



Introduction

Thank you for inviting me to speak at the Harvard Business School. We are fans and have read many of the HBR articles and papers. John Macomber asked us to “go deep” when responding to his questions about the construction process during IPD. Therefore, I reached out to leaders across DPR to contribute their thoughts to John’s questions. The written version of my remarks include contributions from George Pfeffer, Dick Kerzic, Tom Krajewski, and Dean Reed, all of whom are responsible for providing thought leadership and delivering Integrated Project Delivery and Lean projects for our customers.

WORKING EFFECTIVELY WITH SUBCONTRACTORS AND BUILDING PRODUCTS COMPANIES

Question #1: What are the opportunities and exposures with respect to: shop drawings, supply chain visibility, extending the collaborative agreement to key subs?

Extending IPD Agreements to Key Subs

Extending IPD Agreements to key Subcontractors only enhances the entire project team’s ability to reduce waste, cost and time to market. Opportunities in several areas include: 1) detailed input into design scope and layout, 2) integration of prefabrication into design, 3) providing detailed cost as an input to design, and 4) providing visibility to delivery and costs in the Subcontractor supply chain.

Integrate Fabrication & Delivery with Design/Cost as Input to Design

We can integrate fabrication and delivery with, and make cost an input into design, resulting in a lower total overall cost.

Let the designers design for aesthetics and function, and let the suppliers do the fabrication drawings and production. This eliminates unnecessary effort for the architect and, in fact, allows him/her more time to get the design and function correct.

Selecting & Committing Early

The issue for many Owners, and for us as well, is committing so early to one or another Subcontractor. IPD is not for every sub firm or supplier. They have to “get it.” Exposures largely involve the early commitment to Subcontractors and spending more money upfront. However, our evidence over the last couple of years is clearly resulting in significant paybacks in value for projects that bring on the right Subcontractors earlier into the design process.

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We involved a design-build HVAC/Plumbing contractor early on the AIA National Headquarters Renovation, and they jumped headlong into BIM and transformed their company's design effort and field operation. Now, they lead the DC Metro area in their Virtual Design capabilities. Our team set a budget and continued to refine it as design progressed, always heading in the right direction of greater savings. With true IPD, the entire savings comes to the team, not just the sub as in other delivery models.

For certain issues, we, sometimes, tend to think of Owners as those outside the thoughtful consideration of integrated process. At its core, IPD must, first, be a commitment by the Owner and driven by the Owner. With that mindset it an easy leap to understanding and developing controls and processes for selecting and committing early. This is why educating Owners to the benefits and processes of IPD are so important.

Supply Chain Visibility

Committing Before Supply Capabilities Understood

We ask specialty contractors to bring in the team they will put on a project so we can discuss their ideas and capabilities to manage their supply chain along with ideas they will bring for creating greater value.

Know Before It's Too Late

Finally, we can see into the fabrication shops and know when materials and equipment will really be delivered to the jobsite. Here is an "all too typical" story from one of our projects: The college preparatory school that all of my children have and are attending. We recently completed construction of a new classroom building after dealing with the problems caused by not getting the right materials or by getting them at the wrong time. This happened with metal decking, cladding tile, and casework.

We ended up spending 15% of the contract value for casework on expediting and overtime to make up for late delivery. Here's what happened. It took 4 months for the subcontractor to produce the shop drawings, 2 months for the architect to review and ultimately reject them, another 2 months to resubmit and still another 2 months before the drawings were approved and released for fabrication. After all that time, they would have arrived far too late, which prompted our project team to do what they could to make up time.

The construction team needs to identify those interim milestones to monitor work as it progresses, not just rely on anyone's word that it will show up on time. We, as the General Contractor, must understand everyone's work to be able to support the full team's effort.



Getting It Wrong

Taichii Ohno, the principal developer of the Toyota Production System explained that his goal was: "To produce the right product at the right time in the right quantity for the customer and to produce exactly what you need and nothing more..." That's what we'd like to do as well. But it's easier said than done.

We all have no choice but to be sure that material and equipment arrives before the earliest date it might be installed. And, we want to error on the side of too much rather than too little. That leaves us with piles of material to move an average of 3 to 5 times before they are installed.

