo y por ende a la obra en su conjunto.

Como en toda la Metodología Lean Construction, para el éxito de la planificación de una obra con LPS, serán esenciales las personas, la fiabilidad del equipo y la eficiencia de sus componentes.

Para su implantación en España es importante que superemos tanto la falta de formación en la materia, como la falta de liderazgo o de compromiso, ya que son factores clave para que se pueda avanzar en ello. Todos los miembros del equipo tienen que sentirse parte de este y colaborar de verdad, y para conseguirlo la información entre todos tiene que ser transparente [11].

La construcción en España es muy ineficaz porque no se colabora de verdad, no se entiende el proceso en su conjunto, no se comprende que cada subcontrata no es una isla, sino un miembro del equipo en el que el éxito es de todos, pero también el fracaso es de todos, independientemente de cada uno haya cumplido bien con su cometido individual.

Un buen resumen esquemático de todo lo dicho es el que los Profesores Glenn Ballard y Gregory Howell, establecieron como principios básicos del Sistema del Último Planificador:

- Estabilizar el flujo de trabajo.
- Reducir la variabilidad del flujo.
- Mejorar el funcionamiento del proceso.

7. CONCLUSIONS

LPS, as we can see, is therefore a Collaborative Planning, from which a collective commitment derives.

It is basic for its application that the team involved understands that is participating in a system and the breach of a compromise affects the rest of the interveners.

The actuation with LPS solves, as any other of the Planification Methods before mentioned could not do, the variability that is always in construction, doing a continuous tracing of the work development, and in consequence adapting the answer to the circumstances that could be produced, for achieving the goals established in the start point of the work. The compromise must be understood by each member of the team as something of his own, which if it is reached not only has benefits for others, but also for himself, and finally for the work as a whole.

As in every Lean Construction Methodology, for the success of the planification with LPS, people will be essential, including the reliability of the team and the efficiency of its components.

For its implementation in Spain it is important to overcome both the lack of training in the subject, as the lack of leadership or commitment, as they are key factors for progress in this, all team members must feel part of this and really collaborate, information among all must be transparent [11].

Construction in Spain is very inefficient because people involved does not collaborate, the process is not understood as a whole, it is not assumed that a subcontract is not an island, but a member of a team, in which the success belongs to everyone, but the failure also belongs to everyone, independently that each one could have done correctly its individual duty.

A schematic resume of all said above is the one that Professors Glenn Ballard and Greg Howell established as the fundamentals of Last Planner System®:

- Stabilize the workflow.
- Reduce flow variability.
- Improve process operation.



Fig.7: Los principios básicos de Last Planner System® (Fuente: Ballard y Howell, 1994) / The basic principles of Last Planner System® (Source: Ballard and Howell, 1994)

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Una mejora en la planificación de la construcción: El Sistema del Último Planificador (Last Planner System ®).

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Palabras Clave: *Planificación, Sistema del Último Planificador, Last Planner System ®.*

Desde hace aproximadamente cinco años, se está utilizando cada vez más en España el Sistema del Último Planificador (Last Planner System ®), debido a la mejora que su utilización produce en la productividad de la construcción, alcanzándose, con su uso, mejores resultados en la consecución de los objetivos de: Coste, plazo y calidad de los proyectos.

Fueron los Profesores Glenn Ballard y Greg Howell de la Universidad de Berkeley en California, Estados Unidos, quienes a principios de los años 90 del pasado Siglo investigaron sobre una forma de planificación de la obra que, dentro de la filosofía Lean Construction, fuera más acorde con las especiales características del proceso constructivo.

En el año 2000, el Profesor Glenn Ballard presentó su Tesis Doctoral en la Universidad de Birmingham (Reino Unido), titulada: "The Last Planner System of Production Control" (El Sistema del Último Planificador de Control de la Producción), en la que da forma definitiva a la metodología.

Ya en el año 2011 los autores: Rodríguez Fernández, A.D.; Alarcón Cárdenas, L.F.; y Pellicer Armiñana, E. publicaron un artículo en la Revista de Obras Públicas, Órgano Profesional de los Ingenieros de Caminos, Canales y Puertos de España, sobre la materia, titulado: "La gestión de la obra desde la perspectiva del último planificador" (<http://hdl.handle.net/10251/29189>):

La Construcción sin Pérdidas (Lean Construction) aporta numerosas técnicas asociadas para mejorar el proceso constructivo, y una de ellas es el Sistema del Último Planificador.

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UNA MEJORA EN LA PLANIFICACIÓN DE LA CONSTRUCCIÓN: EL SISTEMA DEL ÚLTIMO PLANIFICADOR (LAST PLANNER SYSTEM ®)

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Madrid 6 de Marzo de 2019

¿UNA HERRAMIENTA OBSOLETA?

Diagrama de GANTT

En un diagrama de GANTT, cada tarea es representada por una línea, mientras que las columnas representan los días, semanas o meses del programa, dependiendo de la duración del proyecto.

El edificio para estudiantes de la municipalidad de Lima (García Polanco, 2010). Los autores se quisiere colocar en colaboración con el planificador de la obra.





