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Editorial:

Lean and Integrated Project Delivery

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Context

The construction industry is unsafe, inefficient, fraught with errors and litigation. Traditional transactional contracts and practices rigidly delineate responsibilities with much elaboration on the consequences of failure. This context reinforces risk-abating behavior, causing project teams to not engage in collaborative processes and presenting an adversarial construction culture, much to the disadvantage of all stakeholders. Owners are losing money on projects, architects and engineers are not seeing the quality of design increase, and constuctors are bearing a great deal of financial burden and risk in the process. Construction may be best described as a "wicked problem" fragmented by the complexity of the subject, social interactions and latent technology (Conklin 2005). The results of this fragmentation have been quantified in terms of waste and poor productivity.

In 2007 Paul Teicholz of the Center for Integrated Facility Engineering (CIFE), Stanford University, calculated the productivity within the U.S. field construction industry relative to all non-farm industries from 1964 through 2004 (Eastman *et al* 2008, 8-10). During this 40-year period US productivity outside of construction has doubled while labor productivity within the construction industry is estimated to be 10% less than what it was in 1964. Labor historically represents 40-60% of construction's estimated costs. Owners are therefore actually paying 5% more in 2004 than they would have paid for the same building in 1964. Likewise, Horman and Kenley (2005) report that across a variety of circumstances and contexts, 49.6% of construction operative time is devoted to wasteful activities. Granted buildings are much more complex from a systems and performance perspective today than they ever have been, yet other industries harnessing integrated processes have increased productivity *and* increased customer value (Kieran & Timberlake 2003).

Conceptually, during the lifecycle of a construction project, a project team is responsible for transforming labor and material into a building.

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> *In other words, design and construction can be viewed as a series of activities, where some add value and others do not. There are numerous time-consuming, non-value-adding actives in the design process, such as correction of errors and rework, the physical handling and organization of documents, and transportation, inspection, and movement during the construction process (Eastman, et al 2008, 330-1).*

The key to overcoming this inefficiency in the industry is to identify waste in construction and determine a method for removing waste and replacing it with value adding possibilities. Various strategies and tactics have been developed in order to accomplish such. As an answer to the waste, litigation and lack of integration in the industry, in 2000 Ballard proposed a high level map of the end-to-end design, construction, facility management and demolition cycle — the Lean Project Delivery System (Ballard 2000a). For the last four years The American Institute of Architects has been championing Integrated Project Delivery developing methodologies and contracts to support integrated philosophies (Cohen 2010).

In the UK in 2002 the Strategic Forum for Construction published 'Accelerating Change', which also called for integrated project teams, integrated supply chains and integrated work flows (Egan 2002). In 2008, the Construction Users Round Table (CURT) published 'Key Agent's of Change' redefining lean construction as lean project delivery to emphasize that the principles of lean are about the entirety of the building industry, including owner, design and construction teams (Sowards 2008).

A key tenet in the exploration of integrated and lean processes is the exploitation of building information modeling, an information rich solids 3D modeling concept that encourages building virtually before building physically. The ultimate implementation of BIM would be an open-source platform where building projects are digitally conceived, programmed, designed, visualized, subjected to various simulations, reviewed for code compliance and constructed directly from the digital model which then would serve the owner in operating the facility. The BIM model (or models) would be a series of interconnected data structures and be directly accessed by all project participants. The realization of this goal would change how projects are created at every stage, yielding new models of design and construction practice. While theoretically feasible, this ideal faces many serious obstacles in reality. Every year researchers and software vendors are making advances in BIM technology (Smith 2010, 72–73).

In a 2010 issue of AEC Bytes, Randy Deutsch reminded his readers of GSA's Charles Hardy's statement "BIM is about 10% technology and 90% sociology". Deutsch went on to assert "ninety percent of what has been written, analyzed and studied about BIM so far is the technology. While the 10% technology works itself out," he continued, "we would as an industry do well to turn our attention toward the 90% that we share, the sociology of Integrated Design."

