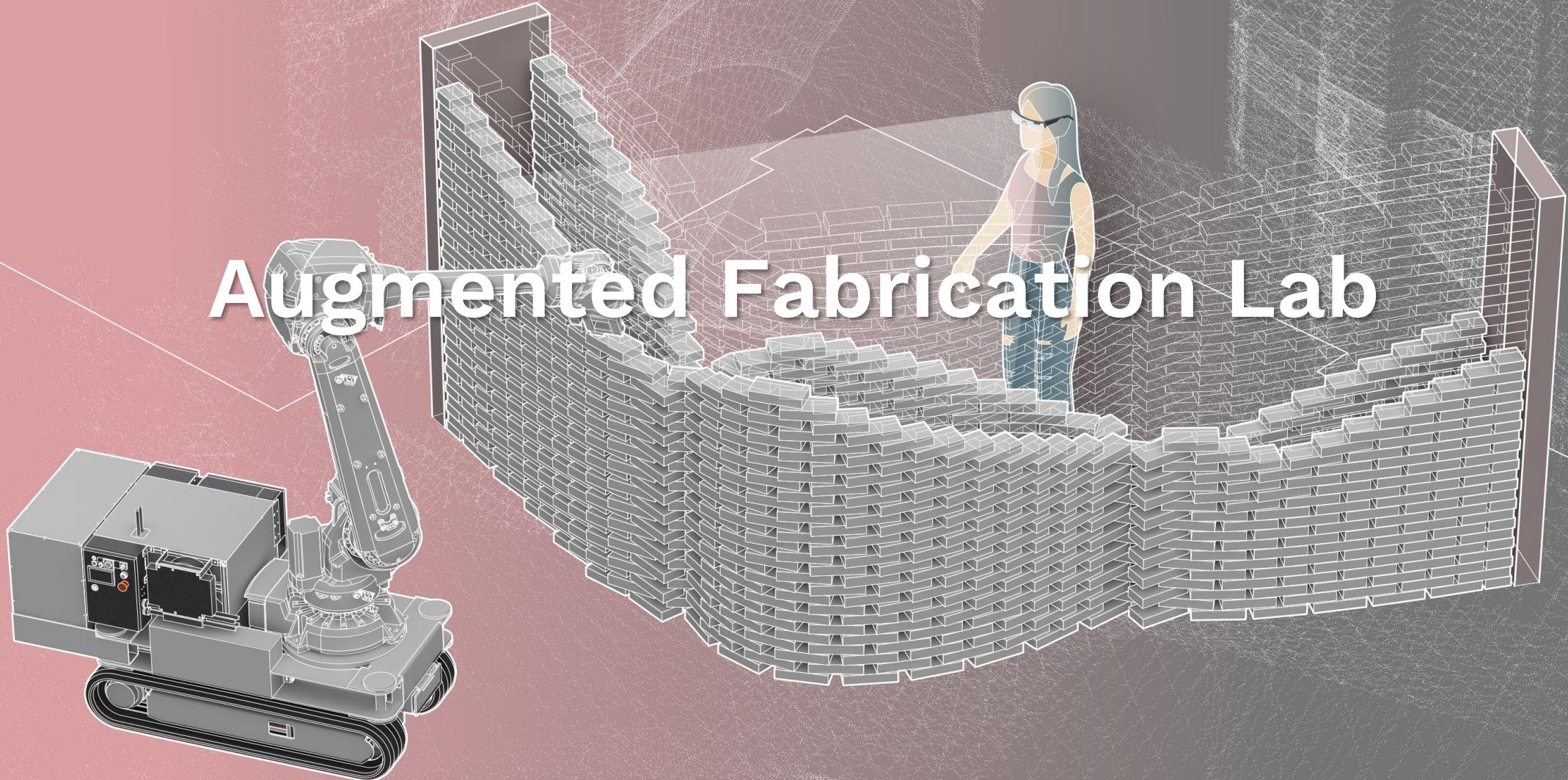


Collaborative Construction

CDF
8.5.2023

Professorship for Digital Fabrication
Department of Architecture
School of Engineering and Design
Technical University of Munich

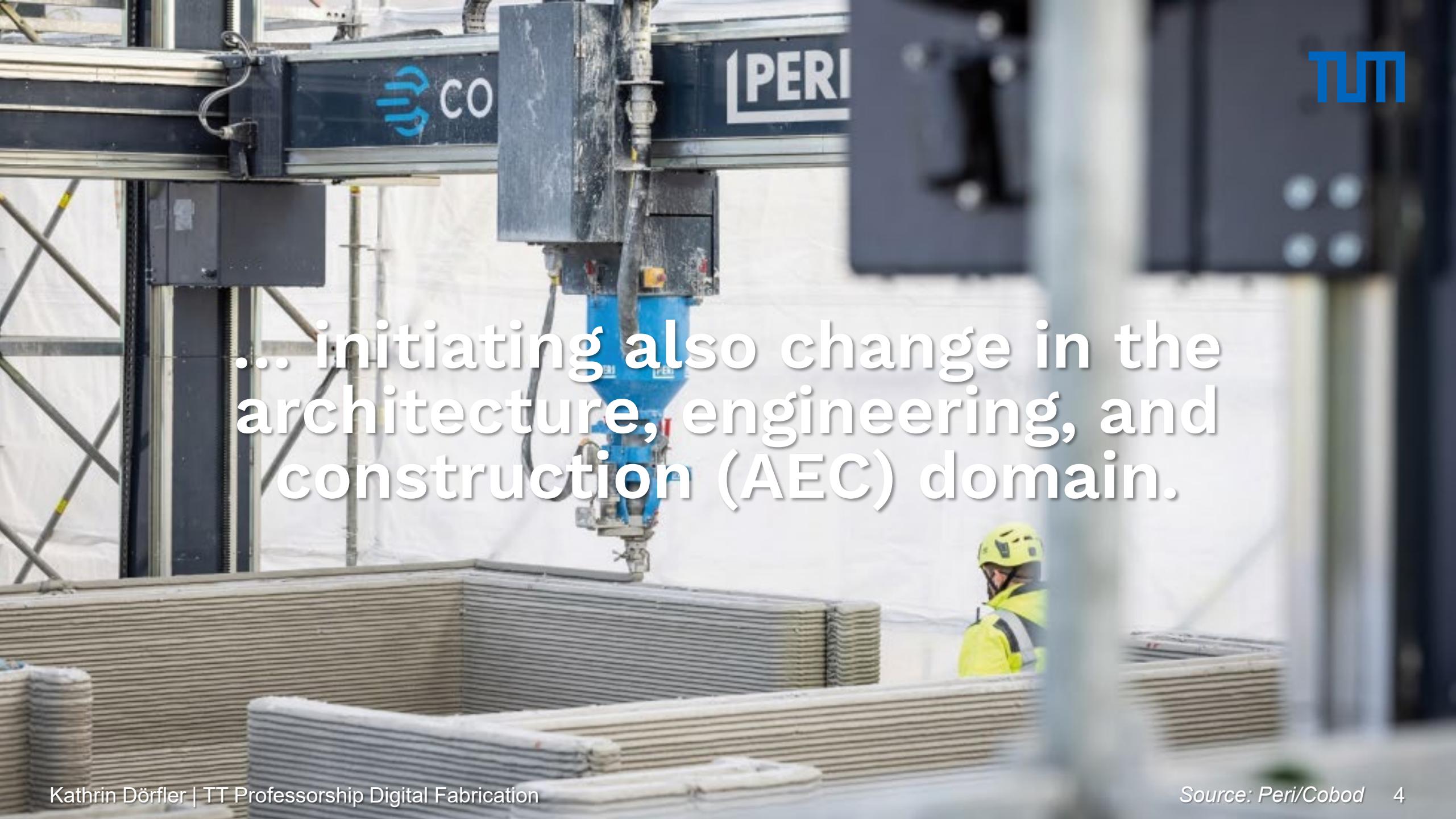
Augmented Fabrication Lab





Digital technology is a powerful tool for managing complex systems...



A large-scale 3D printer is shown in an industrial setting, printing a series of concrete structures. The printer has a blue base and a black frame. The word "PERI" is printed in white on the side of the machine. In the background, there are stacks of concrete prints and a person wearing a yellow safety vest and helmet. The foreground is slightly blurred.

... initiating also change in the architecture, engineering, and construction (AEC) domain.

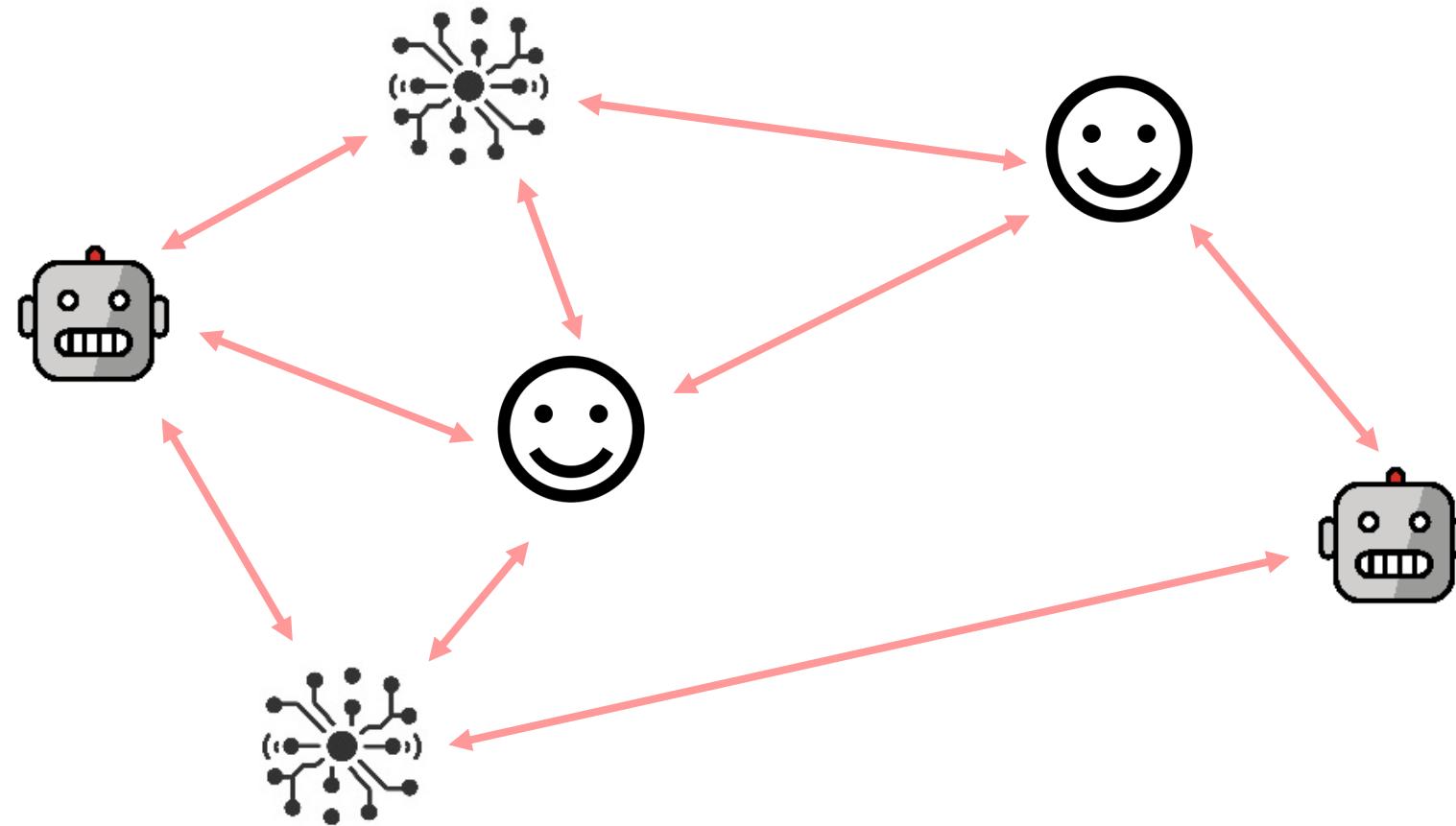
But machines alone won't do it.

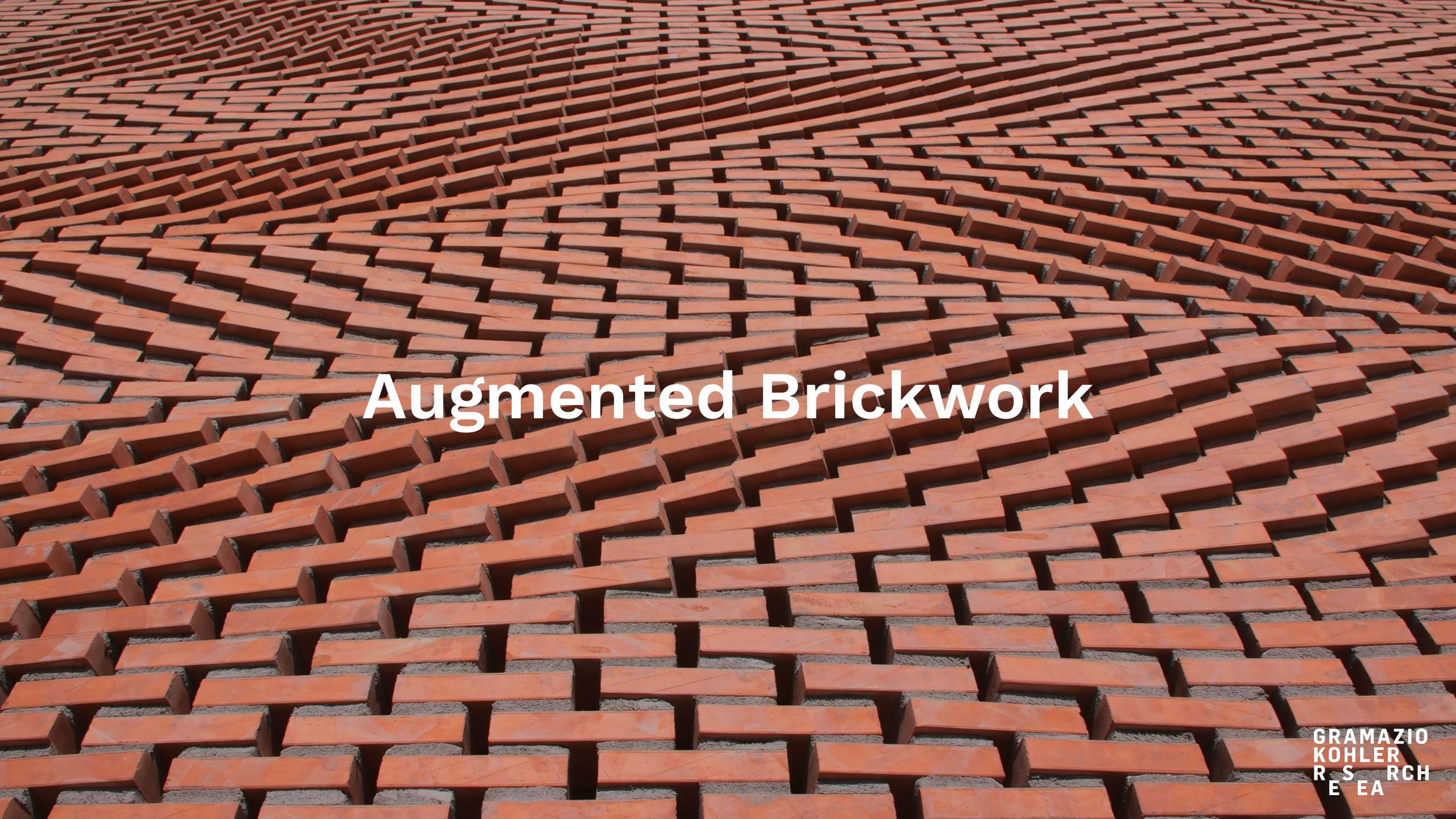
→ higher autonomy yields to less
interaction between humans and machines

Source: Beer, J. M. et al. (2014) "Toward a framework for levels of robot autonomy in human-robot interaction." *Journal of human-robot interaction* 3, 2.