LAS LINEAS DE BALANCE

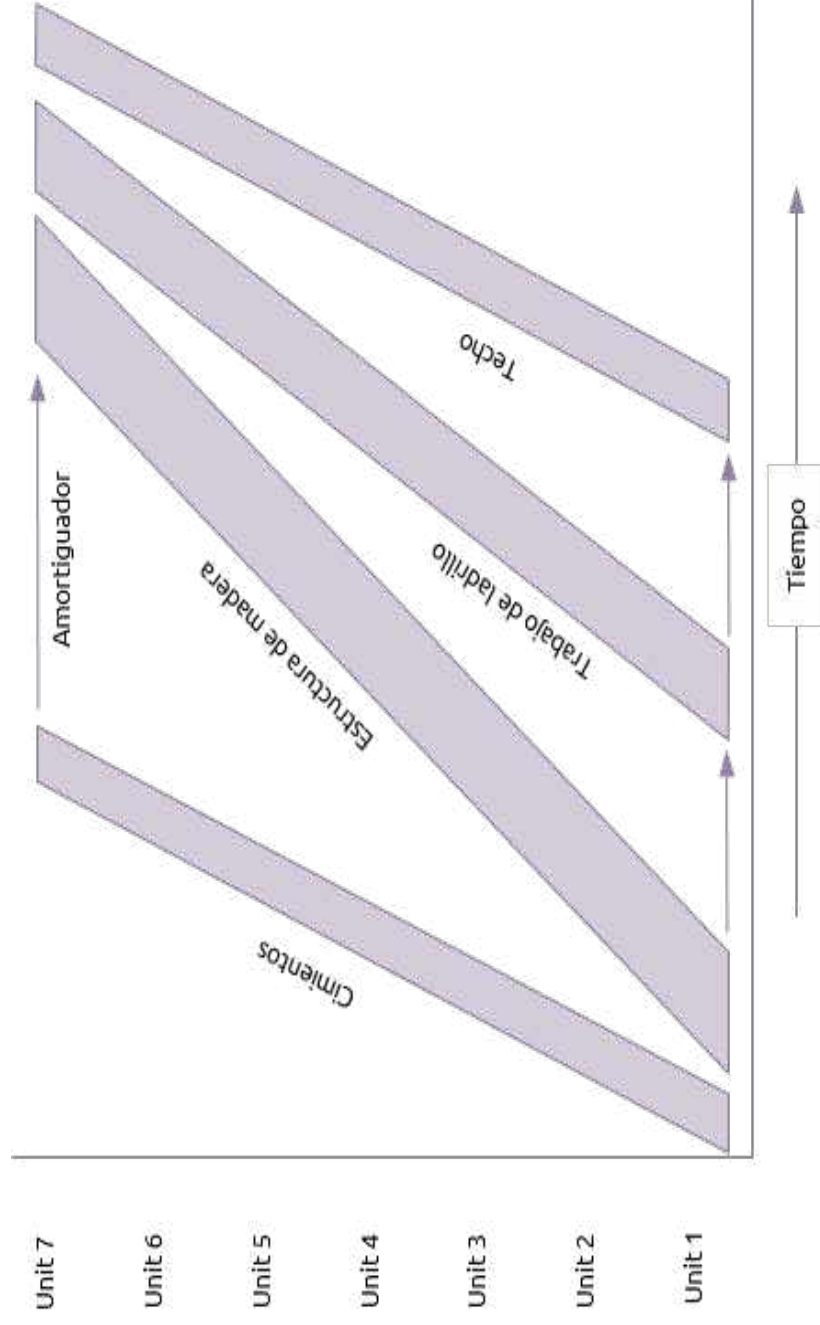


Diagrama de Líneas de Balance (Fuente: Blog Praxis Framework Limited, 2015)