Therefore, lean construction and integrated design and construction are nothing short of a paradigm shift that has systemic implications that are social, cultural, legal, environmental, and economic that gives rise to process questions such as:

- How can the design and the build team integrate effectively to deliver more value for the client?
- How can integrative digital technology support designers and constructors working together?

- What additional collaborative skills do project stakeholder participants need in order to integrate effectively?
- What processes and commercial arrangements such as compensation, contractual obligations and otherwise help project teams work together to create the value that clients, owners and users want?
- What barriers must be overcome to create the desired value?

The articles in this special issue of the Lean Construction Journal work to ask timely questions and begin to find answers to how design teams and the build teams can integrate effectively in order to deliver more value for owners. This topic is explored through the lens of two tools of engagement: Lean Project Delivery and Integrated Project Delivery. The editors sincerely hope that this will spawn continued discussion on the relationship between these delivery systems, in order to foster additional operational methods and aid in realizing a more socially innovative, productive, context in which buildings are realized.

The four papers in this special issue approach the subject from a variety of viewpoints.

- **Singleton & Hamzeh** take an owners stance to examine the relevance of IPD for construction procurement for the US Navy;
- **Cho & Ballard** examine the contribution Last Planner makes Integrated Project Delivery;
- **Ghassemi & Becerik-Gerber** look at the barriers to Integrated Project Delivery and what can help AEC professionals surmount them
- **Kim & Dossick** ask *What makes the delivery of a project integrated*? In the case of the Children's Hospital, Bellevue, WA project.

Lean Project Delivery

In 1950 after World War II, Eiji Toyoda, visited the Ford auto manufacturing plants in the US and returned with a mission to extend Toyota's impact globally, taking on the super manufacturers of the day. Eiji felt that using the American System of Manfuacturer methods would not accomplish this; they needed to take the best from Fordist mass production and adapt it to achieve high quality, low cost, and flexible outputs. Toyota determined that the best way to accomplish this was to remove waste from production (Liker 2003). Today, the principles of what became the Toyota Production System (TPS) are known more widely as "lean production". Much has been written about lean production, including Womack and Jones's book *Lean Thinking* (1996) that adapts the principles of Toyota to more conventional business practices.

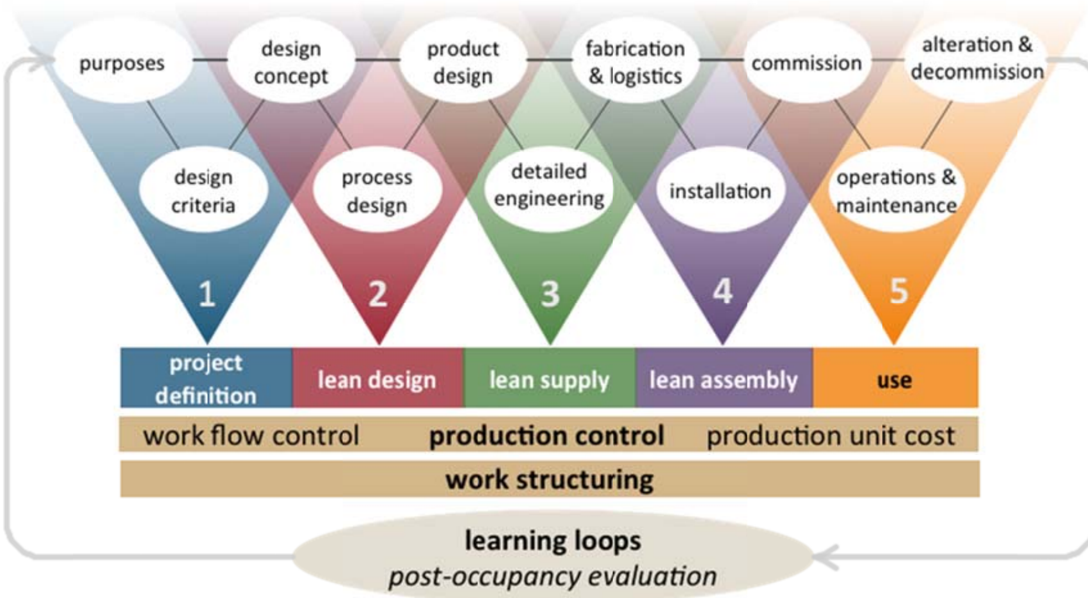

Figure 1: The Lean Project Delivery System™ (after Ballard 2000b).