The key to Just-in-Time delivery is to stabilize actual construction. That requires our operations people and Subcontractors to leverage BIM and master production planning. We are concentrating on doing this, but recognize that it takes serious effort and some time to develop these skills.

Shop Drawings

Concurrent with Design

Shop drawings are done as part of design, as what the AIA now calls the "Implementation Document." These models and drawings are done concurrently with design. We are eliminating a time consuming step.

This sequence eliminates the unnecessary activity of Architectural drawing details that have no relevance to the final product. Concern for the interface/overlaps is where the energy needs to be spent. Let those that know their product best provide the details that are most important to its integrity. Doing this early also sets us up to pre-fabricate much more than when the shop drawings are done late in construction.

Pressurizes Design

Building the project virtually during design and creating the construction documents from the 3D model, puts much greater responsibility on the Owner to decide and the A/Es to freeze the design. We've noticed that IPD projects essentially look very much like Fast-Track Design-Build projects.

Question #2: Can waste in the construction phase be reduced? Which waste and why?

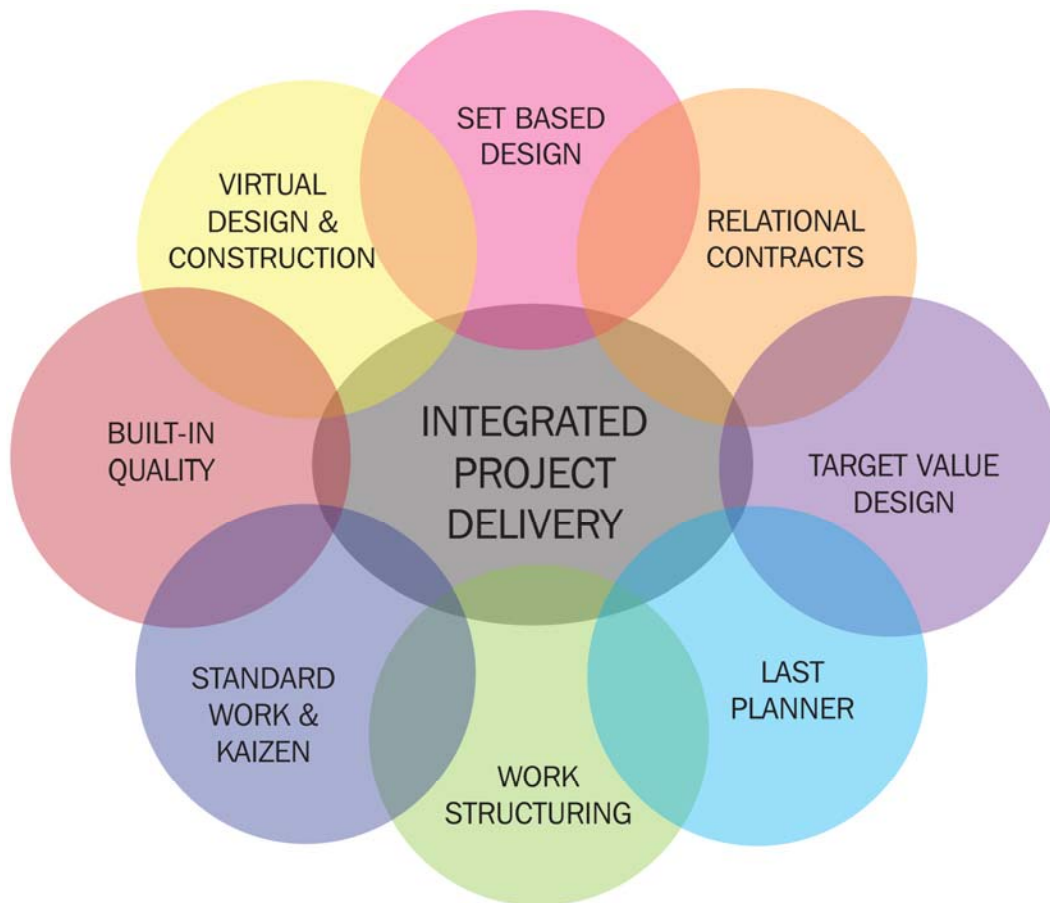
Can Waste in the Construction Phase Be Reduced?