EL MÉTODO PERT

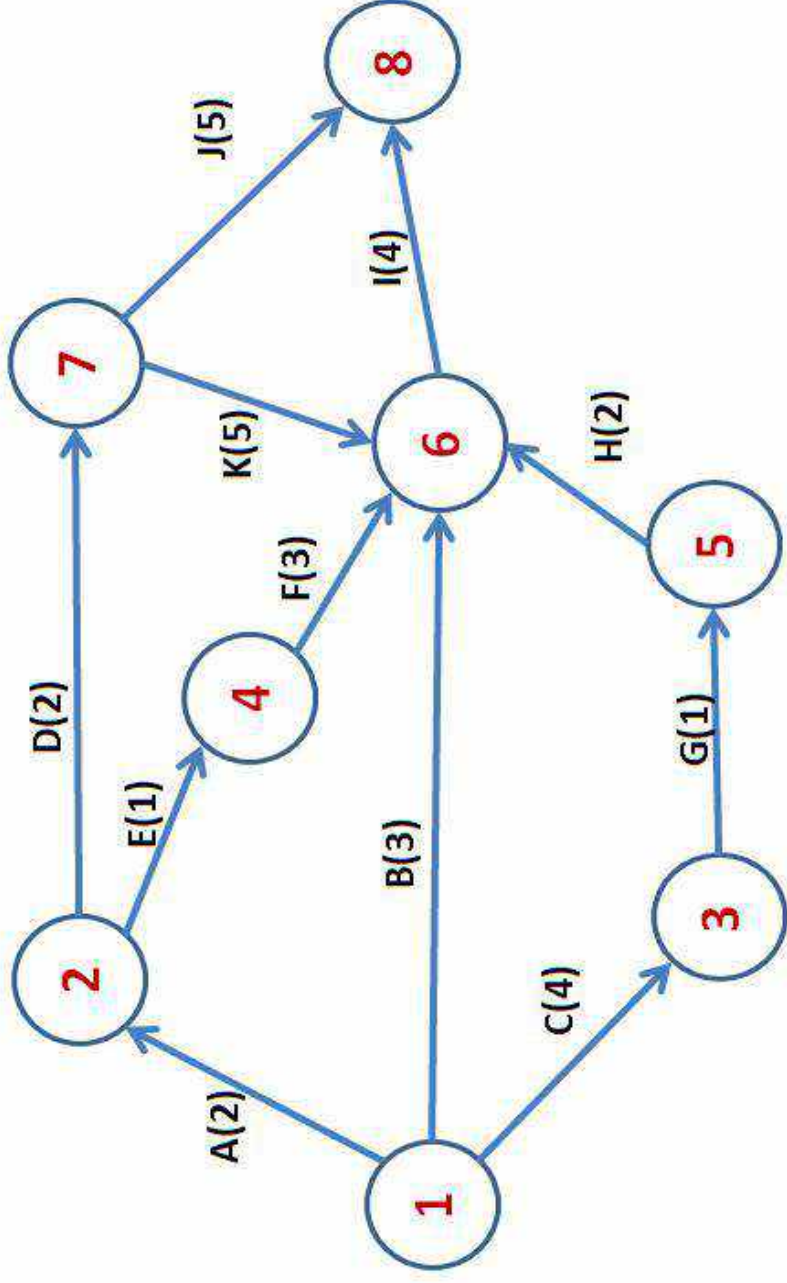
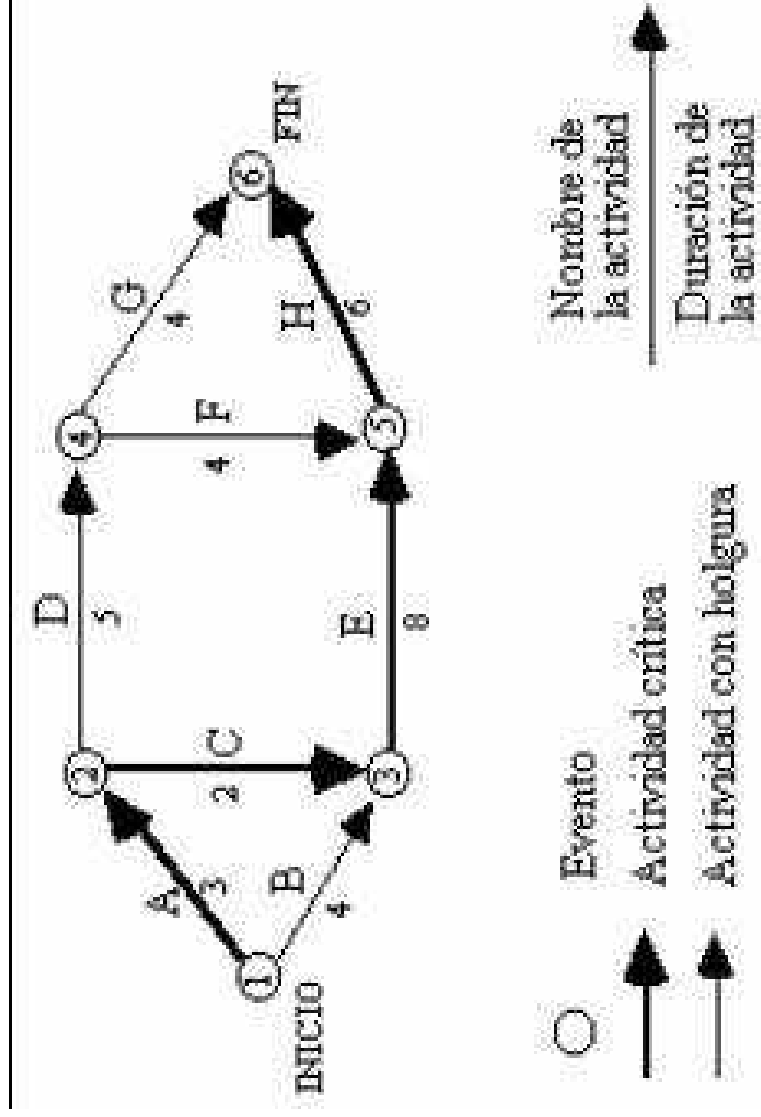


Diagrama PERT (Fuente: Blog Sinnaps, 2018)



EL MÉTODO DE LA CADENA CRÍTICA



4º CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN (CITE 2019)



UN NUEVO ENFOQUE



Concepto nuevo de Taiichi Ohno: La idea del flujo. La producción debía fluir rápida y suavemente durante todo el proceso y una de las principales tareas de los directores es identificar y eliminar los impedimentos que dificultan dicho flujo (Muda).



El flujo en Lean Construction según el Profesor Glenn Ballard: Los proyectos de construcción generalmente operan entre el 55% y el 60% de fiabilidad en la finalización de las tareas del día siguiente (ver www.leanconstruction.org), es decir, la construcción hoy en día logra terminar un poco más de la mitad de lo que se planea hacer 24 horas antes.



LOS PRINCIPIOS LEAN

Según Lean Thinking/Womack & Jones, 1996, Lean es:

- Un viaje hacia la perfección. *Kaizen*
- Implantar un sistema *Pull* frente a uno *Push*
- Maximizar entrega de Valor y eliminar *Muda*
- Identificar los flujos de valor
- Hacer que estos flujos de valor fluyan



KAIZEN

改 Kai = El cambio.

善 Zen = Lo bueno.

El cambio a mejor, la mejora continua como filosofía de trabajo y de vida.

Es un concepto filosófico taoísta y budista, pero también es un compromiso del equipo de trabajo.

Buscar el beneficio común, del equipo, de la empresa, de la comunidad, de la sociedad.



SISTEMA PULL FRENTE A PUSH

Sistema Push: El tradicional

Basado en un sistema de grandes lotes de producción, en la demanda prevista, y en mover o empujar materiales y producción aguas abajo hacia el siguiente proceso, sin tener en cuenta el ritmo actual de trabajo, el siguiente proceso ni la demanda real.

Este sistema genera sobreproducción, exceso de inventario, transporte innecesario, ineficiencias etc.



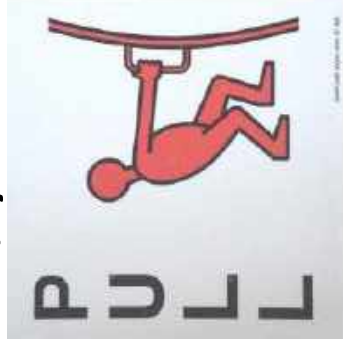


SISTEMA PULL FRENTE A PUSH

Sistema Pull: Lean

Las actividades aguas abajo dan la señal de aviso de sus necesidades a las actividades aguas arriba, con lo cual conseguimos eliminar el exceso de inventario y la sobreproducción.

Es un sistema para conseguir el Just In Time. Es el cliente (interno o externo) quien tira de la demanda, y no el productor quién empuja la producción hacia el cliente.





