REVIEW OF LEAN DESIGN MANAGEMENT: PROCESSES, METHODS AND TECHNOLOGIES

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1 BACKGROUND

Lean Design Management (LDM) has been used by lean practitioners to manage the design process in construction. Several methods, processes and tools have been successfully implemented, such as the Last Planner System (LPS), Target Value Design (TVD), Set-Based Design and Design Structure Matrix. However, despite the increased use of LDM, many attributes are still applied in an isolated manner. Thus, there is a lack of an integrated framework which takes into account possible combinations of LDM methods, processes, and technologies used by designers and construction companies.

2 METHOD

- First, a **literature review** was carried out, aiming to investigate the concepts related to LDM.
- Second, a series of small **international case studie**s (mini-cases) and
- face-to-face company-level **interviews** were done, aiming to find out the main concepts, systems and tools used by the companies.

A standard list of 25 questions was prepared and 12 semi-structured interviews were done in three countries (Finland, Norway and United States/California). Norway and California were selected because several case studies had been reported in lean construction literature. Finland was selected because Finnish contractors have formed a Vision 2030 consortium which explores LDM as a topic in their research program.

3 RESULTS

The case study and interview findings were categorized in three groups of attributes:

1. Social processes,
2. Methods, and
3. Tools and technologies.

All the attributes identified from the literature review, interviews and mini-cases are listed in Table 1. Combining interview and mini-case data with literature review, we formed an idea of what are the current best practices globally. Each company or mini-case has an "X" in the cell if they are applying the method or tool in their current projects. Circled X's are those new attributes, that are less documented and were discovered from the mini-cases or interviews.

To select a combined model (which includes methods, processes and tools) for testing in future research and case projects, a workshop was held with Finnish construction and design companies

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participating in the Vision 2030 consortium. They selected the combination of tools and methods for testing in case study projects presented in Table 1.

Table 1: Attributes of Lean Design Management.

Attributes of Lean Design Management	Veidekke	Skanska Norway	Ramboll	Skanska USA	Mini Case 1, HerreroBoldt	Mini Case 2, Suffolk	Case 1 to be tested	Case 2 to be tested	Case 3 to be tested
1. SOCIAL PROCESS									
LPS	X	X	X	X	X	X	X	X	X
Big Room	X	X		X	X	X	X	X	X
Co-location					X				
Integrated Concurrent Engineering (ICE)	X	X					X		
Collaborative Planning in Design (CPD)	X								
2. METHODS									
Level of Detail (LOD)						(X)		X	X
Location-Based Design Management (LBDM)					(X)				
Target Value Design (TVD)				X	X				X
Set-Based Design (SBD)			X	X			X		
Choosing by Advantages (CBA)							X		
Real-time cost estimation						(X)		X	
3. TOOLS / TECHNOLOGIES									
Virtual Design and Construction (VDC)	X	X	X	X	X	X	X	X	X
Design Structure Matrix (DSM)				X			X		
Dialogue Matrix (DM)	X	X					X		
A3 Report					X				
Scrum			X						

4 Conclusions

The contribution of this research is to review different social processes, tools and methods based on the literature and evaluate their use within different companies by using interviews and mini-cases. In addition to the LDM tools reported in literature, we found three new ones in the interviews. All the social processes, tools and technologies form a toolbox of design management. Some of the tools, for example LPS and BIM/VDC, have been studied more than others, but different combinations and how they generate positive interactions and outcomes have not received the attention they deserve.

Projects are unique and design is a complex art of producing engineering outputs of customers' needs. Finding the optimal balance between people, process and technology, is hard because different companies use different attributes, as we found from the interviews and mini-cases. Thus, in our future empirical research we attempt to test the proposed models and combinations to find out how they affect the project teams and design management results. Performance measurement metrics to evaluate the results of case studies also need to be developed.