Like GM...

Without question! We are back where GM, Ford and Chrysler were in the 1970s compared to Toyota. We just don't see the waste because much of what we do is to protect ourselves from risks and uncertainties created by working in silos.

Sub-Optimization

What we fight every day on all but IPD projects is what the Lean people call "sub-optimization"—organizations, whether design firms or contractors, focusing first on their own interests. All goes back to that planning concept that if we know the entire project team's needs, we can all more efficiently produce better results.





Which Waste and Why?

General Conditions

We are now consolidating jobsite offices into a single trailer and sharing office staff and even pooling administration. Besides dumpsters and clean-up, we are planning to centralize material handling and to share equipment such as fork and man lifts.

Prefabrication vs. Build Onsite

Prefabrication keeps materials off the floor (out of the way of workers), eliminates moving it a minimum of 3 times, and makes it safer. It also allows for the right installation the first time, which eliminates rework. On the Camino Medical Group Mountain View Medical Center, the HVAC contractor had only 43 man-hours of rework out of 25,000 spent on rough-ins.

Labor

As with many businesses, the largest cost is labor. It follows that the largest opportunity for savings or reducing waste is labor. There is a lot of humor in the construction industry built upon the idea of waste: like five men leaning on shovels watching one man dig; or redoing something and saying “we should have looked at the drawings first.” There is tremendous waste as a result of poor or lack of daily and weekly planning. The reality is that we need more planning and re-planning to account for all of the variables in the construction equation—not less.

Question #3: What are the pros and cons of collaboration vs competition with respect to subcontractor prices?

Competition on 1st Cost

Best Value Competition & Collaboration

With all due respect to John Macomber and Harvard Business School, I want to say that we don't see this as a question of competition or collaboration. We want, and are trying our hardest, to get both.

Our method is to establish a baseline, set targets, and challenge competing firms to innovate. We choose one of these firms, who we've already pre-qualified based on past performance, as well as the particular people they are proposing for the project.

Savings

Savings will hit the incentive sharing pool, and if the right partner is selected, they will have identified efficiencies in other trades' work relative to their own to save even more costs.

DEALING WITH THE UNEXPECTED, UNANTICIPATED, OR CHANGED

Question: Unanticipated items. What if there is a change, a concealed condition, a substitution? Opportunities and obstacles for the product and the cash flow?

Change, Concealed Condition, Substitution?

It depends on when the change happens. We build virtually like we build physically: floor-by-floor and area-by-area. This requires that we lock-in the major design elements, and we must carefully plan and manage the design. So a user change during design is not free of impacts and cost, but it is certainly much easier and cheaper to incorporate than during construction. Plus we can understand the impact of the change much better with BIM because we can see it.

More upfront input from stakeholders, and more design decisions earlier means more front end costs, but saves on back end. If possible, spend some time examining “concealed conditions” in the early stages using above-ceiling laser scans or live field inspections. This can reduce standby and redesign costs during the most costly phase of construction.

Changes made by the Owner are inevitable. In a Lean, collaborative environment, there is greater demand on everyone, including the Owner. Everyone needs first to deeply understand the issue, and second, explore “many” solutions and carry more than one forward. Many seemingly arbitrary changes are avoided with this methodology.

Opportunities and obstacles for the product and the cash flow?

The industry is moving to a model of offsite fabrication and onsite assembly, away from stick-by-stick construction onsite. This will require more money earlier but allow us to reduce, but not eliminate, contingencies to account for a poor supply chain.

PRACTICE MANAGEMENT, STRATEGY, INVESTMENT

Question: Strategy, people, investing, hiring. What does a “former” GC firm have to do for investing and hiring and filtering opportunities if it expects to compete in the IPD world? Will this change the structure of the industry?

Investment

Organizations must prepare for a different world to succeed in it.

This preparation does and will continue to cost money, to be paid by organizations operating on even slimmer profit margins. Just look at the investment many of us have made in BIM!

Employee Development

By far the largest investment is training our staff and field forces to become effective facilitators of IPD, while thinking and practicing Lean. We've found the best method is learning in action, which is another one of the reasons we are pursuing projects in which we can integrate the owner, design and construction into a single team.