Lean construction adapts lean thinking to the construction industry. The Lean Project Delivery System (LPDS) is a product of the Lean Construction Institute founded by Howell and Ballard to develop a leaner way to design and build capital facilities (Ballard 2000b). LPDS uses an approach to project delivery that works to dissect the physics of design and construction in order to remove waste at each component. LPDS consists of 13 modules, 9 organized in 4 interconnecting triads or phases extending from project definition to design to supply and assembly, plus 2 production control modules and the work structuring module, both conceived to extend through all project phases. (Figure 1). The post-occupancy evaluation module links the end of one project to the beginning of the next. Designed to support a new and better way to design and build capital facilities, LPDS captures both the linear and the iterative nature of the design and construction process and recognizes the importance of certain aspects of design and construction happening in parallel rather than sequentially.

Last Planner®, also a trademark of the Lean Construction Institute, manages production control in the LPDS and is the primary tactic by which LPDS is delivered. Emerging from studies of construction production and productivity by Howell and Ballard in the 1980s and first published in 1994, Last Planner, is a construction specific system designed to improve production predictability in project-based environments.

LPDS and Last Planner are production management theories and methods for creating successful project outcomes — including cost, schedule and scope (Ballard 2000b).

The keystone of both LPDS and LPS is people. Lean project delivery works when individuals make and keep commitments. Trust and relationships develop on the basis of reliable promises. The Last Planner System is a *commitment management system* and its principal metric is *PPC,* a measure of planning quality, which is the percentage of promises (to do work in the next week or day) completed when promised. Lean is a communication rich and controlled process of construction production that builds on the principles of lean production and operational control found in manufacturing (Macomber Howell & Reed 2005).

Apart from LPDS & Last Planner *tactics* used within lean construction include:

- **Value Stream Mapping**: By mapping the current value stream of the "product", or the building, waste can be identified, plans for removing the waste and the process is further optimized for the future. This is iterative, requiring teams to constantly be working to refine and optimize the design of the project delivery, rather than reworking at a later date (Salem & Zimmer 2005; Yu et al 2009).
- **Target Value Design** (TVD): TVD brings designers together with constructors from the start of design to create the value required by the customer with the customer's allowable cost. The process doesn't begin until there is agreement among the parties that the clients' request is reasonable – that only follows a detailed validation of the business case. TVD requires early and intensive collaboration and integrated knowledge share and decision-making (Ballard 2009; Long et al 2007).
- **Set Based Design**: This enables a range of discipline specialists, including constructors, to develop a set of possible solutions to product and production design problems and then to decide at the *last responsible moment* which combination of options they will go with. Deciding at the last responsible moment
    - allows the project team time to develop a number of design options in parallel and then choose between them with agreement among stakeholders.
    - reduces the need for later rework (Ward et al 1995, Sobek et al 1999, Kennedy 2004, Morgan & Liker 2006, Ward 2007).

Integrated Project Delivery

IPD, like LPD, defines a new way of being and a new set of relationships in a project. IPD is generally supported by a multi-party relational agreement that supports this new way of being. In the words of Darrington *et al* (2009):

> *traditional construction projects are comprised of many two-party contracts that create a vertical chain of relationships that flow back to the owner, but do not interconnect project participants across contractual lines. As a result of this contract structure, each participant operates under commercial terms that provide economic incentive for it to maximize its own interests regardless of whether its actions would hurt other project players or benefit the project as a whole. (see Figure 2)*

