

Using organizational modeling to assess the impact of lean construction principles on project performance

Marcelo Concha, M.Sc. on Civil Engineering in the Pontificia Universidad Católica de Chile, I+D+i Consultant, Centre of Excellence in Production Management, GEPUC, Pontificia Universidad Católica de Chile

Luis Fernando Alarcón, Professor, Department of Construction Engineering and Management, Pontificia Universidad Católica de Chile

Claudio Mourgues, Assistant Professor, Construction Engineering and Management Department, Pontificia Universidad Católica de Chile, Chile

José Luis Salvatierra, Assistant Professor, Department of Civil Engineering, Universidad de Santiago de Chile

I. Background

This article delves the use of organization modeling to assess the impact of Lean construction concepts on project performance. The research calibrated four virtual models of construction project organizations developed using the Virtual Design Team (VDT) method and SimVision® VDT computational tool. The models were validated comparing their predictions with actual results obtained in the projects, and the assessment and approval of technical experts of the companies in the study. Then, the four models were used to evaluate the impact on project performance using alternative organizational designs, each of them inspired in Lean production concepts and principles. The results proved that VDT models can be used to evaluate the impact of the Lean concepts in projects performance, representing these notions in the organizational design and showing the benefits of implementing them. In general, the models predicted positive impact in terms of cost, time, variability and waste reduction in organizations inspired by Lean principles and concepts. These outcomes contribute to expand the uses of VDT methodology, proposing a method to include Lean principles in the organization design, and allowing companies to model Lean Project Management concepts at the planning and design phase, achieving improvements in terms of cost, schedule and variability.

II. Current conditions

Several authors have used various methods to assess the impact of Lean in projects or production (Agbulos and Abourizk, 2003) (Schroer, 2004) (Ales et al., 2006). While these and other studies have contributed much to the understanding of Lean Construction and its impacts, their approach from the perspective of processes has shelved organizational aspects of Lean Construction. The representation of VDT processes allows including transformation and flow processes, with considerations of the value generated by them. At present, the Chilean local industry has not implemented VDT initiatives. For this reason, during 2013 and 2014, four construction projects were studied in order to visualize their performance through VDT parameters. This initiative has already been studied abroad (Ibrahim and Nissen, 2004), obtaining parameters which were used to compare Chilean parameters from this study. However, international initiatives to visualize the impact of Lean concepts through VDT have not been investigated yet, which is the subject matter of the present research.

III. Goals/Targets

- *Found barriers to the implementation of VDT models in real projects.*
 - *Propose a way of modeling concepts of Lean Production with VDT.*
 - *Evaluate the impact of principles of Lean Production in the project performance through the VDT simulation methodology.*
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IV. Research Methodology

In order to define final methodology a preliminary procedure was defined and tested. Data was collected from interviews, field visits, tender files with project information and a survey to collect information related to input parameters of SimVision® and flow processes. The full procedure described as follows.

Stage	Specific objectives
MODELING AND CALIBRATION	<ul style="list-style-type: none"> Variable selection Data collection of study cases (4 projects) Parameters calibration (modeled vs real results) Survey feedback and expert validation of results
LEAN CONCEPTS SELECTION	<ul style="list-style-type: none"> Identification of VDT's variables to represent Lean Concepts Value assignment to VDT's variables
VDT SIMULATION	<ul style="list-style-type: none"> Results analysis

It is important to mention that a traditional construction company with four projects took part in this study.

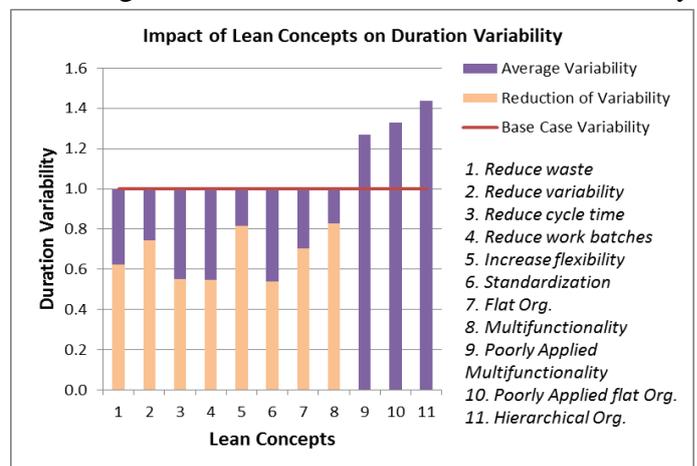
V. Research Findings

Calibration of probabilities parameters from of SimVision® was effective when they were adjusted to the reality of Chilean projects (Ibrahim & Nissen, 2004). Additionally, those parameters were validated by professional respondents.

Particularly, the identified challenges to successful implementation of these models are related to technical details such as improving planning and knowledge management. Additionally, those challenges could be related to efforts made by companies in order to improve their performance and the industry as a whole.

- With regard to the assessment of the impacts of Lean principles using the VDT methodology, a positive impact in all cases with the expected variations between projects was evident. On average, the principles caused greater impact on reducing the projects outputs were "Reduce Variability" and "Improving Flexibility", which shows the importance of generating a continuous flow and reduce uncertainty.

Probability of calibrated VDT	Company A
Probability of Information Exchange	0.733
Probability of Noise	0.300
Probability of Functional Error	0.080
Probability of Project Error	0.080



VI. Conclusions

- This research was able to model Lean Construction concepts through the VDT methodology. This not only achieve to show from another perspective the positive impacts of Lean on the projects results, but also offers a new methodology to include Lean principles in the design of organizations and projects processes.
- The Lean principles that most reduced the time variability in the study projects were the principles "Reduce cycle times", "Standardize" and "Reduce work batches." This is consistent with the definition of these principles in theory. The concepts that had less impact are the principles "Increase flexibility" and "Flat organizations".