Lean Design Forum - Chicago June 1 & 2, 2006

Recommendations for Lean Virtual Design & Construction

Charter

Develop recommendations on using Virtual Building methods in the Lean Project Delivery Process to present to the Lean Design Forum, Chicago June 1-2, 2006

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Objective and Summary

Our starting point is leveraging Virtual Design and Construction (VDC) as a method and technology to eliminate waste in producing a product to satisfy the customer's needs. Our recommendations are grounded in experience. The Virtual Design and Construction Practices Group believes that VDC can be a very useful method for reducing process variability, which causes significant waste in current practice. Applied within the context of Lean Project Delivery, VDC methods can reduce process variability by speeding up the understanding and communication of design requirements and solutions among the many project disciplines. This can enable the timely and concurrent injection of relevant engineering and construction knowledge into the design of the product and process, and therefore reduce design uncertainty, which in turn reduces process variability. Lean VDC methods can also create a shared and coordinated information basis that becomes the foundation for improving delivery of design and fabrication.

The recommendations presented below are the consensus of the group and are meant as a starting point for discussion during the session at the Lean Design Forum in Chicago on June 1, 2006.

Recommendations

Role of VDC in the Lean Project Delivery:

VDC methods are most helpful when they are injected into work processes that are explicit and well-understood by all affected parties.

1. *A Problem of Workflow*
   The problems we face are a matter of work flow and cannot be solved by layering

on VDC as a technology on top of current project delivery. Otherwise, we will automate waste.

2. *Value Stream Mapping and Analysis*
   Teams should do value stream analysis at the outset to determine the place for VDC. However, VSM should not be posed as a prerequisite for teams to experiment and learn the technology.
3. *Return on Investment to the Owner*
   VDC implementation should be looked at from a perspective that this is a Return on Investment by the whole team. This is an investment and the team needs to take responsibility for the return.
4. *Working in the Supply Chain*
   Understand the supply chain dynamics of each project and how lean methods and VDC can be used to eliminate wasteful practices in supply chain hand-offs. Pre-qualify supply chain partners for Lean VDC based project delivery. Recognize that VDC enabled Lean is less about optimizing vertical silos – and more about optimizing workflow horizontally across the design, fabrication, construction supply chain & life cycle. That said, significant benefits can be gained by optimizing BOTH the horizontal process and also the vertical flows, especially within design, and within each subcontractor supply chain.
5. *Reciprocal Dependencies*
   Reciprocal dependencies, i.e., work with mutual constraints, are a major source of design uncertainty. Failure to resolve these dependencies at the right time typically leads to design or field rework. VDC models require and pull design information that exposes reciprocal dependencies that are not typically identified in current design planning.
6. *Pre-fabrication Program*
   There should be an explicit pre-fabrication program to leverage the rich data and capabilities of virtual building for ROI to the customer. Concretely, this means identifying opportunities to fabricate components and even entire assemblies off site rather than on. These opportunities must be discussed and understood by the design and construct team in order to secure composite crews, assembly sites and plan delivery and staging on site.

Forming & Working in the Team

Rapid product and process design is best done with an integrated concurrent engineering approach, using cross-functional teams. VDC methods have proven effective in making cross-functional teams work more productively with higher quality results (output).

1. *Work in Cross-Functional Teams*
   Modeling should be a tool in the hands of cross functional teams designing product and process and working collaboratively on the project
2. *The Big Room*
   VDC implementation requires the team to work collaboratively and interactively to address reciprocal dependencies between trades amongst a multi-stakeholder team. Wherever possible the project team should setup a Big Room when implementing VDC so that modelers can construct interactively.

3. *Team Make-up*
   Select a team intentionally with capabilities to work collaboratively in order to build virtually. Companies and individuals should have the capability to work in what might sometime seem like a chaotic and ambiguous environment.
4. *Leveraging Experience*
   Software cannot replace knowledge and experience or the lack thereof. Virtual Building technologies can and should be used to leverage the talent of experienced designers and builders.
5. *Multiple Models*
   Assemblies and components should be modeled by the companies responsible for their design and / or fabrication and installation. The consequence is that much of the work and value of VDC will come from integrating and coordinating these models. While designers and contractors may need to reach outside their companies for modeling expertise, they should always "own" the product and take responsibility for integrating and coordinating their models with other team members.
6. *Model Purpose*
   The modeling tool for each system or component should be selected to optimize the procurement, engineering, fabrication, delivery and erection of the system/component. The larger integration issues between systems can be resolved in VDC separately, with new integration tools.
7. *Continuous Development of Models*
   Development of the model is an ongoing process and not an event. Plan for a continuous development of the models from concept through construction
8. *Plan & Manage with the Last Planner System*
   Design, and 3D modeling and coordination should be planned and managed using the Last planner System™.
   a. Create Pull / Phase Schedules to plan design work.
   b. Develop work streams to plan Phase Schedule deliverables.
   c. Identify tasks and hand-offs in more detail, and screen for readiness in a Look Ahead Plan.
   d. Ask team members to commit to performing ready work in a weekly Production / Work Plan.
   e. Track reliability and learn from mistakes by monitoring Plan Percent Complete of Production / Work Plan commitments.
9. *Continuous Improvement*
   Maintain and deploy for project-to-project improvements. Adopt applicable lessons learned from other industries: aerospace, petrochemical, product manufacturing.

Setup

1. *Technical Logistics*
   Team should meet and address the technical logistics of collaborating using rich data sharing tools and document the protocols. Things that should be discussed and documented should include the following:
   a. Reference points

b. Above ceiling space allocation between trades
c. Drawing and layers color scheme between trades
d. Weekly coordination, conflict identification and resolution cycle
e. File naming conventions
f. File sharing and backup protocols
g. Versioning system
h. Compatible software; DWG 2002 or better for many projects.
i. Object Enabler software to see others 3d entities.
j. Setup common title blocks and view ports for all trades to use.
k. Color code trades for 3D Clash Detection overlay.
l. Remote access to shared server.

2. *Electronic Data Exchange*
   Minimize duplication of effort and loss of time by using direct digital exchange within a cross functional team of designers and fabricators and explore more opportunities to use the digital models for pre-fabrication offsite
3. *Use of Rich Data in the VDC models*
   3D object models can be much more than geometric data. Cost, performance data and operational information can be loaded into the objects, making them useful for estimating cost, building performance evaluation, and maintenance
4. *Structural Model*
   Structural model is the critical piece for the process of coordination of MEP systems. Teams should start with the structural engineers model and then end with the fabricators model to coordinate the MEP systems
5. *Production of 2D Drawings*
   2D Drawings should be produced out of the model, not in parallel.