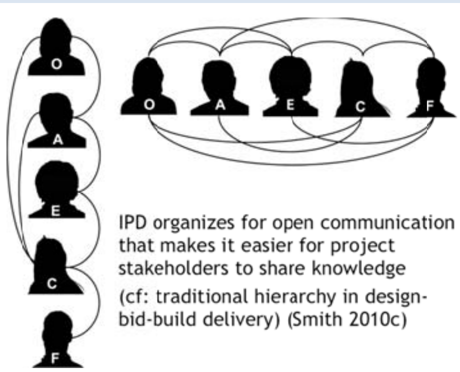

Figure 2: Traditional vertical & IPD flat relationship structure

Traditional contracts are transactional, yet construction is effected through relationships that encompass a myriad of transactions, which is why proponents of integrated delivery prefer to work with relational contracts that recognize the reality of what needs to happen for successful project delivery. Encouraging collective sharing of risks and cost savings, relational agreements enable parties to treat projects as collective enterprises, optimizing the project as a whole and enabling the movement of money across traditional commercial boundaries.

IPD contracts

The first multi-party relational agreements in the construction sector were developed for and by the UK offshore oil and gas industry in the 1980s. There are now a number of different relational agreements available internationally:

- Integrated Form of Agreement for Lean Project Delivery (USA 2005)[4]
- AIA C191-2009 Standard Form Multi-Party Agreement for IPD (USA 2009)[5]
- ConsensusDOCS300 (USA 2007)[6]
- PPC2000 & PPC2000 International (UK 2000)[7]
- Alliancing Agreements (Australia, Finland, evolved from UK agreements developed in 1980s)[8]

Relational contracts create a collaborative system with shared responsibility for managing and sharing risk and incentives tied to the amount of value generated by the end product (O'Conner 2009). The Integrated Form of Agreement, first published in 2005, requires the use of lean methods and Last Planner (Lichtig 2007). All others have components that resemble lean principles, but use their own approach to integrated delivery. As an example, in the United States, two industry organizations have led in publishing contracts that take the desirable elements of both design build's speed and information sharing, and performance contracts that emphasize outcomes via shared risk and incentives.

In 2008 The American Institute of Architects (AIA) published two separate Integrated Project Delivery (IPD) families: the so-called transitional AIA A295, built on a construction management at risk model as a transition to more aggressive relational contracting, and the Single Purpose Entity (SPE) family, developed as the contract embodiment of the principles espoused in Integrated Project Delivery: A Guide, published by the AIA in 2007 (Cohen 2007). Based on a cut down version of Lichtig's IFoA, ConsensusDOCS published its Standard Form of Tri-Party Agreement for Collaborative Project Delivery, more commonly referred to as ConsensusDOCS 300 in 2007.[9]

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4 http://www.mhalaw.com/mha/newsroom/articles/ABA_IntegratedAgmt.pdf

5 http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aiab081563.pdf - list of distributors from: http://www.aia.org/groups/aia/documents/pdf/aias076340.pdf

6 http://consensusdocs.org/catalog/300-series/

7 http://www.ppc2000.co.uk/buyppc.htm 17apr10

8 There currently is no standard form Alliance agreement.

9 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.

The AIA developed IPD contracts from product design and production deliveries such as the automotive industry. Effectively, the project players under SPE become a limited liability company. Although all are under one entity, project players, such as the architect, may receive reimbursement for the costs they incur and may earn profit through performance. Providing incentives during the construction process provides motivation for architects, engineers, constuctors and fabricators to work collaboratively so all benefit. If one earns a profit, all earn a profit. Likewise, the team agrees to indemnify one another in the event of litigation, causing all disputes to be resolved outside of the courtroom (Ashcraft 2010).