JIT: LA APLICACIÓN A LEAN CONSTRUCTION

El **JUST IN TIME (JIT)** en Lean Construction significa que:

En la construcción se produzca un proceso continuo, que los recursos adecuados (información, materiales, personas) necesarios para el montaje o ejecución de un proyecto se incorporen justo en el momento en el que se necesitan y sólo en la cantidad en que se necesitan.





LAS NUEVAS TECNICAS LEAN CONSTRUCTION

Sistema del Último Planificador, Last Planner System (LPS) ®

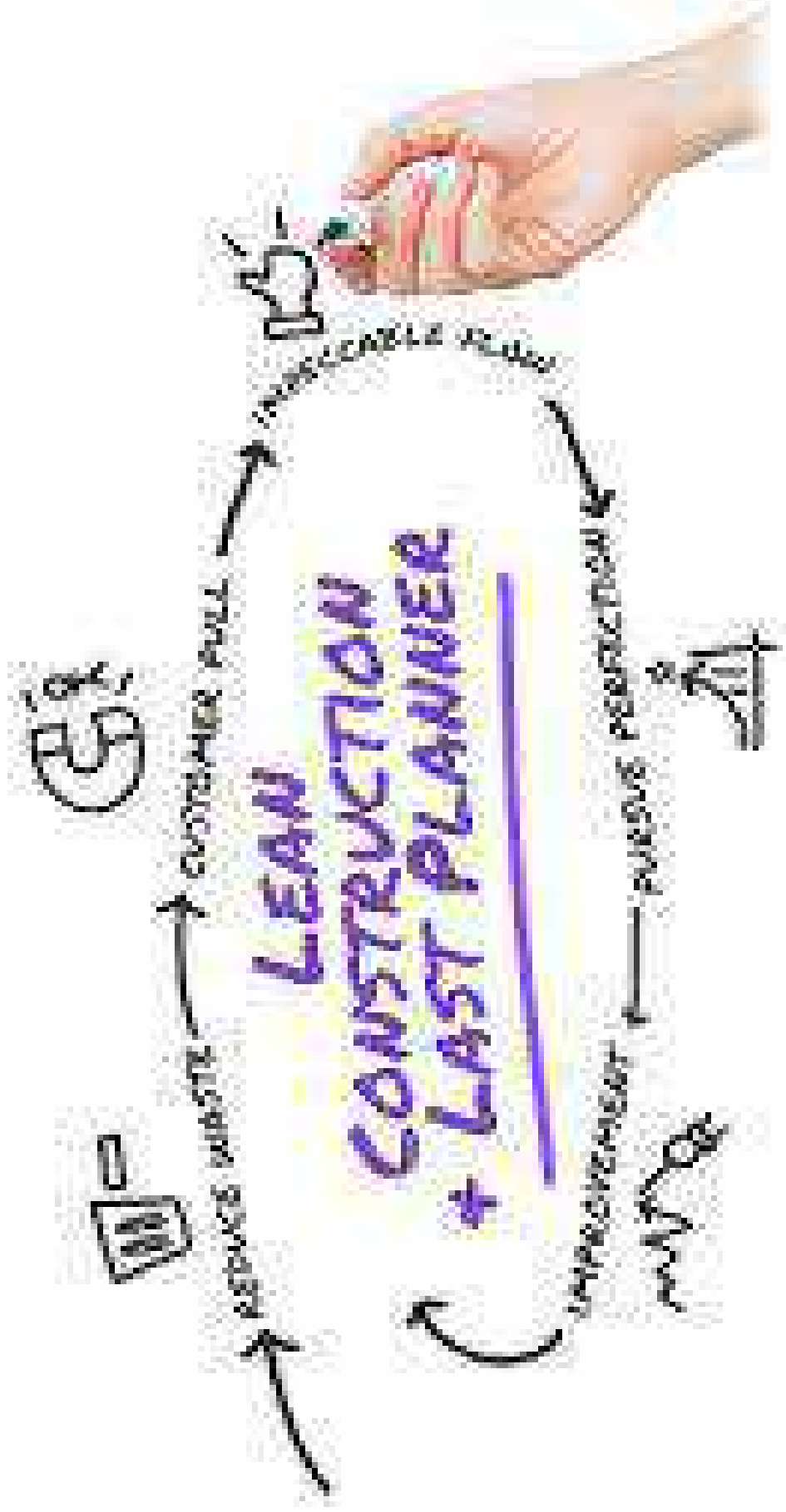
Diseño de Valor Objetivo, Target Value Design (TVD)

Metodos Colaborativos, Integrated Project Delivery (IPD)

4º CONGRESO INTERNACIONAL DE INNOVACIÓN
TECNOLÓGICA EN EDIFICACIÓN (CITE 2019)

