IGLC 2021
LIMA, PERÚ - 29TH ANNUAL CONFERENCE
INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

DIGITALIZATION OF LEAN LEARNING SIMULATIONS: TEACHING LEAN PRINCIPLES AND LAST PLANNER SYSTEM

Diego Cisterna, Mariana Hergl,
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Need for a digital Lean Construction simulation with real-time interaction

Research Gap

- Lean simulations are an appropriate teaching concept[1]
- BUT these are performed mostly physically
- Widespread online teaching by COVID-19 pandemic[2] [3]

→ Further digital development is needed[4] [5]

Objective – Development of a digital Lean Construction simulation

- Run on a digital online platform
- Allows interactions between participants in real-time

1 – Kuriger et al. (2019), 2 – Kim (2020), 3 – Sun et al. (2020) S.687,
4 – Gadre et al. (2011), 5 – Dallasega et al. (2020)

Two simulations were developed using an iterative, user-oriented procedure

- Development based on UX design
- Three iterations following the PDCA cycle including feedback

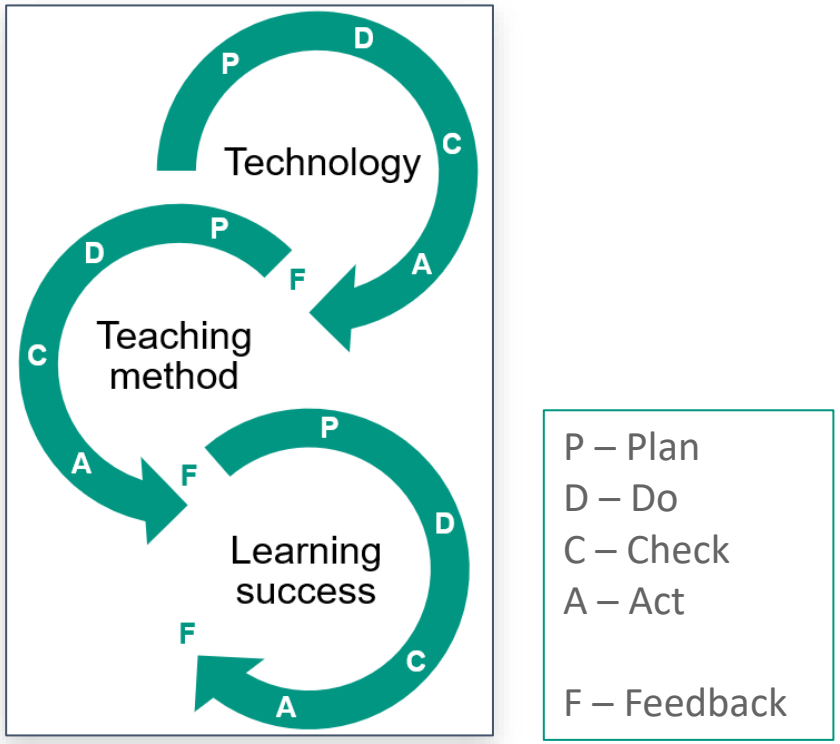


Figure 1. Methodology

MIRO was used as interactive digital platform

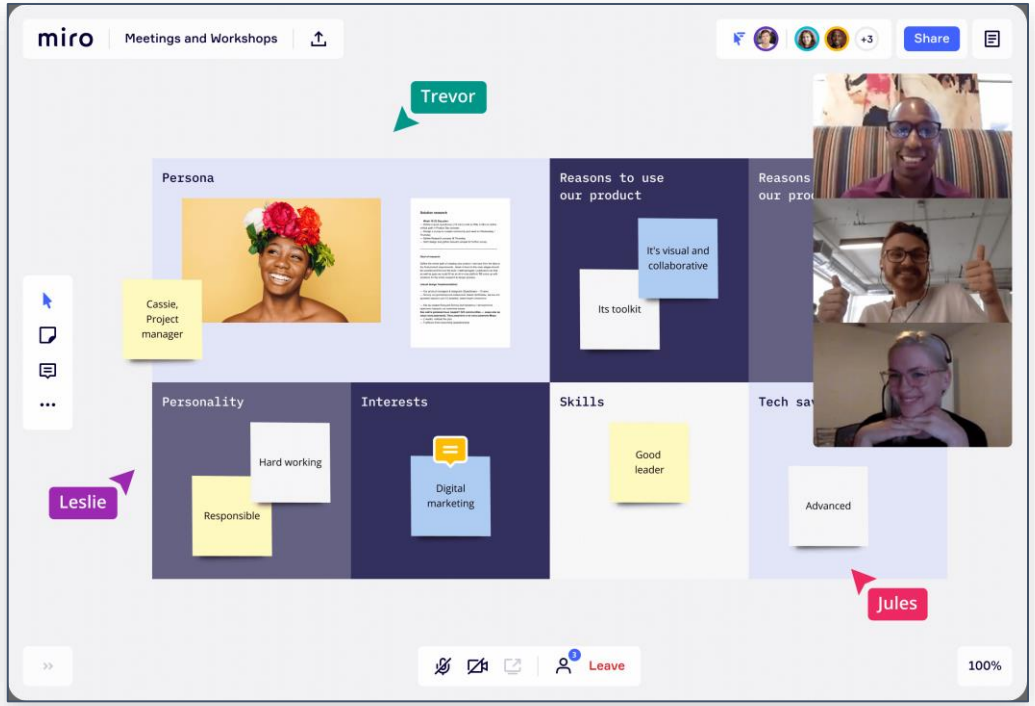
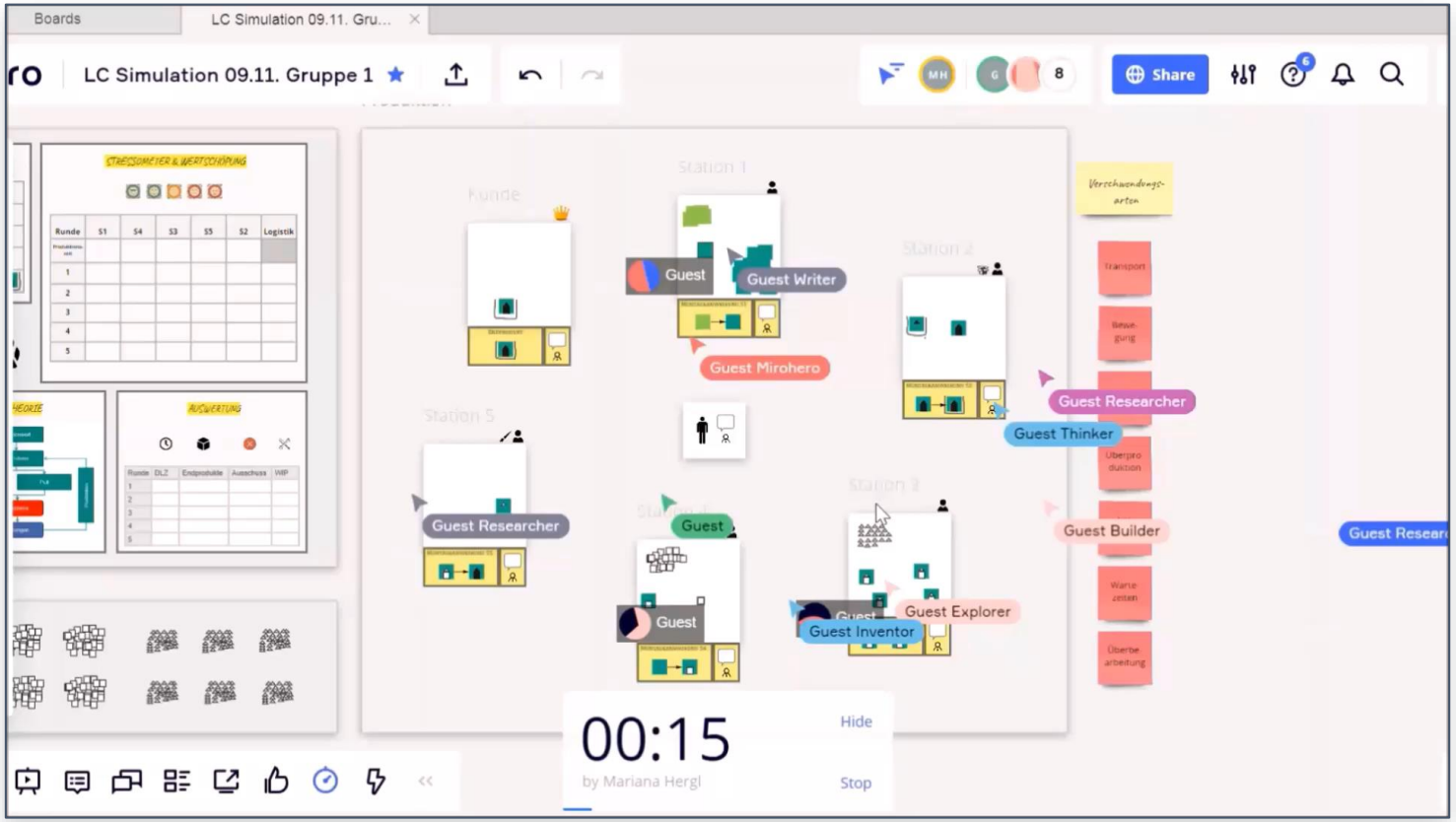