The key tenets of IPD found in five case studies that used the integrated contract structure (Figure 3) show the following performance characteristics (Cohen 2010):

- Early Involvement of Key Participants
- Shared Risk and Reward
- Multi-Party Contract
- Collaborative Decision Making and Control
- Liability Waivers Among Key Participants
- Jointly Developed and Validated Project Goals

In addition stakeholders (primary contract holders) reported the following desirable characteristics on the project case studies:

- Mutual Respect and Trust Among Participants
- Collaborative Innovation
- Intensified Early Planning
- Open Communication within the Project Team
- Building Information Modeling (BIM) Used by Multiple Parties
- Lean Principles of Design
- Construction, and Operations
- Co-Location of Teams ("Big Room")
- Transparent Financials (Open Books)

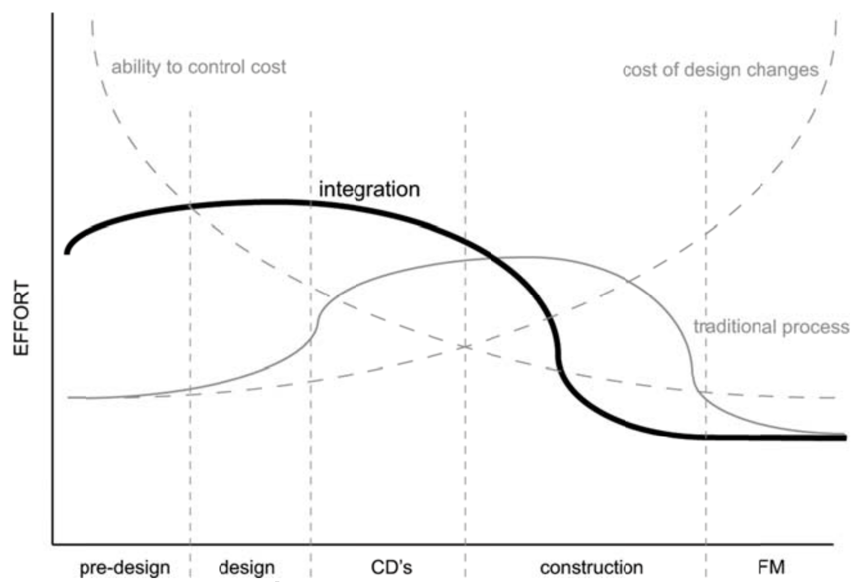


Figure 3: MacLeamy Curve

The “MacLeamy Curve” illustrates the concept of making design decisions earlier in the project when the opportunity to influence positive outcomes is maximized and the cost of changes minimized, especially regarding the designer and design consultant roles.

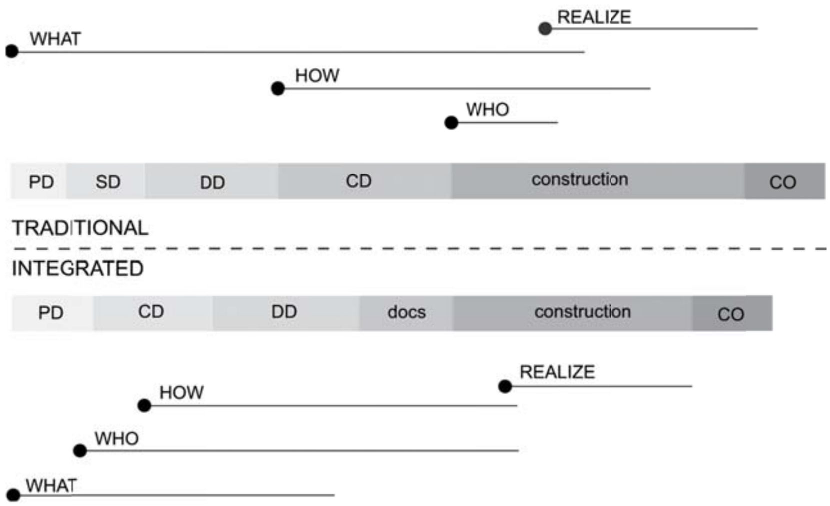


Figure 4: IPD Workflow Mapping

The project flow from pre-design to closeout in an integrated delivery is different from traditional in that it does not use the conventions of SD, DD, CD that tend to create workflow barriers. These phases of a traditional design process do not encourage collaboration.

With the constructor and key specialist constructors – such as subcontractors that have a major stake in the project delivery – & the designers (the WHO) are involved in clarifying project purpose and scope from the outset, and then in design, production design (the HOW) can proceed alongside that of the product (the WHAT) – the two are inter-dependent (even if they have not been treated as such in traditional delivery). Some involved in IPD are suggesting that the design process is now shifting from 4-phases to 2-phases.