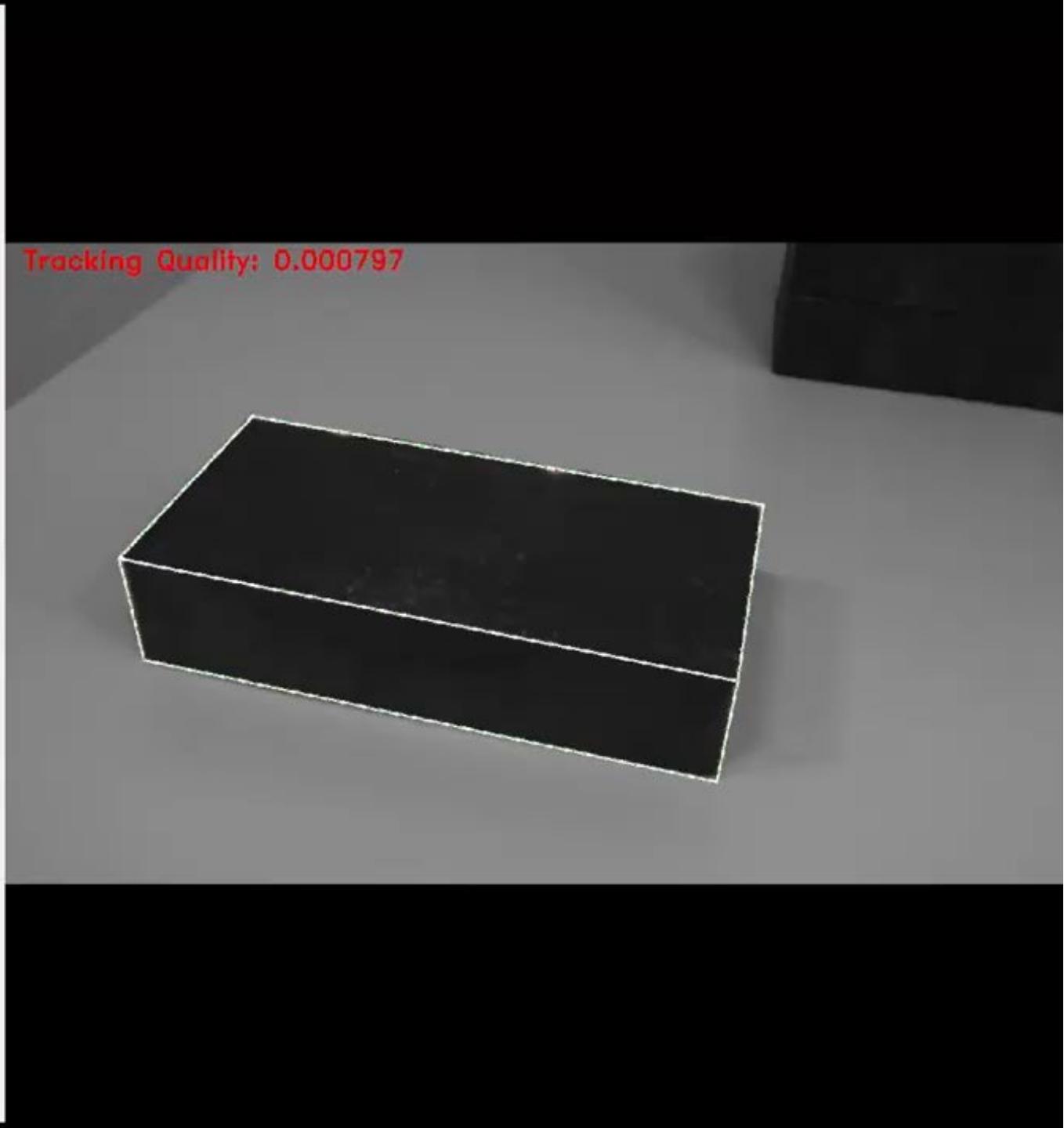
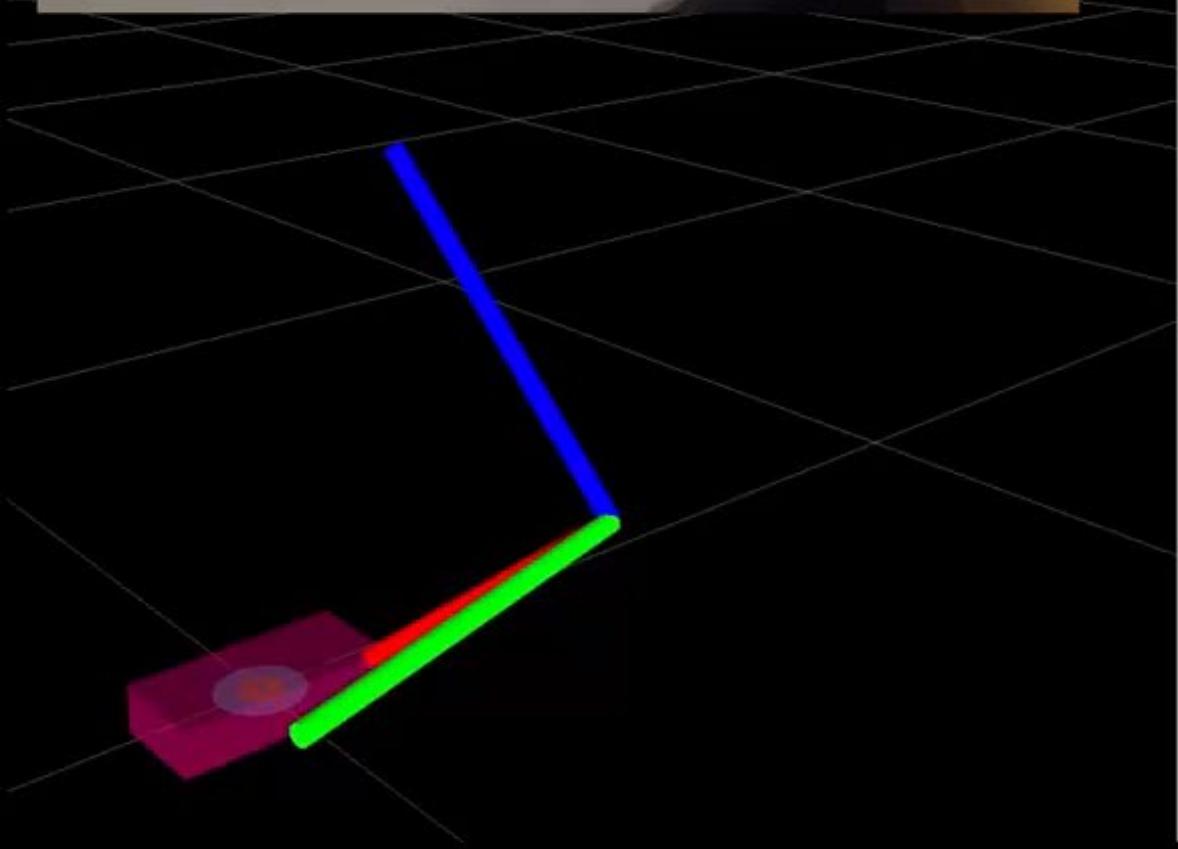
→ higher autonomy yields to **more**
interaction between humans and machines

Source: Beer, J. M. et al. (2014) "Toward a framework for levels of robot autonomy in human-robot interaction." *Journal of human-robot interaction* 3, 2.

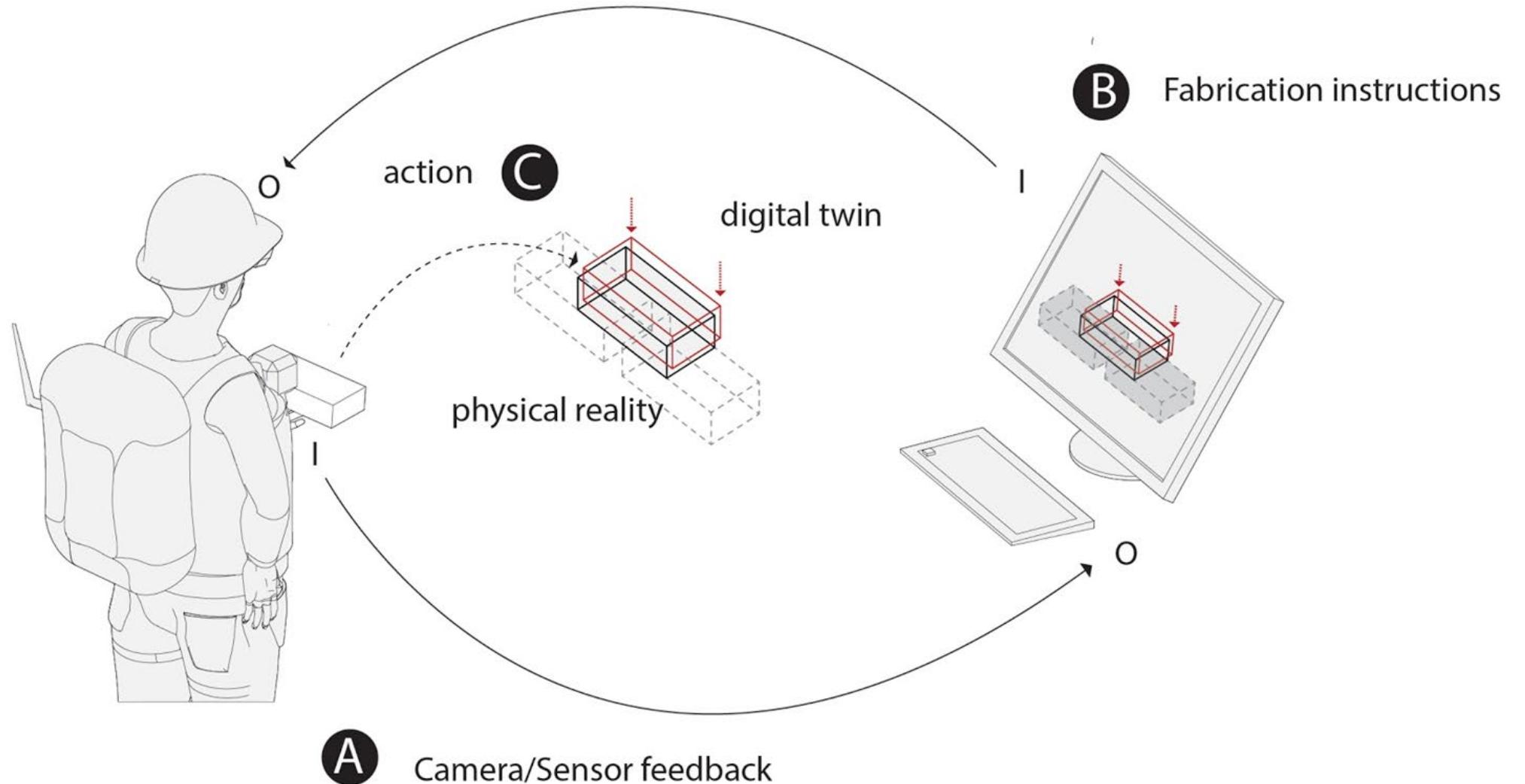




Augmented Brickwork







Screen

Scaffold

Shading System

Scissor lift

Visualization
Laptop

assistant

operator

mason

An aerial photograph of a vineyard showing numerous parallel rows of grapevines. The vines are trained in a vertical zigzag pattern, creating a rhythmic, striped texture across the landscape.

AUGMENTED BRICKLAYING

GRAMAZIO
KÖHLER
R S RCH
E EA

ETH zürich

Prototype as Artefact – Open-ended Collaborative Assembly Processes

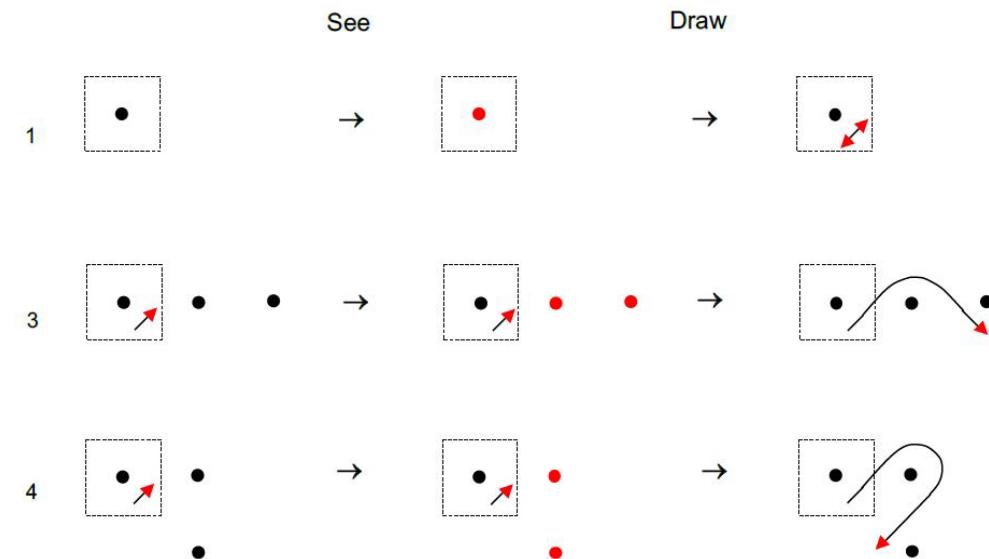
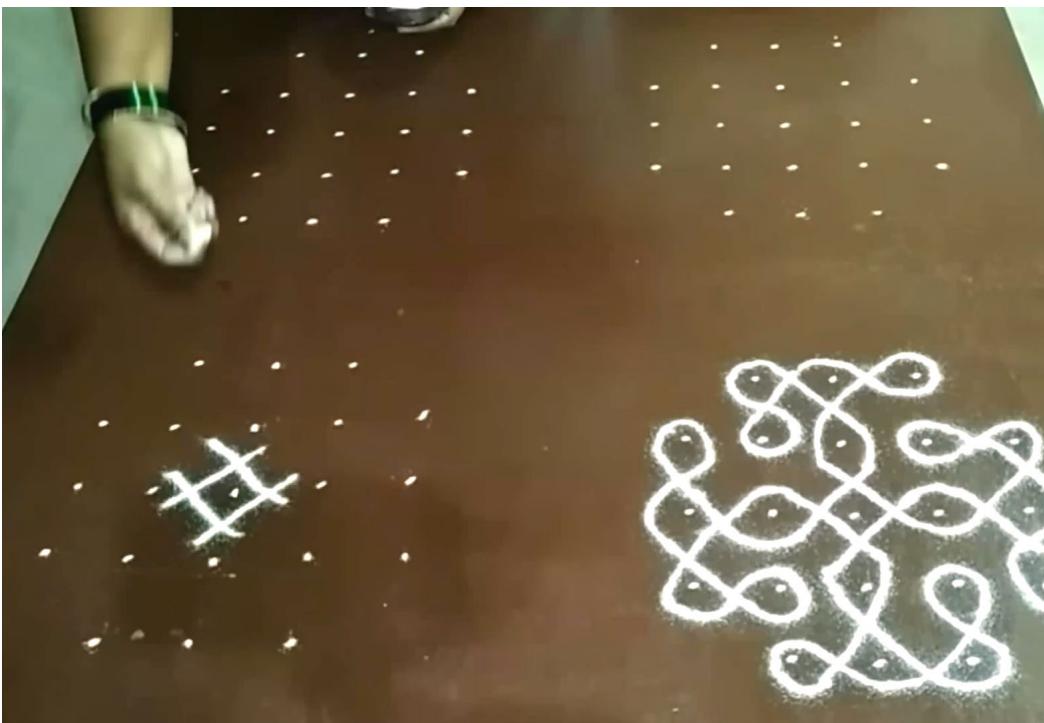


Linear Digital Design-to-Fabrication Workflows



All design decisions are made prior to production.