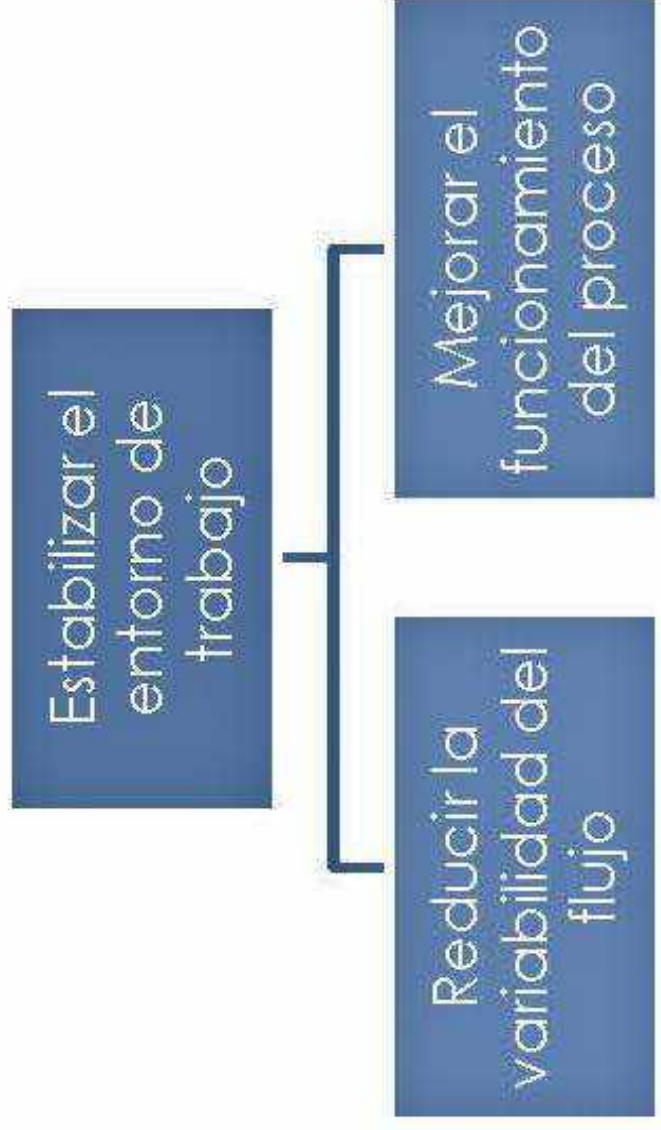


LAST PLANNER SYSTEM[®]



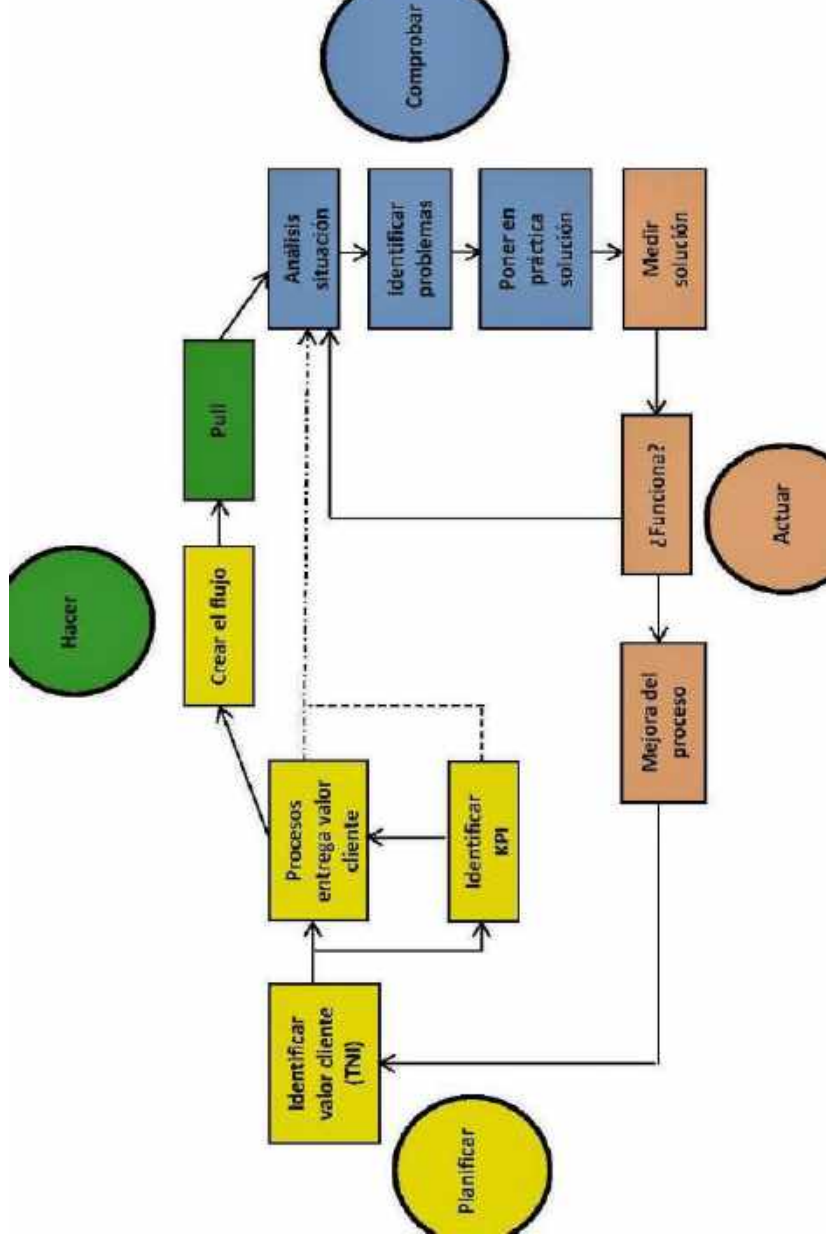


LAST PLANNER SYSTEM[®]



Los principios básicos de Last Planner System[®] (Fuente: Ballard y Howell, 1994)

LAST PLANNER SYSTEM®



Esquema Global del Ciclo de Deming: Plan (Planificar), Do (Hacer, Check (Comprobar) Act (Actuar)
(Fuente: Napolitano y Cerveró, 2013)



LAST PLANNER SYSTEM[®]

Método creado por los profesores Glenn Ballard y George Howell a finales de los años 90

- LA PULL SESSION
- Se abre el programa maestro en paquetes de trabajo más manejables, fases.
- Se ajusta la secuencia y se nivela el flujo de trabajo según la capacidad.
- Se analizan las actividades y se identifican las restricciones. Las actividades sin restricciones formarán el inventario de trabajo ejecutable.
- Se nombra un responsable y fecha para liberar la restricción.