In an integrated delivery, documents are simply an extension of early decisions regarding ‘how’ or the design of production shortening the overall time of design delivery. In projects employing a high degree of offsite fabrication, they may take the form of bridging documents, allowing the fabricator to develop elements of package for construction. Early participation of regulatory agencies (RA), specialist constructors, and fabricators allows shortening the documentation and construction phases (Smith 2010, 58–59)

LPDS & IPD Dialectic

Figure 4: Delivery system's three domains: organizations, operating system and commercial terms

Lichtig has proposed three domains of project delivery (Figure 4): the project organization - how the parties participating in the contract are organized; the project operating system - how the project is managed on an overall and day-to-day basis; and the project commercial terms - the contractual responsibilities and associated compensation (e.g. Thomsen et al 2010, 10-11).

Traditional construction is dominated by transactional and adversarial commercial terms supported by a centralized Critical Path based operating system and a wary organization forever looking over its shoulder and ready at any moment to cover its arse.

The challenge to the traditional ways of doing things emerged initially from the adoption of a new collaborative operating system that focuses on both what SHOULD be done and what CAN be done. Last Planner made apparent waste in other domains and led some owners, constructors and designers to experiment with more collaborative ways of working. This in turn led to a good hard look at the adversarial commercial terms that led to the production of the Integrated Form of Agreement in 2005.

AIA California Chapter subsequently christened elements of this *package* Integrated Project Delivery – IPD. The domain most commonly omitted from IPD manifestations is the operating system – Last Planner. Therefore, IPD is primarily a relational legal framework that aligns the interests of project participants with those of the owner.

Developed five years before research on relational contracts within the lean construction community, LPDS is primarily a map of a collaborative process that aligns the collaborative project organization and the project operating system (i.e. Last Planner, Target Value Design, Set Based Design, etc.) without reference to any specific commercial terms. It can be made to work in any commercial/contractual environment — in some more easily than in others.

LPDS approaches problems related to production in construction both in physical and in systems terms believing that issues of organization and contract can only be resolved by assuring they best manage the *physics* of production. This approach is in contrast with efforts that start with issues of motivation and contract and never come to grips with the work itself (Howell 1999).

IPD contracts, with one notable exception (IFoA) focus their attention on changing just the organization and commercial terms. Cohen (2010) suggested that

> *"Within the industry, there is a fair amount of confusion about the difference between lean construction and IPD...*

but then went on to add to the confusion by suggesting that:

> *Lean construction is a production control system that seeks to apply principles of the "Toyota Way" of manufacturing to the construction process. Just as BIM is a tool that is useful, but not in itself sufficient for implementing IPD, lean construction is a set of tools in support of IPD but is not the entire process."*

In our view Lean Construction is more than just a production control system and more that simply a set of tools — it offers a new way of thinking about and managing work in projects. As many of the cases Cohen reviewed demonstrated, LPDS has much to contribute in an IPD contractual environment.

Both LPDS and IPD are built on a collaborative ethic, both look at the end-to-end design and construction process, and as with any social complex enterprise, the differences follow the different viewpoints of the authors. For example, IPD is written from a design perspective - that of architects and engineers, while the authors of LPDS came from a construction production background.

These differences of context from design and construction are played out in their respective approaches to business strategy.

Business Strategy

Businesses can be generally categorized as service or product. Service organizations have a high degree of user and client interaction relying heavily on customer input at various intervals. As interactions and inputs increase, inefficiencies do as well. Product industries on the other hand have less direct client interaction and are more focused on reducing time invested for output generated. Construction is both a service and product industry involving service processes and non-service activities. The design professions rely primarily on a service model of delivery, meeting client needs and generating ideas, while constructors are typically concerned with producing a product – but as Jim Caroll, then of the Washington Group, said some years ago:

> *An Owner needs to decide what it's buying - a product - or a team to solve a problem that no one completely understands and that keeps changing*

This is just as true in the post design phase as it is in pre-construction – as client needs continue to emerge and change.