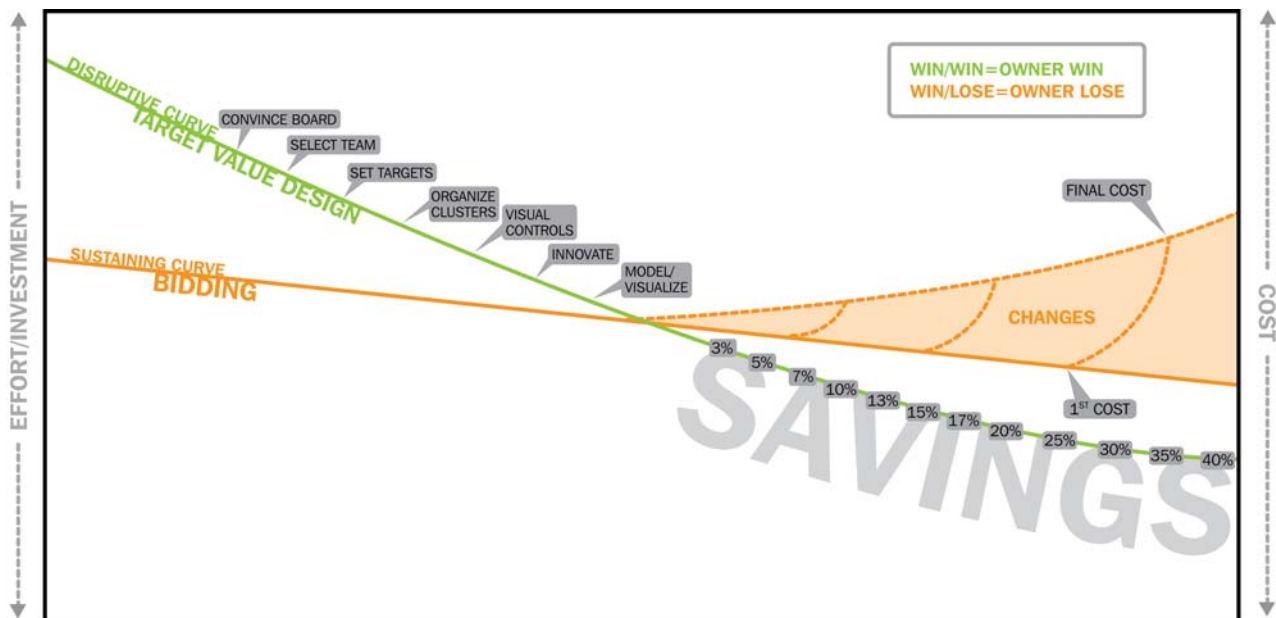
Leadership Capability / Skills

Not everyone in the firm (or Subcontractor) can lead an IPD project. Some will need a twist from a team leader to stay on track. We need to get the people together who can share common goals for the project and behave in a way to support its end goal, not just the firm's interests. The best and brightest should be at the table to be able to discuss optimal solutions. That usually means some level of experience needs to help inform those interactions. If you send your young star alone to a design meeting, are you really offering the best opportunity for IPD to generate the best solutions?

Target Value Design

Target Value Design (TVD) requires more expertise than taking off and pricing quantities. Technically, the estimators need the skill to estimate conceptually, from napkin sketches, so to speak.

The estimating effort is ongoing, with the design disciplines and trades organized into TVD "Cluster Groups." Budget targets must be set and progress must be reported out of these groups, to be compared to targets. This work requires much better communication and facilitation skills than many technically competent estimators currently possess.



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Design Management

The entire design and preconstruction team need to co-create a schedule to deliver design to support construction. DPR, as a GC, is finding it necessary to first lead the development of the design schedule, and then manage to it. This requires a much greater understanding of the design process than many of our people have gained working mostly on the construction side of project delivery.

Structuring Work

BIM and IPD are finally giving us the opportunity to look at the three critical elements of the value equation: 1) the building—the product in the Lean world, 2) how we're going to build it—the process, and 3) where and how the parts will be fabricated, packaged and delivered—supply.

Very few of our people have had the opportunity to really do this the way we will in the future. They will have to learn by doing and mentoring others.

