Lean Construction 4.0: Exploring the Challenges of Development in the AEC Industry

Farook Hamzeh
Associate Professor, Department of Civil and Environmental Engineering, University of Alberta, Edmonton, Alberta, Canada; email: hamzeh@ualberta.ca

Vicente Gonzalez
Associate Professor, Department of Civil and Environmental Engineering, The University of Auckland, Auckland, New Zealand; email: v.gonzalez@auckland.ac.nz

Luis F. Alarcon
Professor, Department of Construction Engineering and Management, Pontificia Universidad Católica de Chile, Santiago, Chile; email: lalarcon@ing.puc.cl

Salam Khalife
Ph.D. Candidate, Department of Civil and Environmental Engineering, University of Alberta, Edmonton, Alberta, Canada; email: khalife@ualberta.ca

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What is Lean Construction 4.0?

Synergies between Lean Construction and Industry 4.0 technologies = Lean Construction 4.0

<table>
<thead>
<tr>
<th>View</th>
<th>Main Principles</th>
<th>Associated Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformation (Conv. view)</td>
<td>Realize value-adding activities efficiently.</td>
<td>1. Decompose the production task; 2. Minimize the costs of all decomposed tasks.</td>
</tr>
<tr>
<td>Value Generation View</td>
<td>Improve customer value.</td>
<td>1. Ensure that all requirements get captured; 2. Ensure the flowdown of customer requirements; 3. Take requirement for all deliverables into account; 4. Ensure the capability of the production system; 5. Measure value.</td>
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TFV Approach (Koskela 2000)

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Technologies partially adopted in the Architecture-Engineering-Construction (AEC) industry.

- Machine learning and predictive models (Mansouri et al. 2020)
- Mixed-reality and robotics (Ahmed 2018)
- Computer simulation and modelling (Abdelmegid et al. 2020)
- Cyber-physical Systems (CPS) (Lu et al. 2020)
- Digital twin construction (Sacks et al. 2020)
However, the AEC industry’s unwillingness for a widespread adoption of Smart and Digital Technologies has pushed away the opportunity to achieve the “Industry 3.0 transformation”, which is an essential pre-condition to adopt an “Industry 4.0” state as in manufacturing (Farmer 2016).
Lean Construction 4.0 - FOUNDATIONS

People/ Culture
- Motivated for Improvement
- Proactive Leadership
- Promise Based Management
- Cross Functional Teams
- Competent

Process/Philosophy
- Lean Principles
- Reduce Waste
- Increase Value
- Optimize Globally

Technology
- Industry 4.0 Technologies
  - VDC/ BIM
  - Virtual Reality
  - Machine Learning
  - Automation
  - Etc.
“The essence of management is not techniques and procedures. The essence of management is to make knowledge productive, which is a good starting point for the definition of Lean Management”.

Peter Drucker
Motivation for Construction 4.0

Problem when the triad is ignored:

• Overemphasis on technology

• Inadequate implementation strategies

• Limited and incomplete impacts of Industry 4.0 on project/company results

• Long, slow implementation processes with uncertain results
How Academia can Contribute to LC 4.0?

• Explore the integration between Lean practices and I4.0 technologies (Sanders et al. 2016; Tortorella et al. 2020).

• Develop methodologies to identify how the success of LC 4.0 implementation (process) can impact the performance of projects and companies.

• Develop benchmarking and decision tools to support the choice of the best LC 4.0 implementation strategy.
Lean Construction 4.0 to address Challenges and Opportunities stemming from Industry 4.0 technologies
Questions for Discussion

• What are the **necessary adjustments** that the Lean Construction community would introduce to Lean Construction 4.0 to cater to future challenges?

• What is the **role of the people-process-technology** triad to revamp the Lean Construction research towards a Lean Construction 4.0 ideal?
Questions for Discussion

• What changes will Industry 4.0 bring into the work of professionals in the AEC industry? What is the role of Lean Construction 4.0 in this?

• What type of training will be required from the future workforce to be “up to date” with Lean Construction 4.0 in terms of processes and technologies?

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THANK YOU