Both designers and constructors want to do more with less. IPD and LPDS approach this aspiration from their similar but different perspectives. In order for these systems to work together both the overarching service aspects and the production aspects of construction must be brought into closer alignment.

Ironically, the small differences between design and construction, service and product, manifest in IPD and LPDS, highlight the very purpose of lean and integrated delivery – to provide a common platform by which the parties may communicate.

Despite their different viewpoints and approach to business, IPD and LPDS have many similarities and are in reality complementary. Highlighting these differences helps not only to illustrate how similar they are, but more importantly, to identify the communication and cultural barriers that need to be overcome.

Perhaps the most important lesson of the LPDS and IPD dialectic is the likelihood that both will be replaced by a new improved way of being. As Mark Dodgson (1993) writes in *Technological Collaboration in Industry*:

> *There is no one correct solution or answer for every alliance; each one must be designed and managed in its own unique fashion to fit its own circumstances…. The innovation process is iterative, and its management should be integrated throughout its various stages. Strategic management cohesion is necessary through the process.*

Conclusion

The papers in this special issue do not explicitly differentiate Lean Project Delivery System from Integrated Project Delivery, rather suggest that every strategy and tactic that increases the value for the client and end users is moving the integration paradigm to continue to shift the fundamental practices of how buildings are designed and delivered in a positive direction. But in the end, strategies and tactics determine the methods for practice. LPDS and IPD are current good practice for increasing value in delivery, and as with any process they can be improved. What is needed is both theoretical and applied research of integrated and lean delivery in the form of models and tools and their application in case studies that effectively realize project success goals through their implementation. This journal is one venue for this kind of case study research. The editors would call for a movement toward project documentation and reporting to develop databases of projects that work toward the goals of both LPDS and IPD[10].

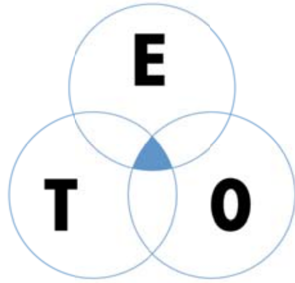
Theoretical models will take the performance data from the case studies and continue to refine and develop additional tools to the wealth of resources in LPDS and IPD. Tornatzky & Fleischer (1990) outline three criteria that have proven necessary for complexity to thrive within collaborative contexts in other industries (Figure 5):

- environment,
- organization and
- technology.

Environment refers to the social, cultural, infrastructural, political, and market context in which buildings develop. Organization refers to linkages, communication, and responsibility given to building industry participants. Lastly, technology includes the availability and characteristics of the digital tools and material technology itself.

These factors are interdependent, autonomous yet impacting one another systemically. Out of balance, the system cannot be sustainable.

[10] www.leanlearninglab.co.uk is one such repository for project information



The kernel in the center represents the sustainable balance of factors that have proven necessary for complexity to thrive in collaborative contexts in other industries (Smith 2010, 47-48).

Figure 5: Environment Organization and Technology Venn diagram.

Table 1 shows the links between the papers in this special issue and these factors.

Table 1: connections between the papers in the special issue and Environment Organization and Technology

authors|title	**E**	**O**	**T**
Singleton & Hamzeh: Implementing IPD on Navy Construction Projects	◆	◆	❖
Cho & Ballard: Last Planner and Integrated Project Delivery	❖	◆	❖
Ghassemi & Becerik-Gerber: Transitioning to Integrated Project Delivery: Potential Barriers and Lessons Learned	◆	◆	❖
Kim & Dossick: What makes the delivery of a project integrated? a case study of Children's Hospital, Bellevue, WA	❖	◆	◆

◆ = strong connection; ❖ = weak connection

Singleton and Hamzeh's paper titled *Implementing IPD on Navy Construction Projects* evaluates which techniques contained within IPD and their associated efficiency improvements and waste reductions may directly benefit NAVFAC projects and public sector construction projects in general. As this paper is written from the perspective of a specific owner and three specific case studies, its environmental context is important to the study. The authors identify numerous integrated techniques that could be successfully implemented on NAVFAC projects with no changes to contract laws and resulted in an organizational tool which can be helpful in identifying which projects are preferred for implementing the IPD techniques identified.

