Decision analysis using virtual first-run study of a viscous damping wall system

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Preface to the A3

An A3 is a problem-solving tool, however, it can be used in other ways and the corresponding A3 formats vary depending on the purpose of use. For example, Toyota uses three basic types of A3 reports (Shook 2008, Sobek & Smalley 2008):

- problem solving
- proposal
- status.

This A3 is a summary of our research on Virtual First-Run Studies (VRFSs), therefore its story line represents the flow and structure of a scientific paper.

In creating this A3, the authors attempted to structure it so as to add the most value to Lean Construction Journal readers. Only the information and data judged to be the most essential are presented in a logical flow to help readers quickly capture the key contents and results of the research. For a detailed description of the research method used, the case study itself, and evidence to support the conclusions, readers may want to read the full paper by Nguyen et al. (2009) published in the Proceedings of the 17th IGLC Annual Conference.

This A3 is submitted by way of experiment to the Lean Construction Journal and we look forward to receiving further comments and suggestions from researchers and practitioners on the value of reviewing research results in this format.

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References used here and in the A3


A3: Decision Analysis Using Virtual First-Run Study of a Viscous Damping Wall System

1 Objectives

- Researchers have analyzed the effectiveness of 4D simulation in different areas of design and construction but no framework exists to guide the cross-functional project team to structure coordination meetings that take full advantage of 4D simulations in a Lean Project Delivery System™.
- The challenge is to incorporate innovative ideas generated from the design coordination meeting to both product design and process design in order to streamline fabrication, logistics, and construction/installation processes.
- VFRS is a first-run study carried out in a virtual environment, where objects of study are created in a computer model in three dimensions, and those objects are linked to process- and resource data to represent the process of construction.
- While first-run studies (Ballard and Howell 1997) help with process design during the construction phase, the use of VFRSs is proposed to help integrate product- and process design during the design phase.

2 Method

- Researchers became part of the project team, collecting data through observations, interviews, and document analysis while participating in the implementation of the experiment and helping make adjustments to the experimental process.
- VFRS framework was tested in a Viscous Damping Wall (VDW) case study.
- Researchers adjusted the VFRS framework and recommended the new framework for future application.

3 Proposal

- Researchers worked with the project team to establish a VFRS framework.
- The VFRS framework was tested in a Viscous Damping Wall (VDW) case study.
- Researchers adjusted the VFRS framework and recommended the new framework for future application.

4 Case Study

- A cross-functional team at Cathedral Hill Hospital Project applied the VFRS framework to visualize and evaluate installation options for a Viscous Damping Wall (VDW) system.
- A VDW consists of an inner steel plate connected to an upper floor, a steel tank connected to a lower floor, and viscous fluid in the gap between them as shown in Figure 1.
- CHH project will comprise 155 units of VDWS in the current structural design, standardized to three different sizes of 7’x 9’, 7’x 10’, and 7’x 12’.
- The VDW presented a coordination challenge for logistics and field operations thus the Integrated Project Delivery (IPD) team at the CHH project wanted to further explore different methods for their installation.
- 4D simulations of installation alternatives were presented to the team. Discussion contents fell in five categories: constructability, fabrication, transportation, site logistics, and installation.
- As the result of the discussion, the team came up with another alternative (alternative 4) which was similar to alternative 1 but instead of shipping VDW directly from the fabrication shop (DIS) to the site, VDW will be transported to structural steel fabrication shop (Herrick) and then loaded on the same truck with adjacent columns and girders to be transported to the site.
- By the time of submitting this paper, the final decision has not been made since it is not the last responsible moment for this decision.
- Although alternative 4 costs about $52,000 (12%) more than alternative 3, it ranked highest, in terms of total importance of advantages, at 415. The team may decide to select alternative 4 to install the VDW system if they agree that the increment in the importance of the advantages outweigh the increment in cost.

Conclusions

By helping a project "see" what will happen, VFRS facilitates the coordination between specialists, assists look-ahead planning, and yields reliable estimates of manpower and process-related cost.

In the design development phase, an integrated team of designers, engineers and specialty contractors could perform a VFRS of construction processes to understand the impact of design decisions on coordination, logistics, and construction/installation processes.