Non-linear Craft Workflows



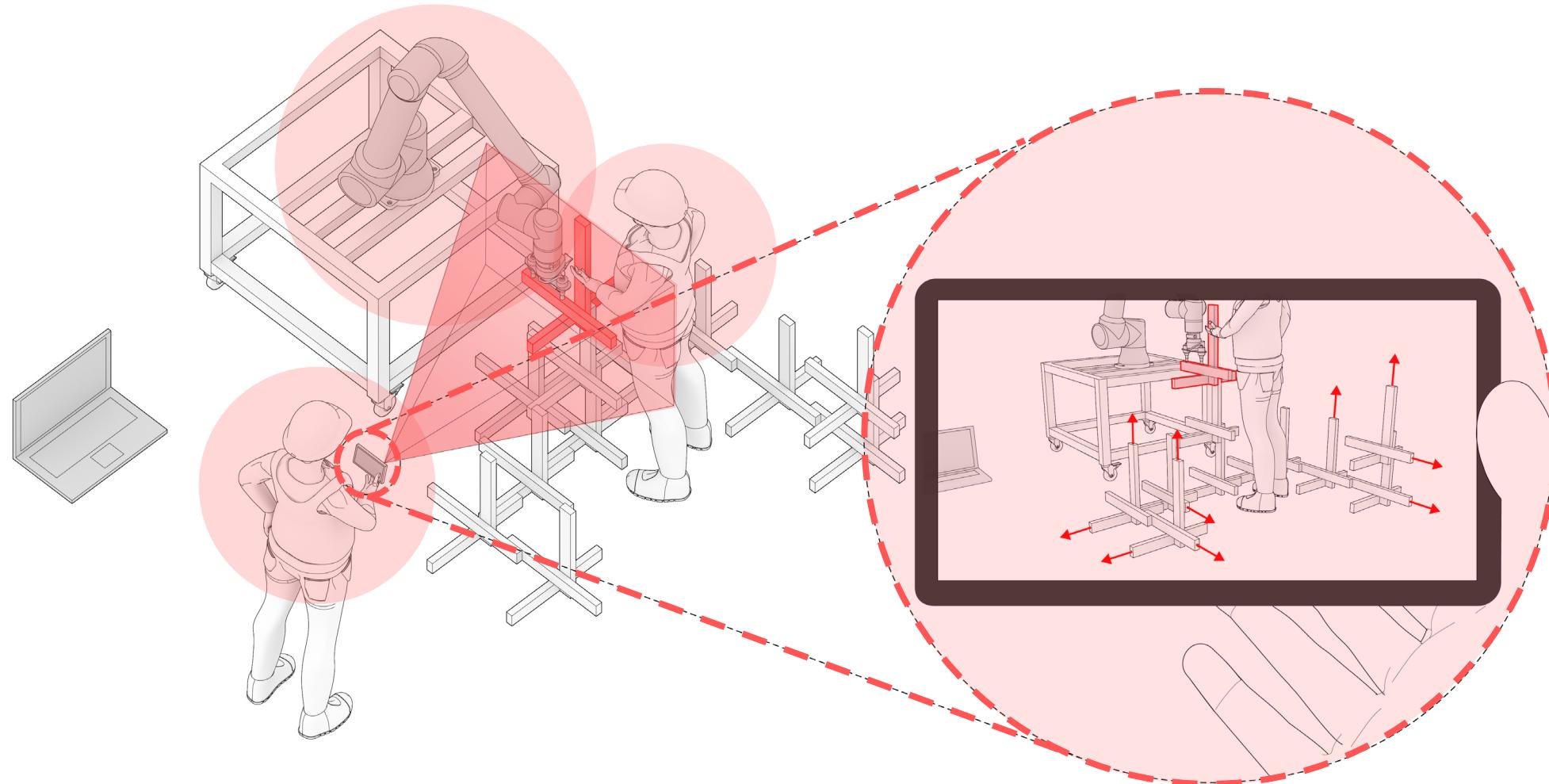
The rules of making grammar. Source: T. Knight 2017

Woman making a kolam pattern.

Source: https://www.youtube.com/watch?v=T2_J6SD-XeU (30.10.2020)

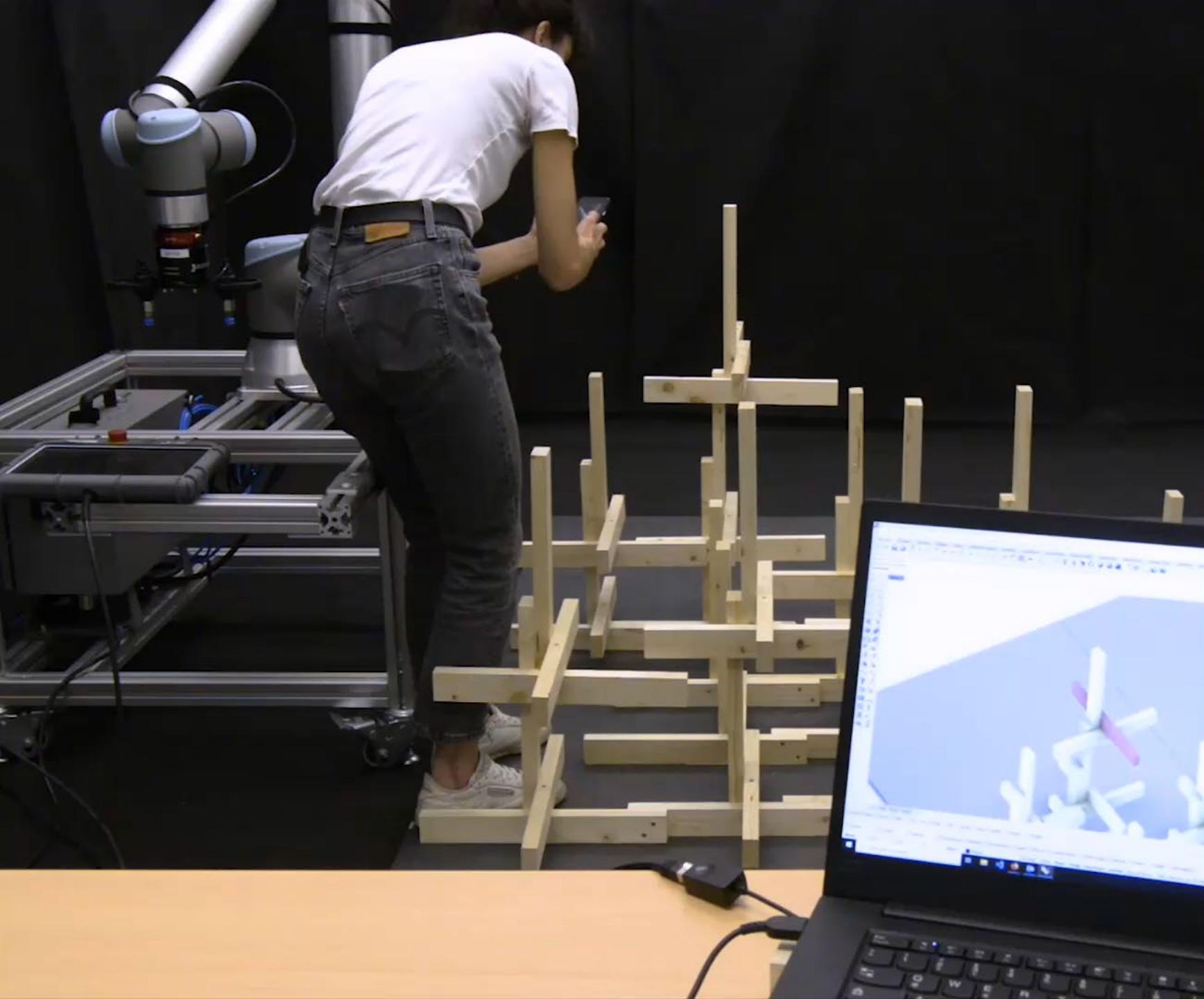
Allow for design decisions during fabrication.

Collaborative Human-Robot Assembly - Setup



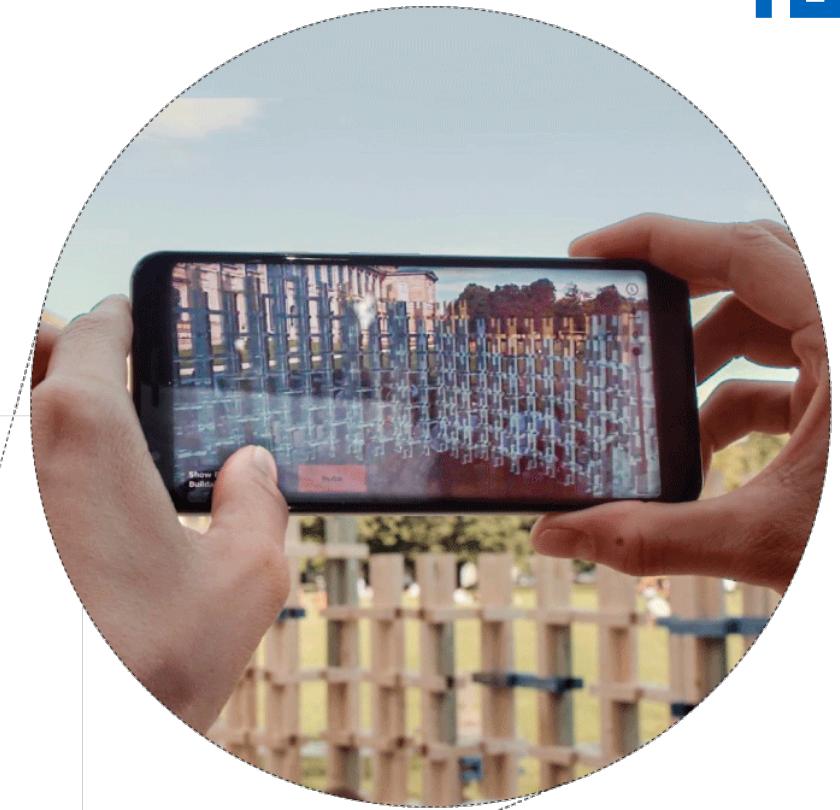
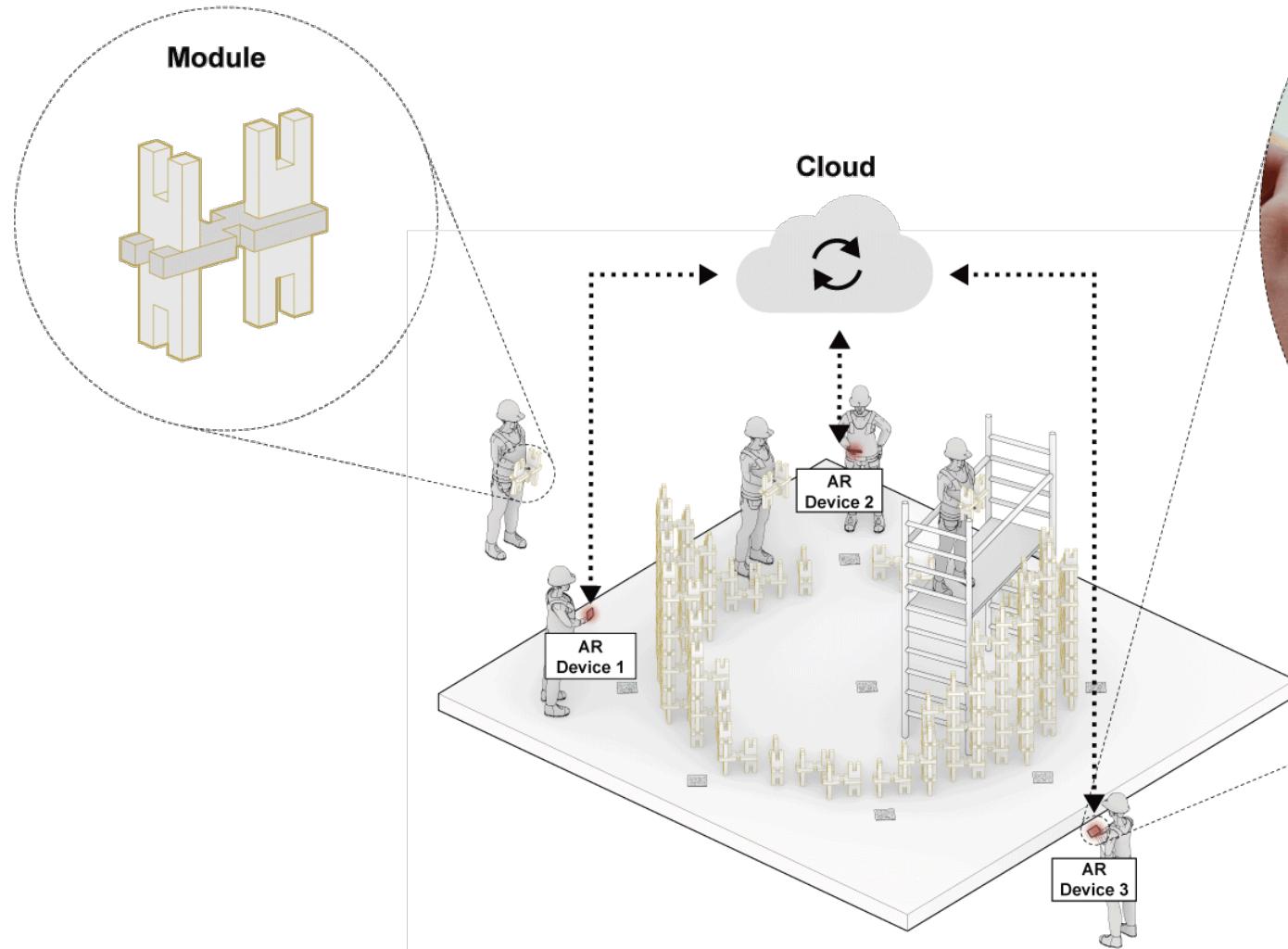
Assembly Grammar