Figure 2. MIRO Online Whiteboard[1]

- Available for free
- Easy sharing
- Real-time interaction
- Tables/Diagrams can be created directly

1 – https://miro.com

Teaching lean principles and LPS in an interactive, digital environment



Video 1. Guiding A Digital Simulation

Both simulations alternate between theory and practice and offer a flexible distribution of roles

Lean Principles Simulation

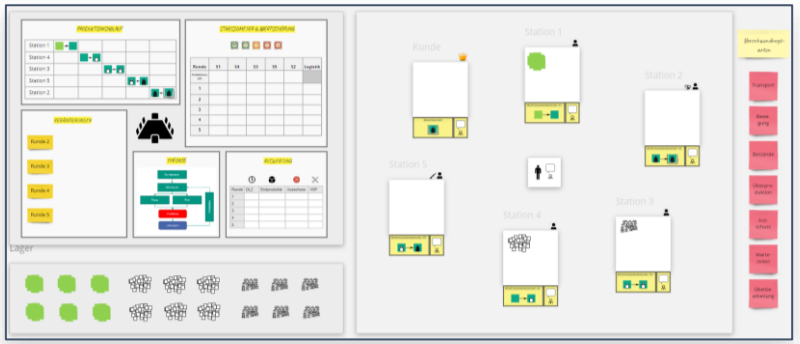


Figure 3. Production Plant

1 ½ h

Manufactured product

7-14 (+ Quality Manager)

LPS Simulation

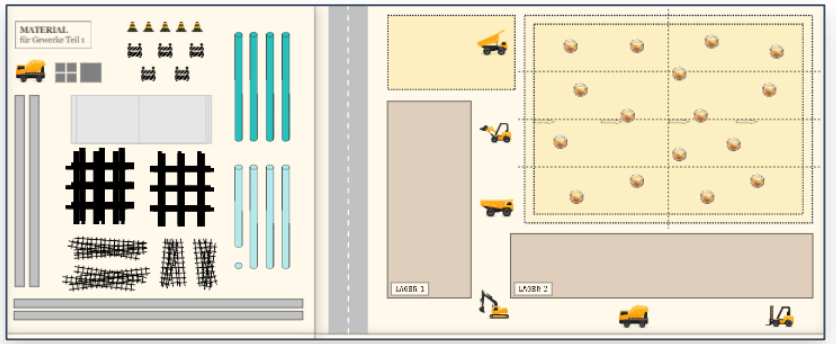


Figure 4. Construction Site

1 ½ h

Shell of a building

6-15 (+ Quality Manager)

The empirical assessment was successful - All rating results are in the upper range

	Design	Fun	Moderation	Technology
Lean Principles Simulation	4.37 ★★★★☆	4.48 ★★★★½	4.59 ★★★★½	70%
Last Planner System Simulation	4.49 ★★★★½	4.35 ★★★★★	4.22 ★★★★☆	80%

★ 1-5 Likert Scale from 1 (very low) to 5 (very high)
Technology of 1% to 100% of Participants Questionnaire

Table 1. Validation Digital Simulations

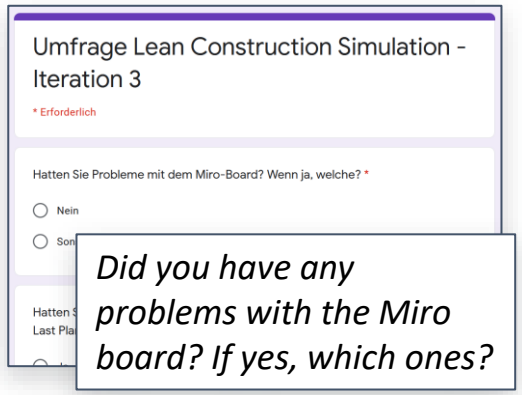


Figure 5. Questionnaire

The developed digital simulations represent a suitable concept for teaching Lean principles and methods