Cho and Ballard's paper titled *Last Planner and Integrated Project Delivery* reports on the correlation between the degree of implementation of Last Planner and project performance. The authors surveyed 'Lean' projects known to adopt Last Planner, including IPD projects, to determine the correlation between Last Planner implementation and Project performance (cost reduction + time reduction); and a T test between IPD and non-IPD projects. The paper is extensively analytical focusing on the organizational physics of lean and integrated delivery. Industry practitioners to design project delivery systems for better performance can use the findings from this paper.

Ghassemi and Becerik-Gerber's paper titled Transitioning to Integrated Project Delivery asks how architecture, engineering, and construction (AEC) professionals overcome the most prevalent barriers of implementing IPD. The paper identifies and reviews how 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. It focuses on environmental and organizational aspects of IPD case studies including selection and integration of players, trust, training, procurement ability and collaborative technology.

Kim and Dossick's paper titled *What Makes the Delivery of a Project Integrated* identifies five contributing factors to the integration of project delivery including contract type, IFOA (integrated form of agreement), culture, organization, lean principles, and building information modeling (BIM). These principles are evaluated through a single case study. The findings suggest primary organizational and technical component strategies to overcome barriers to integration including contract structure, lean tools and BIM.

Further research

We suggest the following research topics for further investigation in integrated and lean delivery. We have grouped the recommendations under Environment, Organization and Technology headings:

- **Environment:** The socio-technical variables that inform the fragmentation of design and construction cannot be treated simply as an operational problem (Tombesi 2010, 135). Transformations in the building industry require both an understanding of physics of project delivery, and the social, cultural, behavioral context in which building practice unfolds. This includes the political and market structures in relation to project delivery, project type, project site and project budget dynamics (every project is unique).
- **Organization:** Continued research and development of Value Stream Analysis, Design Structure Matrices, Target Value Design, Set Based Design and other approaches and metrics for increased predictability and control in design can provide project teams with a wider choice of tactical methods for accomplishing the strategies set forth by both LPDS and IPD. This is closely related to developing methods to evaluate the capability of integrated contracts to support collaborative working from conception to completion.
- **Technology:** BIM has many technical obstacles that must be overcome through research and development to have greater impact as a tool for integrated delivery including adoption, interoperability, ownership and storage of models, personnel training and overhead, and document signing (Thomsen *et al* 2010, 48-58). IPD and LPDS both encourage greater linkage between design and production design, building information modeling and fabrication information modeling. How much further can this process be taken? BIM enables virtual construction. There are already scholars exploring how to take 3D models to the workface on tablets and plasma screens and companies experimenting with it. Beyond BIM, we would like to see socio-technical research to improve flow in production phases of project delivery.

  BIM is a disruptive technology in design. Disruptive technologies have upset many other industries and caused them to be totally rethought. We wonder when this will happen in both construction and in design for construction and what scholars can do to support our industry to develop its agility and adaptability – and, when the disruption comes, to adapt to the inevitable social, environmental, organizational and technical changes.

These topics for continued research in lean and integrated process in construction demonstrate the continuing need for an increasingly broad and systemic view of the industry on behalf of all stakeholders including owners, architects, engineers, constructors, specialists and users. Without these different perspectives, it is difficult to

- identify the structural and social barriers to process innovations such as LPDS and IPD; and
- understand the differences that make the difference in the field and in the design studio.

The integrated way of being requires not just a change in thinking, but changing the methods of work, the nature of the relationships that support the work (as socio-technical theorists have noted *when you upgrade technology (e.g. BIM IPD) it is important to upgrade the social system as well*) and changing research processes (Tombsei 2010, 121).

Finally, this is a call to the professions, trades and especially to researchers to engage in an integrated model of practice that addresses the complexity of the challenge and the opportunity before us.

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