Collaborative Workflow



LoX: Collective AR-Assisted Assembly of Topological Interlocking Structures







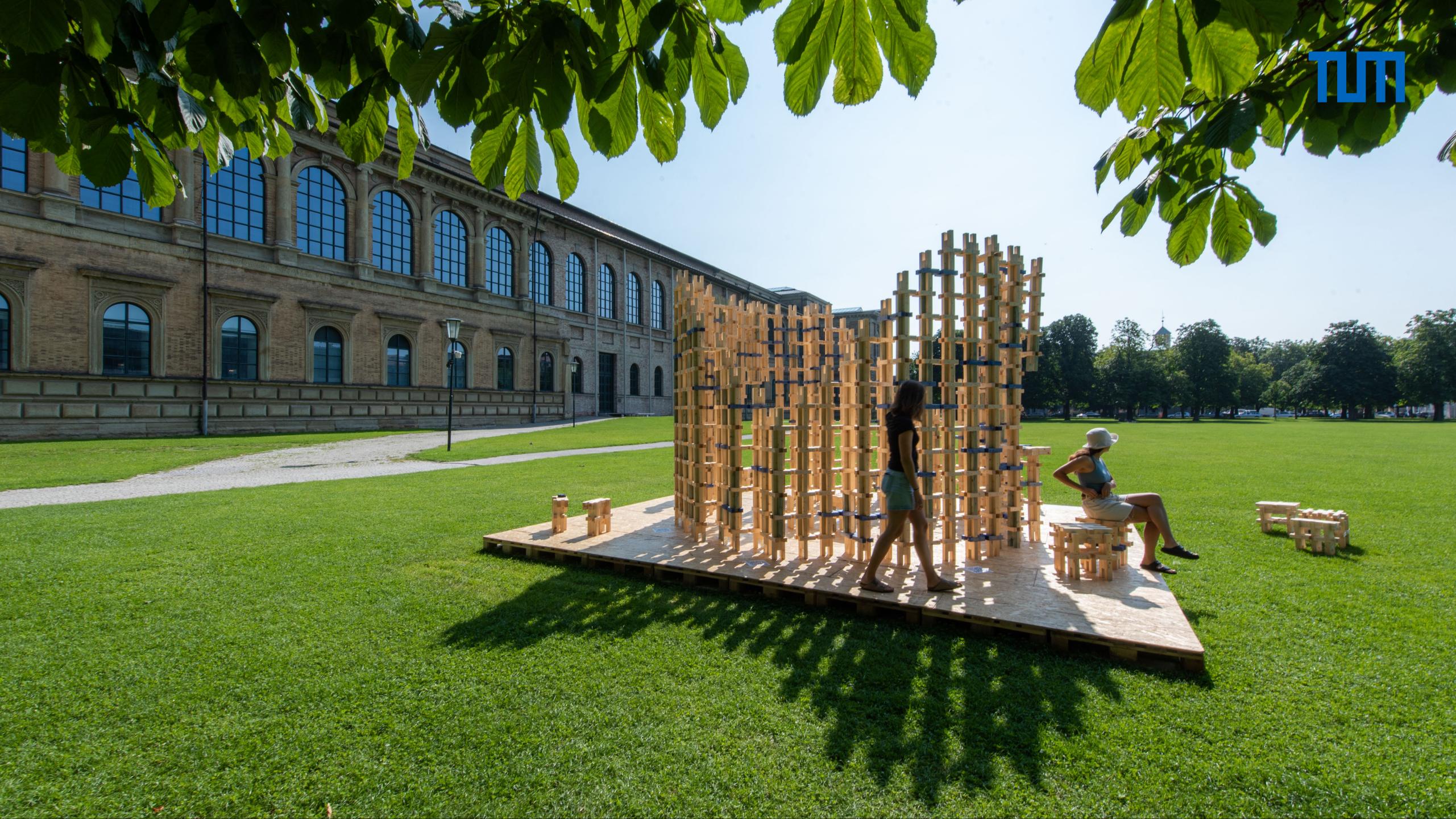
LoX

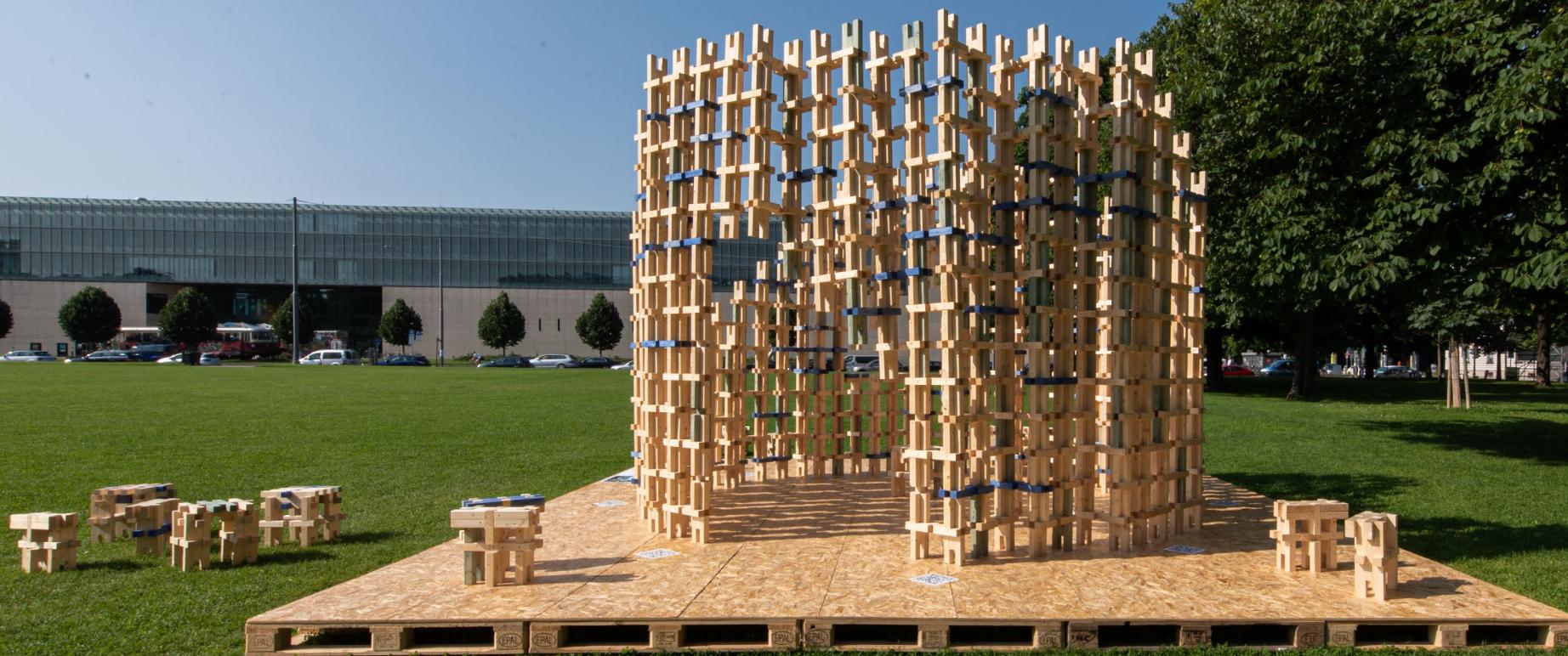
Collective AR-Assisted Assembly of Topological Interlocking Structures



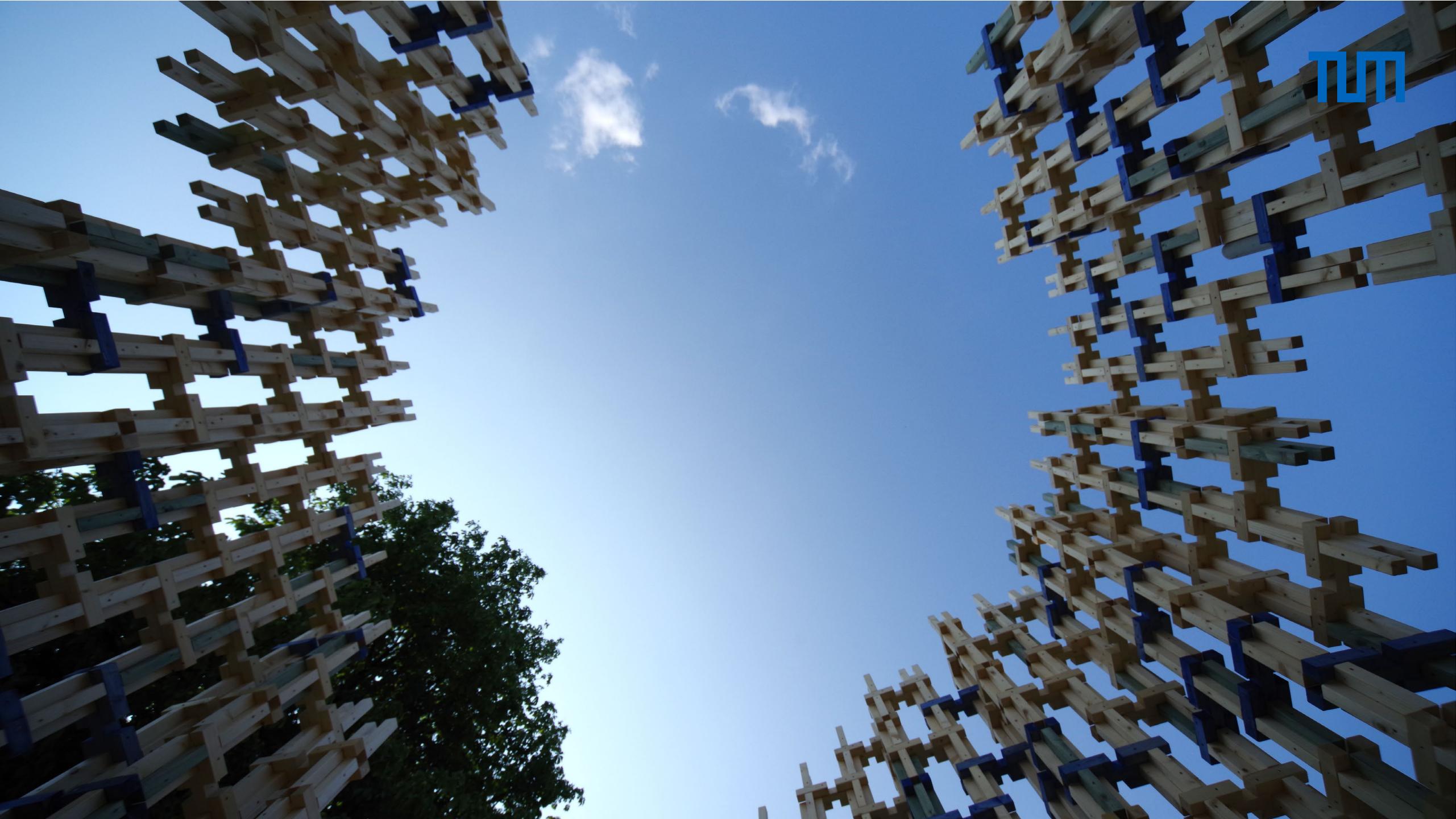
TUM









A wide-angle photograph looking up at a massive, intricate wooden lattice structure. The structure is composed of numerous horizontal and vertical wooden beams, creating a complex, geometric pattern. It is set against a clear blue sky with a few wispy white clouds. In the lower-left foreground, the dark green foliage of a tree is visible. The perspective is from a low angle, looking upwards through the gaps of the lattice.

TUM

Augmented Construction Training

HILTI The Foundation.