**4º CONGRESO INTERNACIONAL DE INNOVACIÓN
TECNOLÓGICA EN EDIFICACIÓN (CITE 2019)**



LAST PLANNER SYSTEM[®]



Pull Session (Fuente: Blog THINK Productivity, 2013)



LAST PLANNER SYSTEM ®

- **LA PLANIFICACIÓN INTERMEDIA (LOOK-AHEAD)**
 - Gestionar las restricciones y garantizar el flujo de trabajo
- **REUNIÓN SEMANAL**
 - Identificar lo que puede hacerse. Acordar lo que se hará en base a compromisos.
 - Medir el cumplimiento de los compromisos y actuar sobre las causas de su incumplimiento.

**ES UN METODO COLABORATIVO EN EL QUE TODO
EL MUNDO PARTICIPA Y SE COMPROMETE**



LAST PLANNER SYSTEM ®

Permite:

- Optimizar los recursos, reducir costes y mejorar la productividad
- Proteger a la producción de la incertidumbre.
- Identificar tempranamente riesgos y oportunidades.
- Mejorar el ambiente de trabajo consiguiendo una mayor integración y conexión con otras empresas.
- Cada subcontratista se compromete a través de la metodología colaborativa.
- Alentar al equipo a comprender y eliminar las restricciones que impiden el trabajo.
- Entender las dependencias con las otras sub-contratas.



MUCHAS GRACIAS

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²Manuel Soler Severino 2ºAutor;

³Eugenio Pellicer 3^{er}Autor;

- ¹ Filiación 1^{er} Autor: Arquitecto, Doctorando DCTA, ESCUELA TÉCNICA SUPERIOR DE ARQUITECTURA,
UNIVERSIDAD POLITÉCNICA DE MADRID. Correspondencia: miguelangel.alvarez.perez@alumnos.upm.es
- ² Filiación 2º Autor: Dr. Arquitecto, Profesor Asociado DCTA, ESCUELA TÉCNICA SUPERIOR DE ARQUITECTURA,
UNIVERSIDAD POLITÉCNICA DE MADRID.
- ³ Filiación 3^{er} Autor: Dr. Ingeniero de Caminos, Canales y Puertos, Catedrático y Director de la ESCUELA TÉCNICA
SUPERIOR DE INGENIEROS DE CAMINOS, CANALES Y PUERTOS,
UNIVERSITAT POLITÈCNICA DE VALÈNCIA.



CITE 2019

4th INTERNATIONAL CONFERENCE ON TECHNOLOGICAL INNOVATION IN BUILDING
4^o Congreso Internacional De Innovación Tecnológica En Edificación

DEPARTAMENTO DE TECNOLOGÍA DE LA EDIFICACIÓN · E.T.S. DE EDIFICACIÓN
UNIVERSIDAD POLITÉCNICA DE MADRID

CERTIFICADO OTORGADO A:

Miguel Ángel Álvarez Pérez

por su participación como **PONENTE** con la comunicación:

AN IMPROVEMENT IN CONSTRUCTION PLANNING: LAST PLANNER SYSTEM ®

IV CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN (4th International Conference on Technological Innovation in Building)

CITE2019

celebrado en la Escuela Técnica Superior de Edificación de la Universidad Politécnica de Madrid,
los días 6, 7 y 8 de marzo de 2019

El Comité Organizador CITE2018

Carlos Morón Fernández
Director del Departamento de Tecnología de la Edificación
Escuela Técnica Superior de Edificación - UPM



POLITÉCNICA



EDIFICACIÓN



¿Por qué los edificios en España resultan siempre más caros de lo presupuestado, se terminan en un plazo superior al planificado y su calidad es inferior a la prevista en proyecto?



Sistemas Tradicionales de Producción obsoletos

Legislación obsoleta: LOE 1999 (20 años)

LA ALTERNATIVA



Sistema de Producción Toyota (TPS)



Manufactura Lean (sin pérdidas)



Pensamiento Lean (sin pérdidas)



LA CONSTRUCCIÓN SIN PÉRDIDAS (LEAN CONSTRUCTION)



TECNICAS DE LA CONSTRUCCIÓN SIN PÉRDIDAS PARA MEJORAR EL PROCESO CONSTRUCTIVO EN ESPAÑA:



BIM- MAPEADO DE LA CADENA DE VALOR (VSM)-SELECCIÓN POR VENTAJAS (CHbA)- **DISEÑO DE VALOR OBJETIVO (TVD)**
SISTEMA DEL ÚLTIMO PLANIFICADOR (LPS)- PREFABRICACIÓN- **MÉTODOS COLABORATIVOS EN CONSTRUCCIÓN (IPD)**

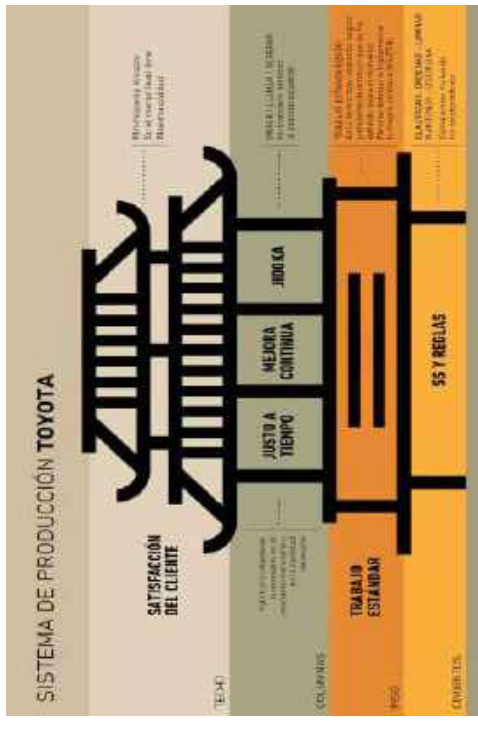
TÍTULO DE TESIS: “LA IMPLANTACIÓN DEL SISTEMA DEL DISEÑO DE VALOR OBJETIVO Y LOS MÉTODOS COLABORATIVOS (TVD E IPD) EN EL PROCESO CONSTRUCTIVO EN ESPAÑA”
UNIVERSIDAD POLITÉCNICA DE MADRID. ESCUELA TÉCNICA SUPERIOR DE ARQUITECTURA DE MADRID. DEPARTAMENTO DE CONSTRUCCIÓN Y TECNOLOGÍA ARQUITECTÓNICAS

DOCTORANDO: Miguel Ángel Álvarez Pérez, arquitecto, PMP.