Managing the Supply Chain

Our BIM engineers recently partnered with our Doors, Frames and Hardware group to manage the receipt and installation of frames, doors and hardware from a 3D model. Our foreman applied a barcode label pre-loading into a tracking system directly from the model as he was receiving each item. We knew exactly when the component was installed as it was installed. There was a 70% time reduction.

Achieving this time savings required inventing a new process, purchasing new hardware and training our people.

Transparency & Visual Control

Our people have spent time designing and producing completely visual reports, consisting of various graphs to help team and cluster leaders quickly understand the progress of our TVD efforts.

The principle of Visual Control, which we are borrowing from the Toyota playbook, is also new to both our Preconstruction and Operations teams. More learning in action and teaching, probably coupled with new software tools, are necessary.

Hiring

We see the need to recruit more people with an Architectural or Mechanical, Electrical and Plumbing/Process Engineering design training or experience, particularly. We are also



thinking our customers, along with us, could benefit from having people who have been trained or worked in Process Engineering.

Filtering Opportunities

True service will outperform the commodity-style bidding contractors, and evaluating the bigger picture with Owners will allow talented, IPD savvy firms to offer a better construction experience, at the best possible value. There is a subtle shift to get IPD right versus design-build, CM and other styles of delivery. Just remember the last best job (usually only one job in a career) and think of the principles and behaviors that were exhibited. Now tell everyone that is how they need to act. Those that get it will rise to the top and will be sought after by experienced owners. The rest can fight for the scraps.

Industry Structure

We will be forming more strategic alliances to pursue entire programs of work. We will be less opportunistic, where we simply react to RFPs coming through the door. These alliances will be based on relationships rather than transactions measured in first-cost.

The Current State of Affairs

Thinking about Toyota, we ask ourselves: Can building a building be just like building a car, and if yes or no, what are the differences?

I think it comes down to the number of decisions that are left open for Owners and Designers to choose. With somewhat limitless options there are somewhat limitless variables leading to a design process that is impossible to manage.

There is a second issue that arises from this. The world of limitless options is the world that Designers have lived in for a very long time. Living in a world where you cannot manage all the variables has changed the skills of the “Master Builder” (originally an Architect) who did manage the process well to a skill-set of trying everything (old and new) and to the most part presenting anything as possible, which is much less focused on management skills.

So it comes as no surprise that Owners have come to believe they can have anything they want with little effect on price. Usually “anything they want” drives the product to mostly unique and custom rather than a smaller set of variables. This process has, in turn, jumped directly to the producers of the building blocks (vendors), who now treat the variable of time as an outcome of all the other custom variables so that you really do not know the variable of time until the building block is near complete and ready to be shipped to the building.

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Finally the construction team has been separated from the design, and is handed an immense set of variables they then need to validate and ensure will work, changing those that are not possible.

Revolutionary Changes

Some of the changes needed to revolutionize our industry:

- Reduce the feedback loop timeline (from months to minutes) on whether a design option is possible or not (could be BIM).
- Bring the Owner, Designer, and Contractor back together early in the process (could be IPD or Design-Build).
- The transparency between the Vendor, Supplier, Subcontractor, and CM/GC is much greater than it is today (could be Supply Chain Management).
- Owners need to be completely informed in all aspects of their decisions and allow the Designer and Builder to guide them (this one is Trust).
- Owners need to get all feedback from their group and stand behind their decisions in timely manner to maximize the process (Owners better manage their internal organizations for the construction process).
- Designers need to refine/define a better management process to deal with the massive amount of information and possibilities existing today that works for the entire start to finish, not just the Design.

Under New Management

I mention management above in a few different spots as some of this clicked when we heard Gary Hamel speak, reminding us that Management was really only developed near the end of the Industrial revolution to find a way to have humans do a seemingly mundane task over and over. This field has evolved to take massively complicated processes (ones that have many variables) and break them down to do able chunks by humans.

Questions to Consider

- Has the Design of buildings become un-managed through Owners believing they can and should “have what I want” and the Designers goal to give the owners what they want?
- Has the supply chain followed suit, waiting until many other variables are resolved (which make products unique and custom-made) before completing work?
- Does treating the variable of time as a consequence of all other variables make it into something that cannot be known with any certainty?