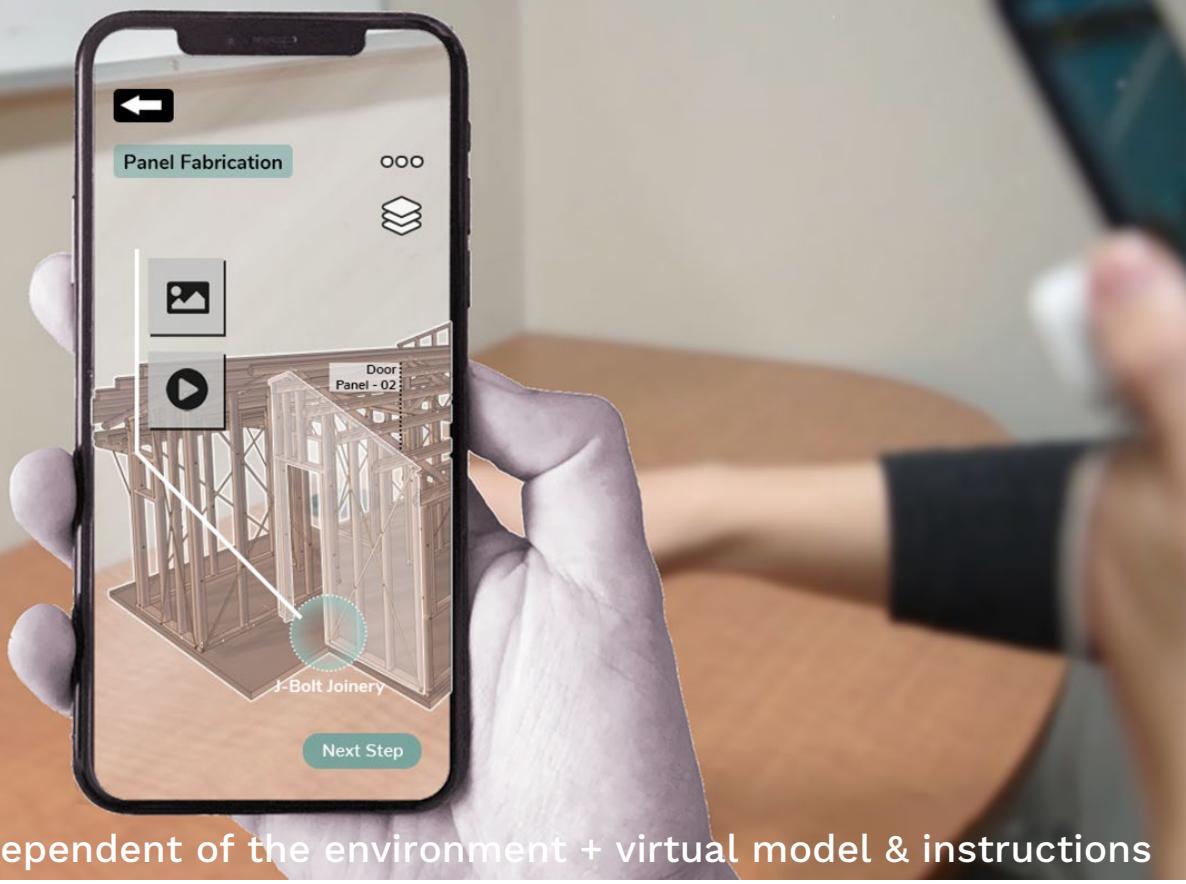




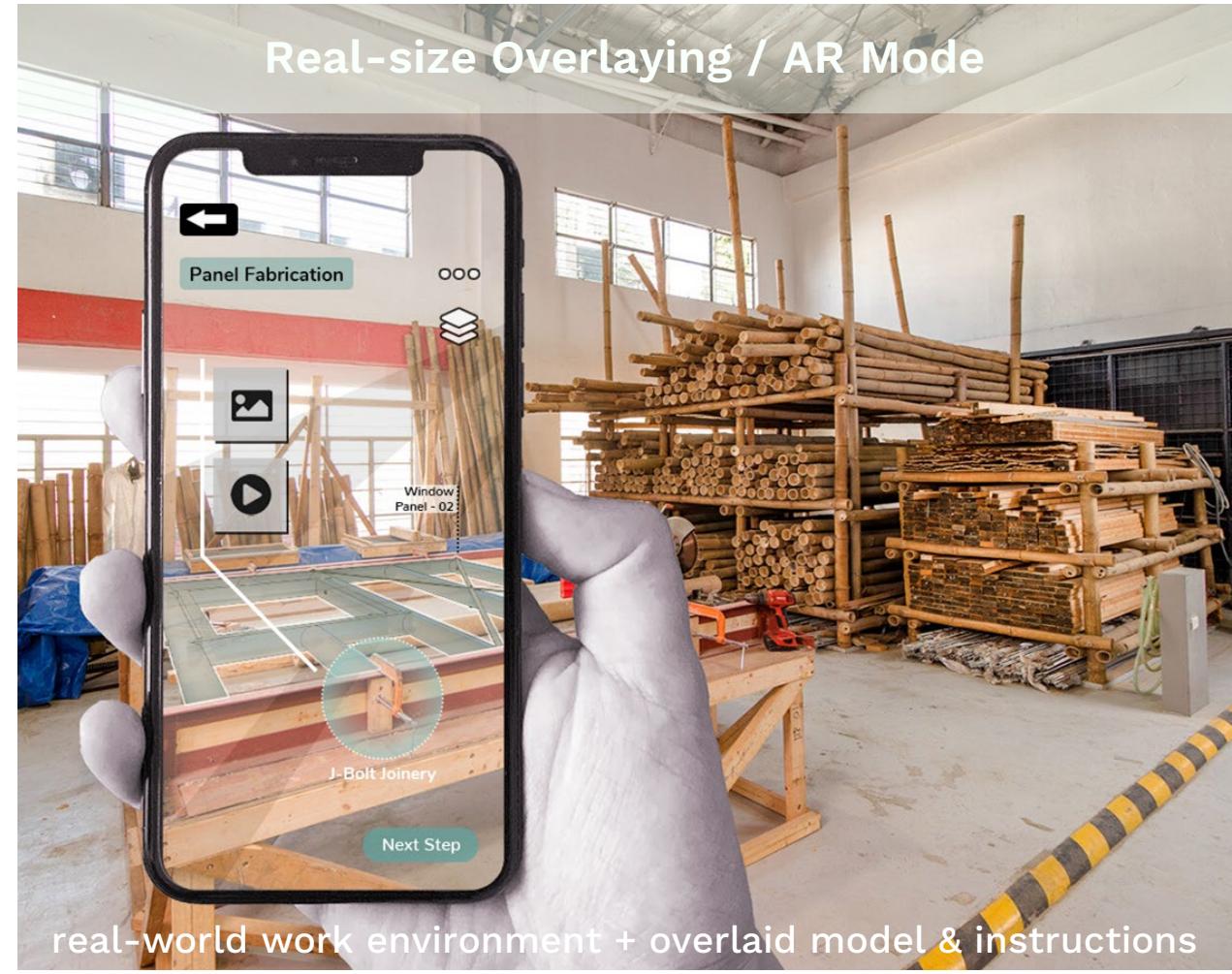


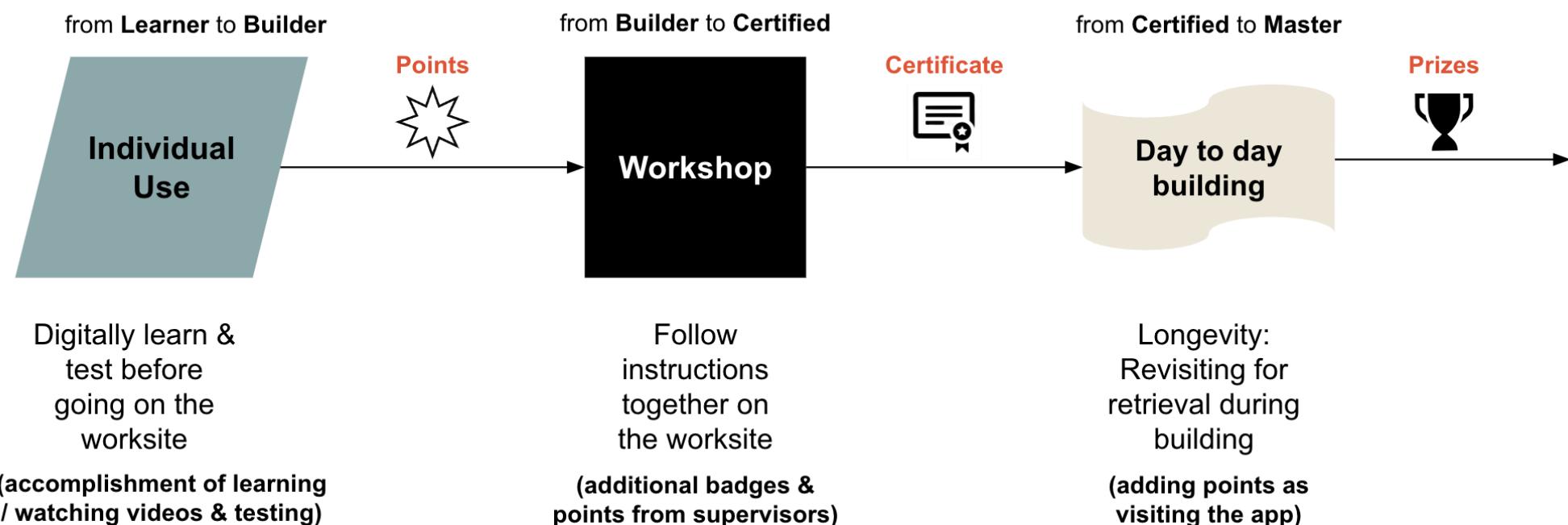


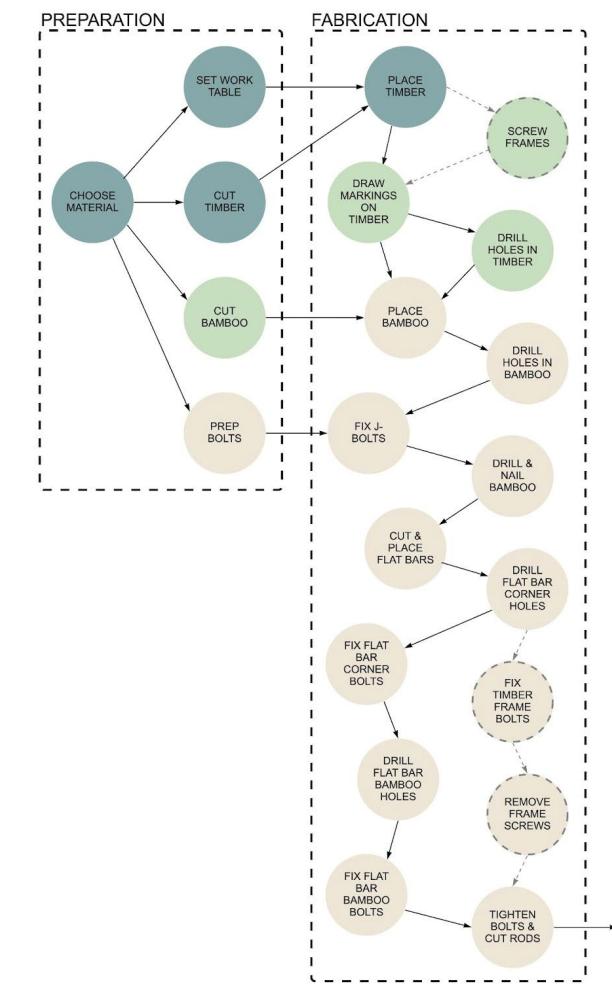
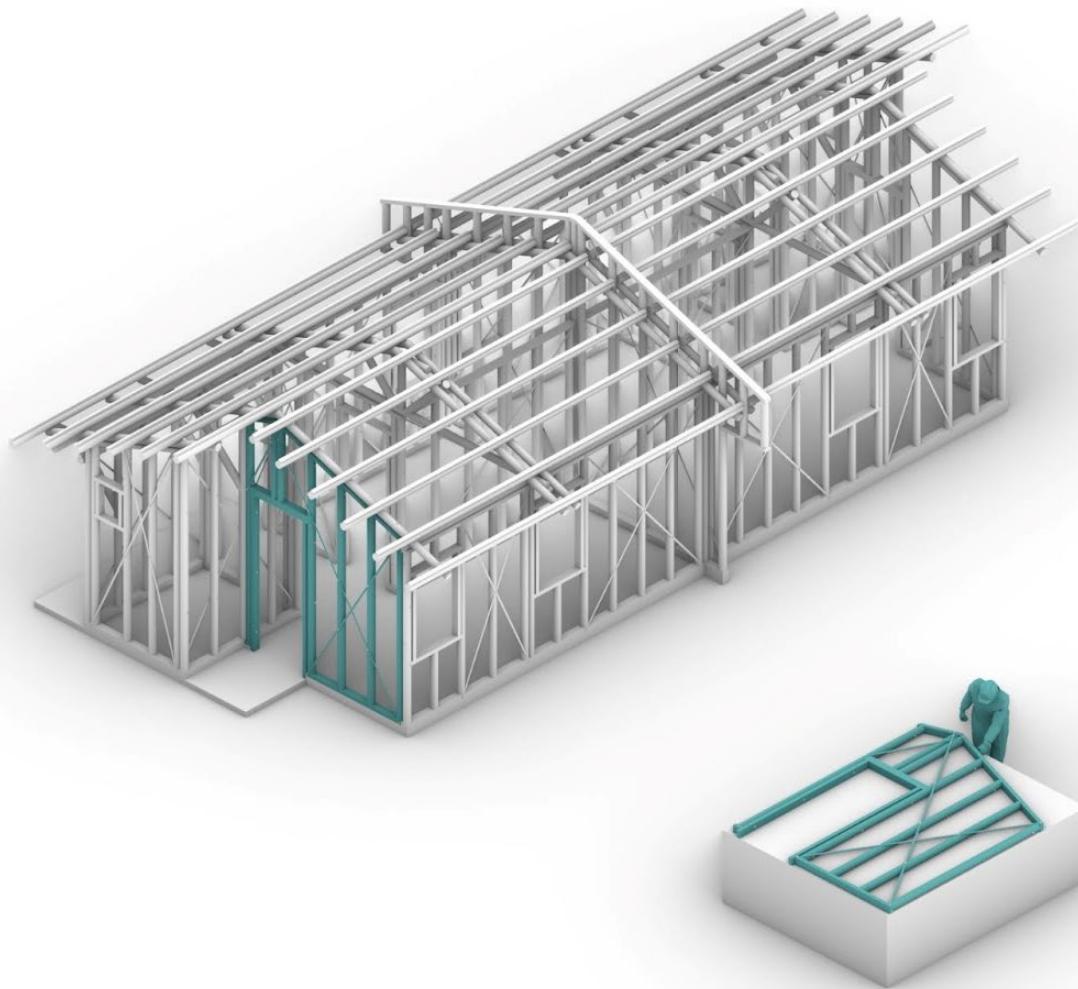
Scaled Digital / VR Mode