DIRECTORES DE TESIS: Manuel Soler Severino, Dr. Arquitecto (Profesor de la Universidad Politécnica de Madrid)

Eugenio Pellicer Armiñana, Dr. Ingeniero de Caminos Canales y Puertos (Catedrático de la Universitat Politècnica de València)

SIMPOSIUM “CUÉNTANOS TU TESIS”-UNIVERSIDAD POLITÉCNICA DE MADRID (UPM)-MAYO 2019





UNIVERSIDAD
POLITÉCNICA
DE MADRID

POLITÉCNICA



Miguel-Angel Álvarez-Pérez

Certifico que ha participado simposio "Cuéntanos tu tesis", celebrada en ETSI Agronómica, Alimentaria y de Biosistemas, durante los días 7,8 y 10 de mayo 2019 (20 horas), dentro del Programa de Formación Transversal para Doctorandos de la UPM.

Y para que conste, se expide el presente certificado.

Madrid, a 10 mayo 2019

Certifies that she/he has attended symposium: "tell us your thesis"(20 hours), held at ETSI Agronómica, Alimentaria y de Biosistemas, on May 7, 8 and 10, 2019 within the program of Transversal Training for PhD students of the Universidad Politécnica de Madrid.

Madrid, May 10th 2019

Prof. Andrés Manzón de Cáceres
Director Escuela Internacional de Doctorado UPM
Director of the UPM International Doctorate School





**UNIVERSIDAD
DE SALAMANCA**

CAMPUS DE EXCELENCIA INTERNACIONAL

PURIFICACIÓN GALINDO VILLARDÓN, Vicerrectora de Posgrado y
Planes Especiales en Ciencias de la Salud de la Uni

versidad de Salamanca,

CERTIFICA:

Que **D. Miguel Ángel Álvarez Pérez**, con DNI: 05409142W ha impartido 10 horas de docencia en la asignatura "Costes y presupuestos" cuyo contenido es: Bim, Lean, Kanban, Métodos de trabajo colaborativo en el "MÁSTER EN DIRECCIÓN Y GESTIÓN DE PROYECTOS", Título Propio de la Universidad de Salamanca, durante el curso académico 2018-19.

Y para que conste a los efectos oportunos, expido el presente certificado en Salamanca a veintinueve de mayo de dos mil diecinueve.



**UNIVERSIDAD
DE SALAMANCA**

CAMPUS DE EXCELENCIA INTERNACIONAL
Vicerrectorado de Posgrado y Planes
Especiales en Ciencias de la Salud



9.2.5.- Curso 2019-2020:



9.5.- Curso 2019-2020:

9.5.1 Congresos

25-03 al 08-04-2020

Asisto Virtualmente al V Congreso de Innovación Tecnológica en la Edificación, CITE 2020, celebrado en la ETSEM, UPM.

9.5.2 Actividades de la UPM

27-02-2020

Asisto a la Jornada “Innovación y Emprendimiento en la Universidad” dentro del Ciclo: Emprendimiento para Estudiantes de Doctorado de la UPM.

9.5.3 Índices de Calidad

Junio-Diciembre 2019

Tutorizo dos trabajos Fin de Máster del Máster en Dirección y Gestión de Proyectos de la Universidad de Salamanca, Campus Zamora.

Renovación de mi Certificación Project Management Professional (PMP ®) en el Project Management Institute periodo 2020-2023.

26-03 al 01-04-2020

Asisto Virtualmente al Curso Lean Construction y la Planificación Colaborativa: Metodología de Last Planner System ® organizado por el Consejo General de la Arquitectura Técnica de España.

14-04-2020

Asisto virtualmente a la Jornada ITeC ¿Qué es la Construcción Lean? Impartida por Víctor Roig.

15-04-2020

Asisto virtualmente a la Jornada ITeC Introducción a los Contratos Colaborativos. Impartida por Pedro Júdez.

22-04-2020

Asisto virtualmente a la segunda mesa de debate Lean. “¿Por qué es necesario Lean Integrated Project Delivery? Estado de madurez en España y con respecto



a otros países organizada por el Consejo General de la Arquitectura Técnica de España.

28-05-2020

Imparto un webinar con Miguel Tapia (CEO de CORE P&CM) en ASPRIMA sobre la Construcción Lean e Integrated Project Delivery.

19 y 20-06-2020

Imparto como Profesor 4 clases en el Máster en dirección y Gestión de Proyectos de la Universidad de Salamanca (Campus Zamora). 1ª y 2ª Clase “BIM, Construcción sin Pérdidas (Lean Construction)” y “Métodos colaborativos en Construcción (IPD)”. 3ª y 4ª Clase “Taller de Constitución de un Equipo Colaborativo (IPD) para realizar un Edificio de Oficinas en Zamora.