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Objectives were met

- Successful interaction in real-time
- Encouraged communication & collaboration

Learning effect was achieved

- Participants moved out of comfort zone
- “Aha” moment was triggered

Advantages of digital simulations could be observed

- High flexibility
- High level of sustainability
- Low costs & effort

THANK YOU!

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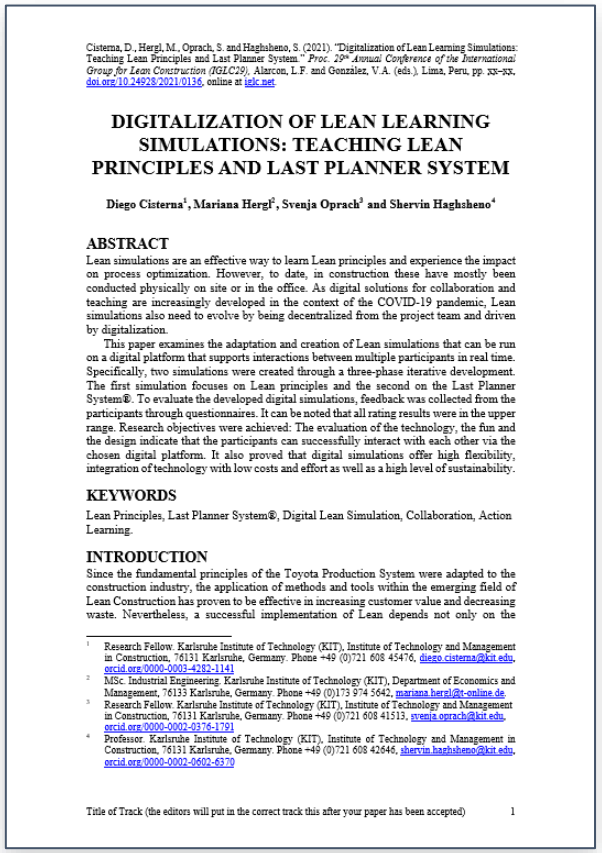

Cisterna, D., Hergl, M., Oprach, S. and Haghsheno, S. (2021). "Digitalization of Lean Learning Simulations: Teaching Lean Principles and Last Planner System." *Proc. 29th Annual Conference of the International Group for Lean Construction (IGLC29)*, Alarcon, L.F. and Gonzalez, V.A. (eds.), Lima, Peru, pp. xx–xx, doi.org/10.24928/2021/0136, online at iglc.net.

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Diego Cisterna[1], Mariana Hergl[2], Svenja Oprach[3] and Shervin Haghsheno[4]

ABSTRACT
Lean simulations are an effective way to learn Lean principles and experience the impact on process optimization. However, to date, in construction these have mostly been conducted physically on site or in the office. As digital solutions for collaboration and teaching are increasingly developed in the context of the COVID-19 pandemic, Lean simulations also need to evolve by being decentralized from the project team and driven by digitalization.

This paper examines the adaptation and creation of Lean simulations that can be run on a digital platform that supports interactions between multiple participants in real time. Specifically, two simulations were created through a three-phase iterative development. The first simulation focuses on Lean principles and the second on the Last Planner System®. To evaluate the developed digital simulations, feedback was collected from the participants through questionnaires. It can be noted that all rating results were in the upper range. Research objectives were achieved: The evaluation of the technology, the fun and the design indicate that the participants can successfully interact with each other via the chosen digital platform. It also proved that digital simulations offer high flexibility, integration of technology with low costs and effort as well as a high level of sustainability.

KEYWORDS
Lean Principles, Last Planner System®, Digital Lean Simulation, Collaboration, Action Learning.

INTRODUCTION
Since the fundamental principles of the Toyota Production System were adapted to the construction industry, the application of methods and tools within the emerging field of Lean Construction has proven to be effective in increasing customer value and decreasing waste. Nevertheless, a successful implementation of Lean depends not only on the

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