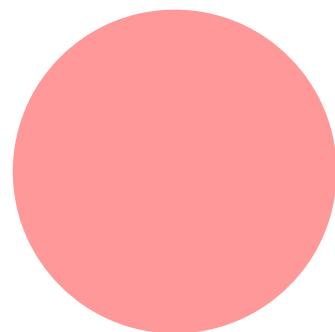


Real-size Overlaying / AR Mode

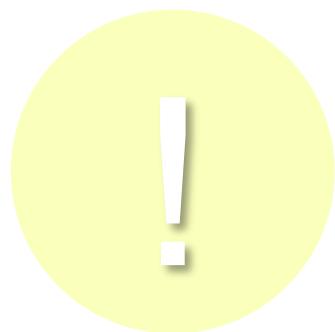








*Action
bubble*



*Information
bubble*



*Video
bubble*



*Question
bubble*

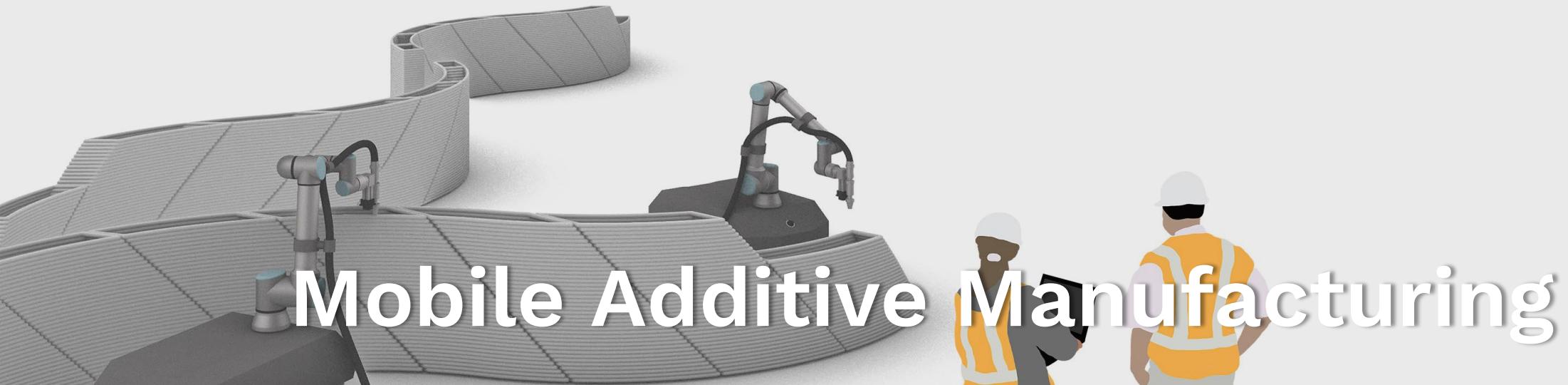




TUM



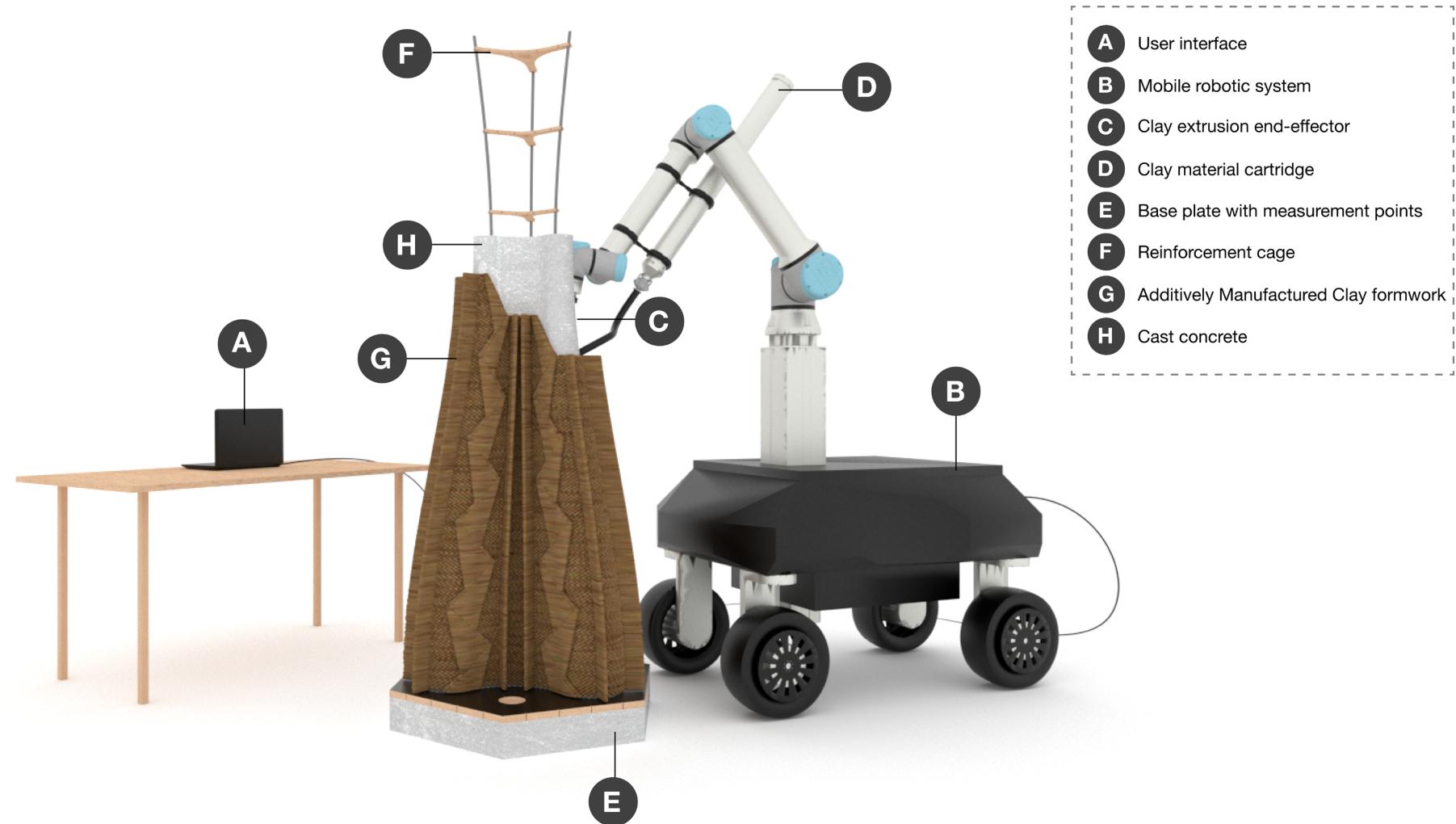
... to be continued.



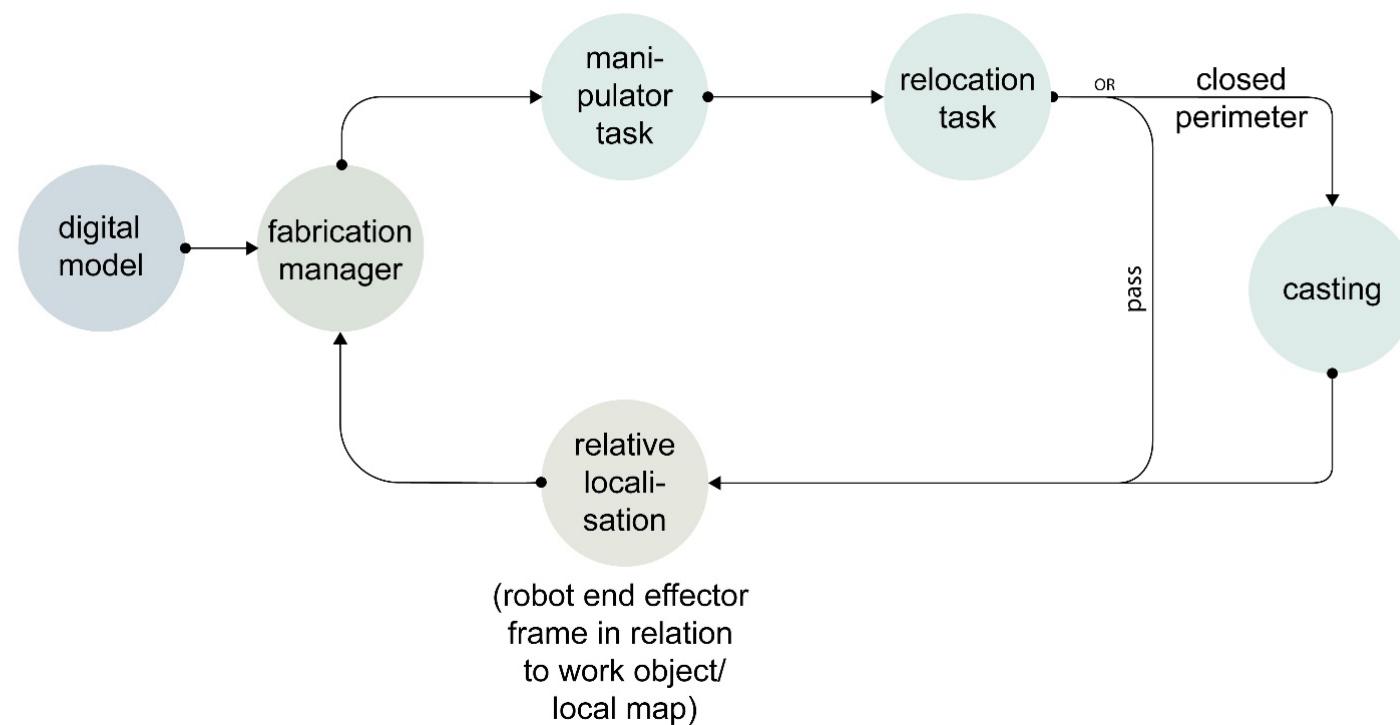
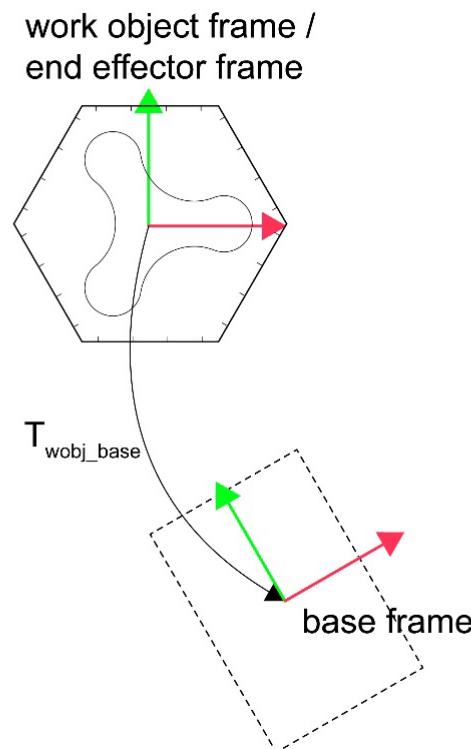
Mobile Additive Manufacturing

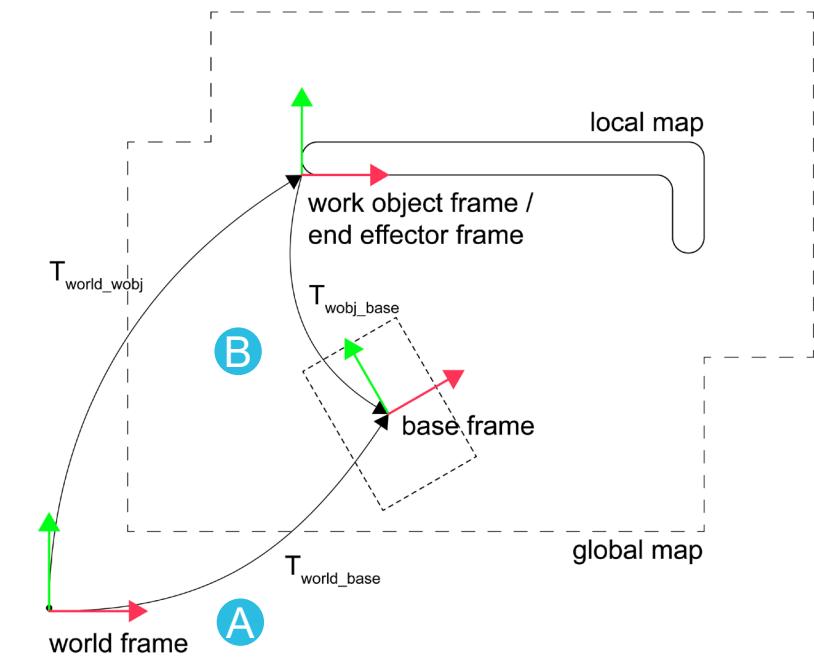
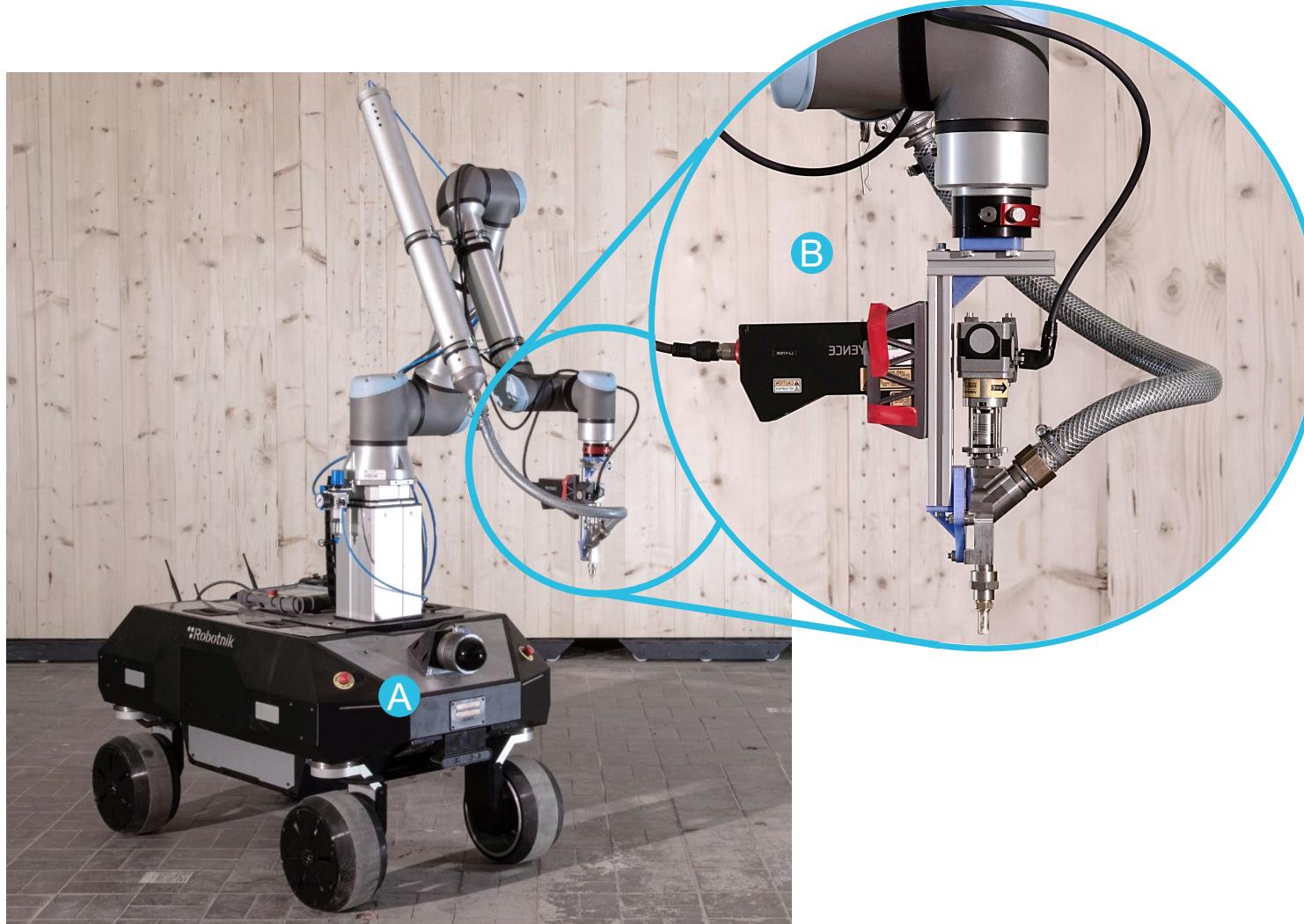