14-07-2020

Asisto virtualmente a la Jornada: La Filosofía Lean y su integración con las prácticas del PMI, organizada por el Capítulo del PMI de Valencia e impartida por Fernando Rodríguez



CITE 2020

5th INTERNATIONAL CONFERENCE ON TECHNOLOGICAL INNOVATION IN BUILDING
5º Congreso Internacional De Innovación Tecnológica En Edificación

DEPARTAMENTO DE TECNOLOGÍA DE LA EDIFICACIÓN · E.T.S. DE EDIFICACIÓN
UNIVERSIDAD POLITÉCNICA DE MADRID

CERTIFICADO DE ASISTENCIA OTORGADO A:

D. Miguel Ángel Álvarez Pérez

V CONGRESO INTERNACIONAL DE INNOVACIÓN TECNOLÓGICA EN EDIFICACIÓN
(5th International Conference on Technological Innovation in Building)

CITE 2020

celebrado entre los días 25 de marzo y 8 de abril de 2020

Organizado por el Departamento de Tecnología de la Edificación

Escuela Técnica Superior de Edificación (Universidad Politécnica de Madrid)

El Comité Organizador CITE 2020

D. Carlos Morón Fernández

Director del Departamento
de Tecnología de la Edificación
ETSEM - UPM



Dña. MARÍA YOLANDA GUTIÉRREZ FERNÁNDEZ, Directora de la Escuela Politécnica Superior de Zamora,
de la Universidad de Salamanca, de acuerdo con la documentación existente en este Centro,

CERTIFICA:

Que D. MIGUEL ÁNGEL ÁLVAREZ PÉREZ, profesor colaborador del Máster en Dirección y Gestión de
Proyectos que se imparte en esta Escuela, ha tutorizado los Trabajos de Fin de Máster relacionados a
continuación:

Título del TFM:

IMPLEMENTACIÓN BIM A PEQUEÑA ESCALA BAJO PRÁCTICAS DE LA GUÍA PMBOK.
Estudio de caso para un estudio de arquitectura.

Datos del estudiante:

ESTER FERREIRA ABRAHÃO
CONVOCATORIA: SEPTIEMBRE DE 2019

Título del TFM:

IMPLEMENTACIÓN DE LA METODOLOGÍA LAST PLANNER SYSTEM EN LA CONSTRUCCIÓN DE UNA
VIVIENDA

Datos del estudiante:

Rosa Martin Martin
CONVOCATORIA: DICIEMBRE DE 2019

Y para que así conste, a petición del interesado y a los efectos oportunos, expido y firmo el presente
certificado en Zamora, a 17 de enero de 2020

La Directora



Fdo.: M^a Yolanda Gutiérrez Fernández

Project Management Institute

THIS IS TO CERTIFY THAT

Miguel Ángel Álvarez Pérez

HAS BEEN FORMALLY EVALUATED FOR DEMONSTRATED EXPERIENCE, KNOWLEDGE AND PERFORMANCE
IN ACHIEVING AN ORGANIZATIONAL OBJECTIVE THROUGH DEFINING AND OVERSEEING PROJECTS AND
RESOURCES AND IS HEREBY BESTOWED THE GLOBAL CREDENTIAL

Project Management Professional (PMP)®

IN TESTIMONY WHEREOF, WE HAVE SUBSCRIBED OUR SIGNATURES UNDER THE SEAL OF THE INSTITUTE



Randall T. Black
Chair, Board of Directors

Sunil Prashara
President and Chief Executive Officer

PMP® Number 1217037

PMP® Original Grant Date 30 September 2008

PMP® Expiration Date 29 September 2023





*Consejo General
de Colegios Oficiales de Aparejadores
y Arquitectos Técnicos*

*Paseo de la Castellana, 155 - 1.º
Telef. ° 91 570.55.88 • Fax: 91 571.28.42
e-mail: consejo@arquitectura-tecnica.com
28046 Madrid*

D. IGNACIO PÉREZ PÉREZ, ARQUITECTO TÉCNICO, SECRETARIO GENERAL DEL CONSEJO GENERAL DE COLEGIOS OFICIALES DE APAREJADORES Y ARQUITECTOS TÉCNICOS,

CERTIFICA,

Que **D. Miguel-Angel Alvarez Perez**, asistió al **Curso Lean Construction y la Planificación Colaborativa: Metodología de las Planner® System**, organizado por el Consejo General de la Arquitectura Técnica de España celebrado los días 26, 30 de marzo y 1 de abril de 2020, con una duración total de 6 horas.

Y para que así conste, se expide el presente Certificado en Madrid a ocho de abril de 2020.





*Consejo General
de Colegios Oficiales de Aparejadores
y Arquitectos Técnicos*

*Paseo de la Castellana, 155 - 1.º
Telef. ° 91 570.55.88 • Fax: 91 571.28.42
e-mail: consejo@arquitectura-tecnica.com
28046 Madrid*

D. IGNACIO PÉREZ PÉREZ, ARQUITECTO TÉCNICO, SECRETARIO GENERAL DEL CONSEJO GENERAL DE COLEGIOS OFICIALES DE APAREJADORES Y ARQUITECTOS TÉCNICOS,

CERTIFICA,

Que **D. Miguel-Angel Alvarez Perez**, asistió a la segunda mesa de debate LEAN: **Por qué es necesario LEAN Integrated Project Delivery: Estado de madurez en España y con respecto a otros países**, organizada por el Consejo General de la Arquitectura Técnica de España celebrada el 22 de de abril de 2020, con una duración total de 1 hora y 30 minutos.

Y para que así conste, se expide el presente Certificado en Madrid a veintisiete de abril de 2020.



D^a ASUNCIÓN GÓMEZ PÉREZ

Vicerrectora de Investigación, Innovación y Doctorado

HACE CONSTAR,

Hereby states,

Que el/la alumno/a de doctorado, MIGUEL ANGEL ALVAREZ PEREZ ha asistido a la jornada formativa ***“Emprendimiento e Innovación para estudiantes de doctorado”*** (2,5 h) celebrado en la ETS Ingeniería de Montes, Forestal y del Medio Natural de la UPM, el día 27 de febrero de 2020 dentro del programa de Formación Transversal para Doctorado de la UPM.

That the student MIGUEL ANGEL ALVAREZ PEREZ as attended the workshop ‘Entrepreneurship and Innovation for PhD students’ (2.5 h), held at the School of Forestry Engineering and Natural Resources (Universidad Politécnica de Madrid), on February 27th 2020 within the program of Transversal Training for Doctorate of the Polytechnic University of Madrid.

Y para que conste y a petición del interesado/a, firmo el presente escrito en Madrid a 25 de marzo de dos mil veinte.

Madrid 25th of March, 2020