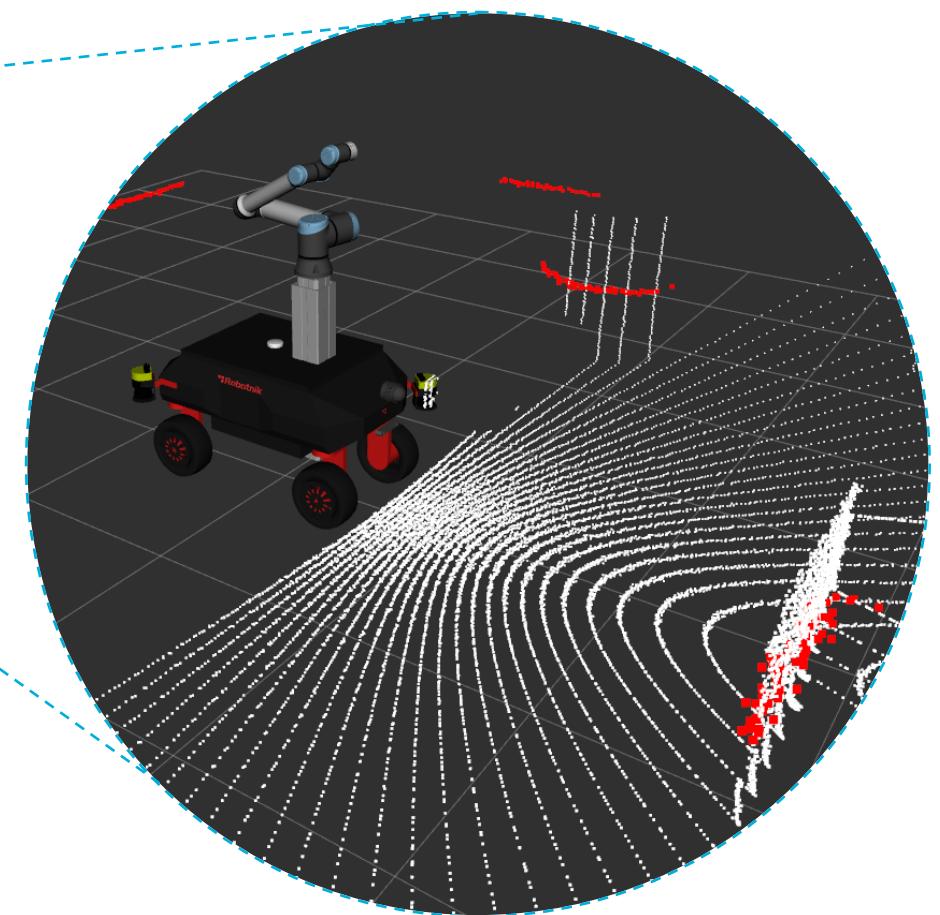
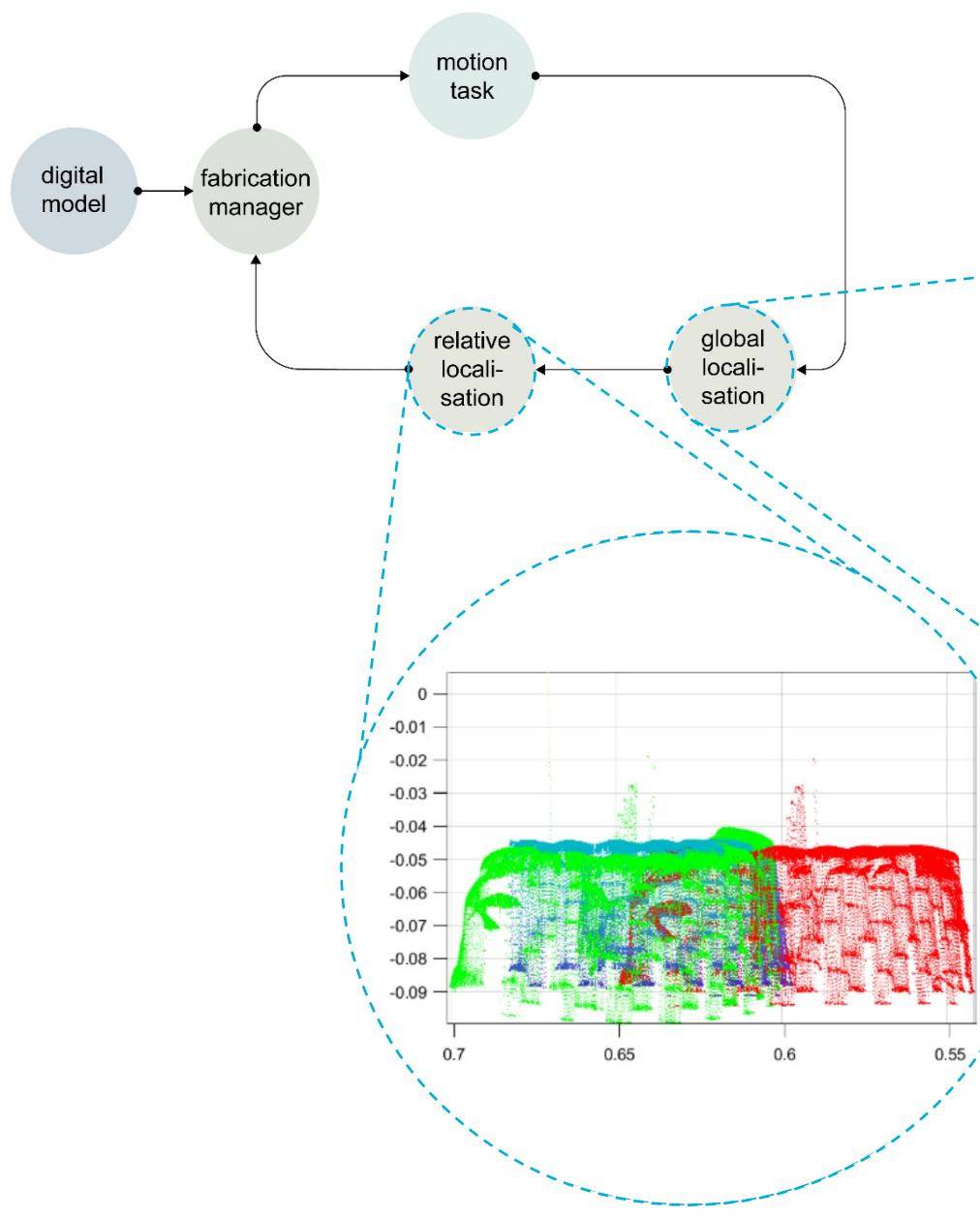






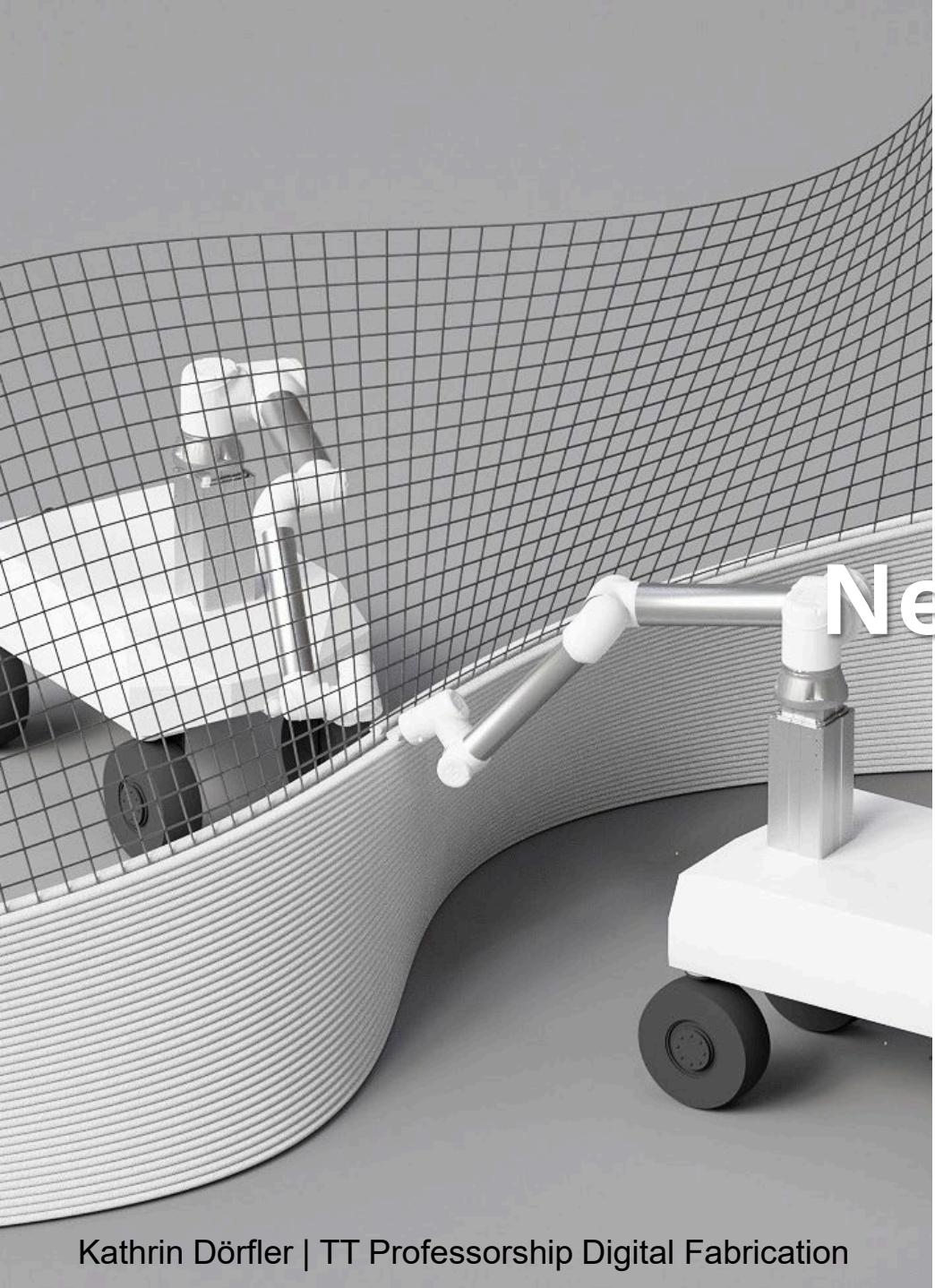




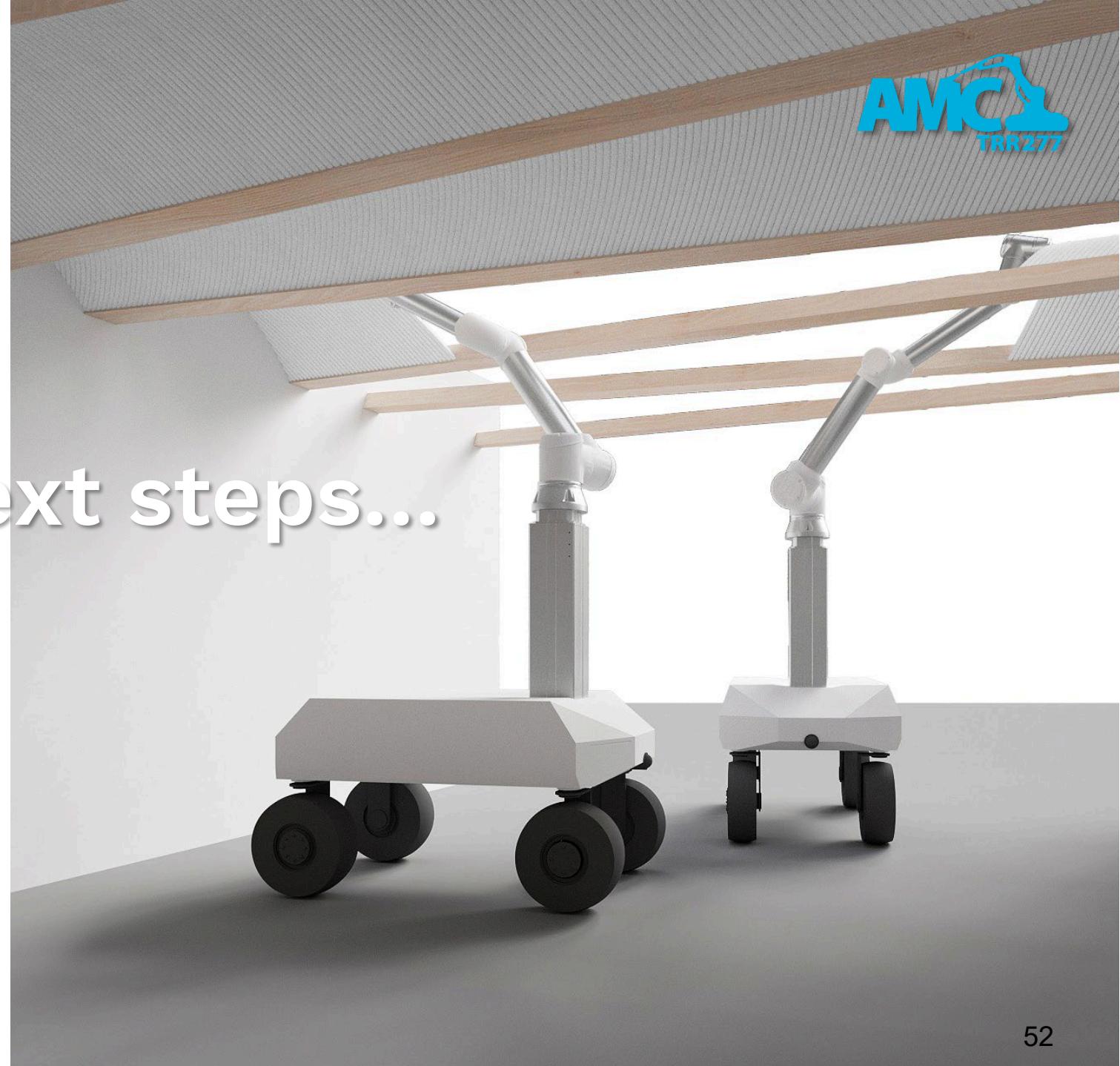


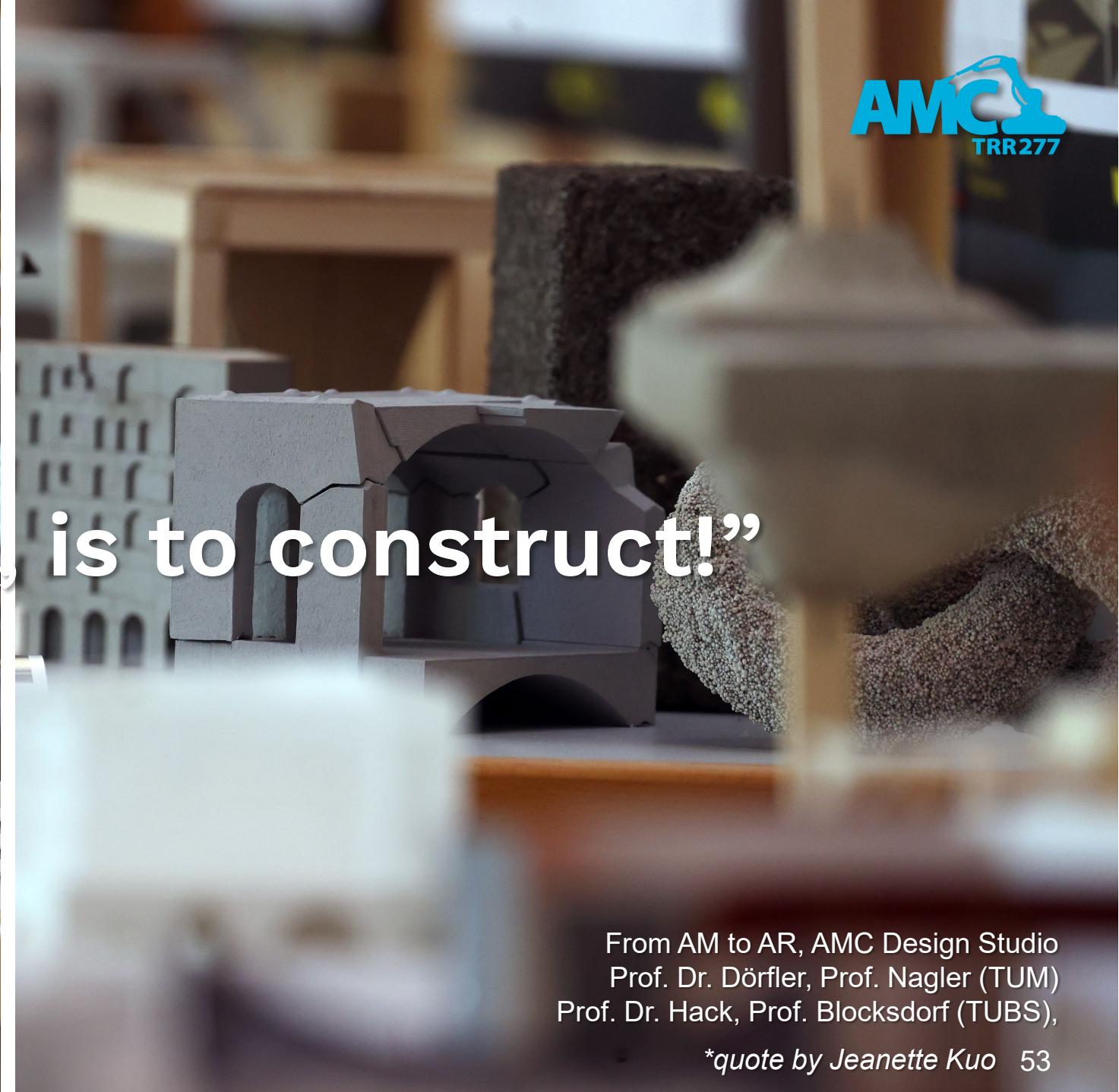


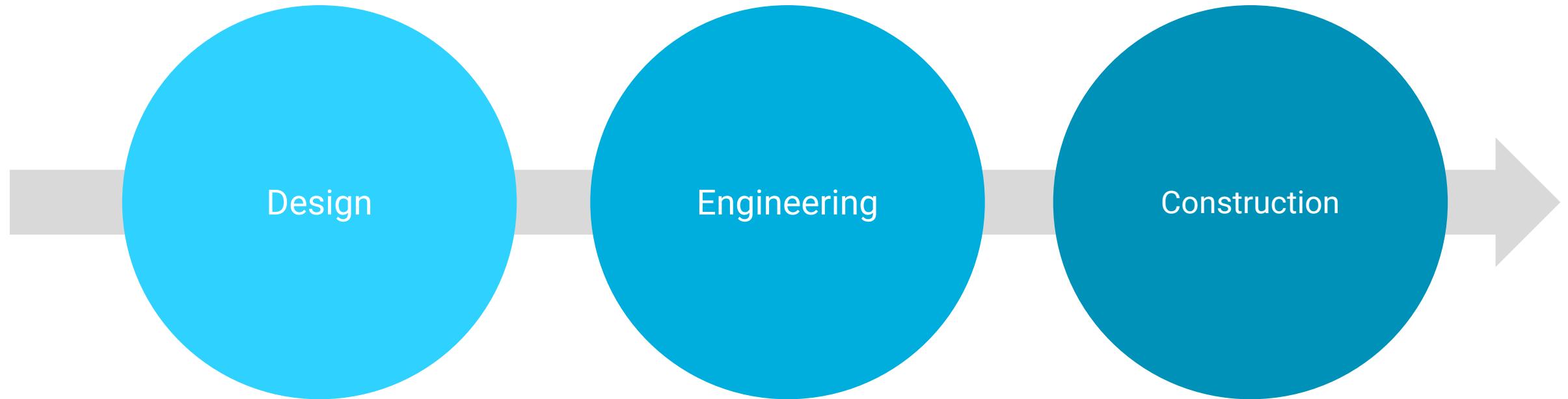


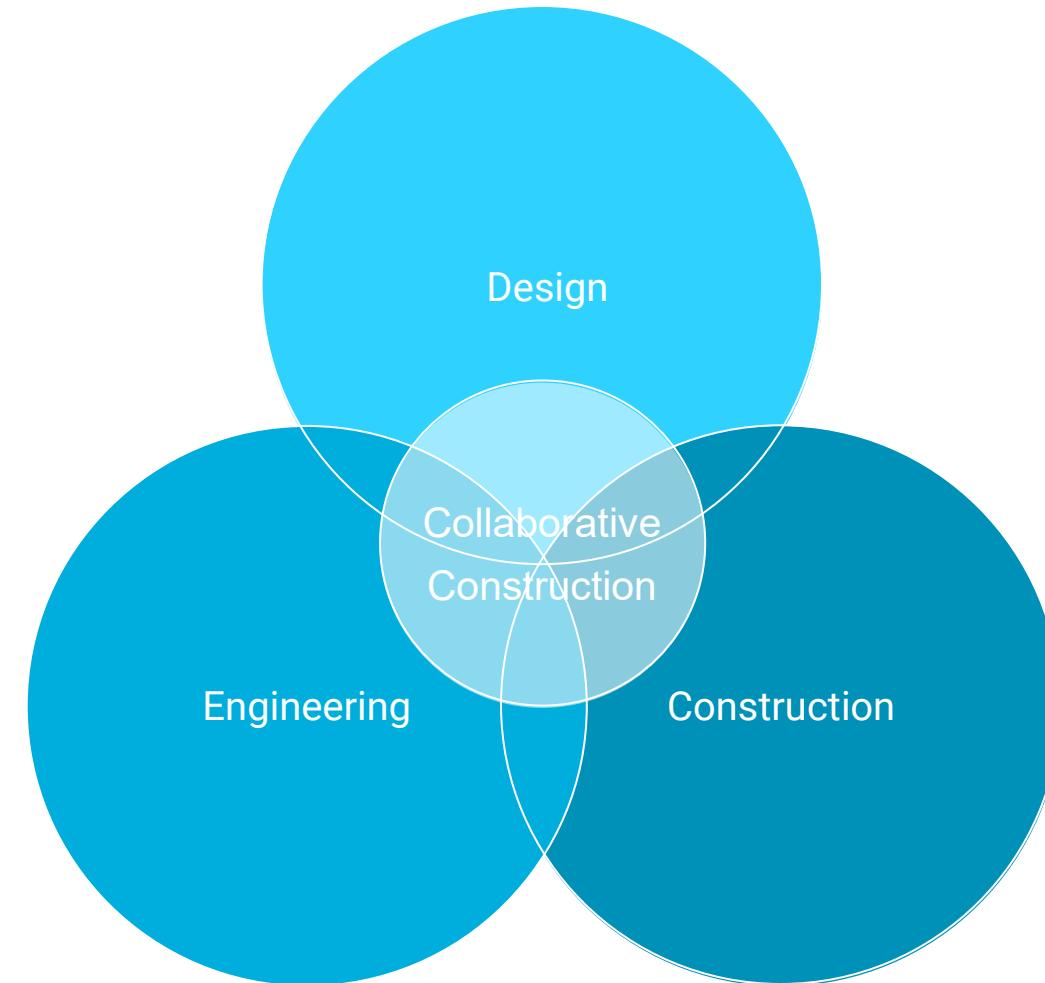


Next steps...



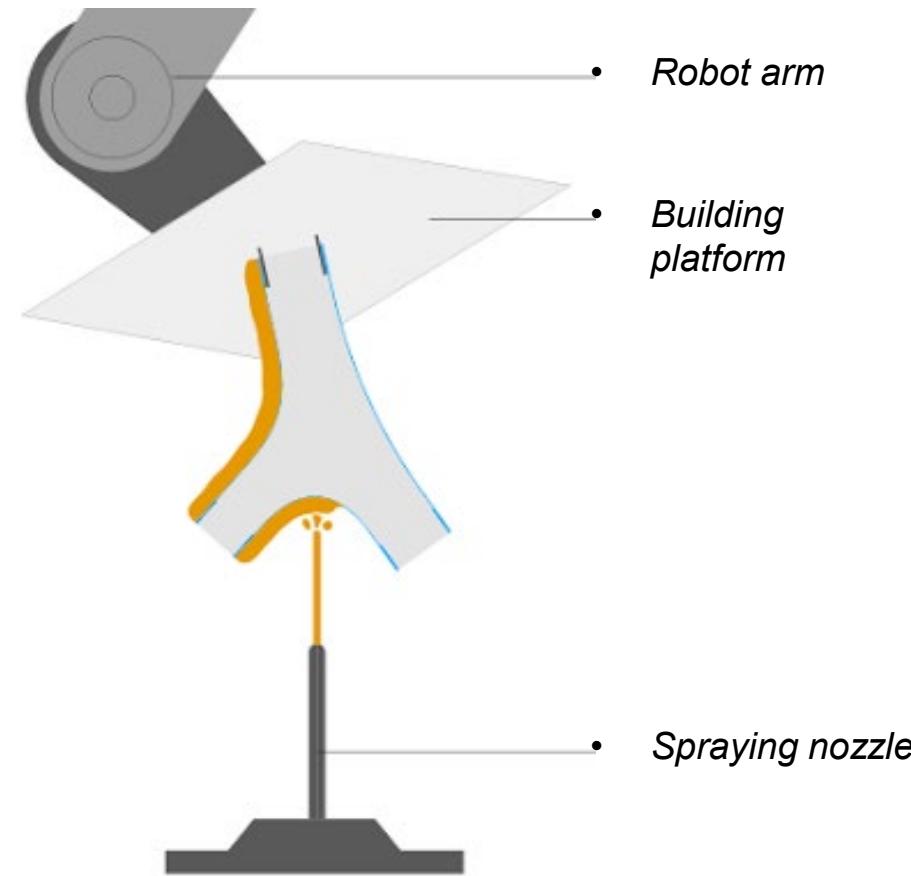




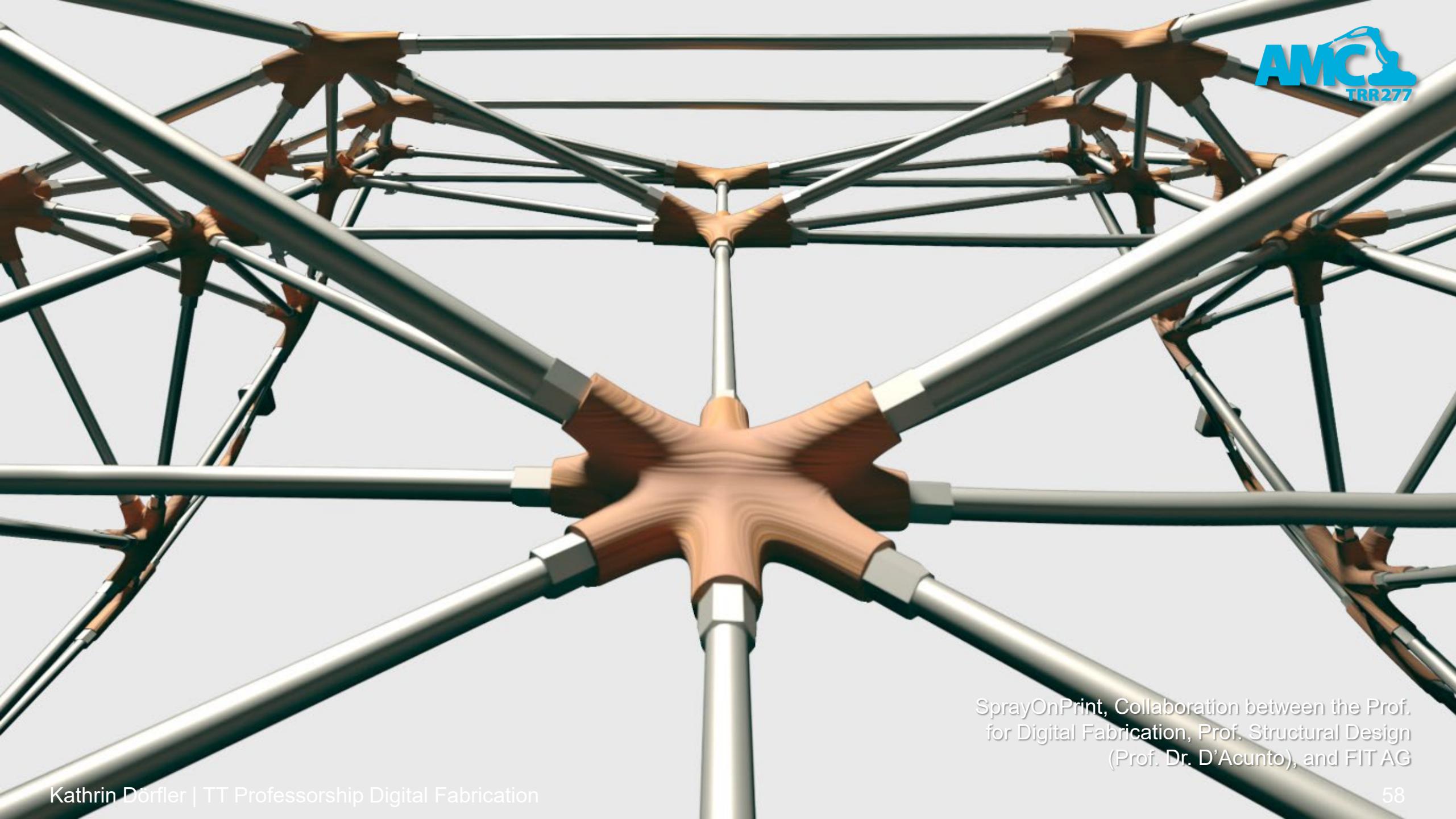




SprayOnPrint, Collaboration between the Prof. for Digital Fabrication, Prof. Structural Design (Prof. Dr. D'Acunto), and FIT AG



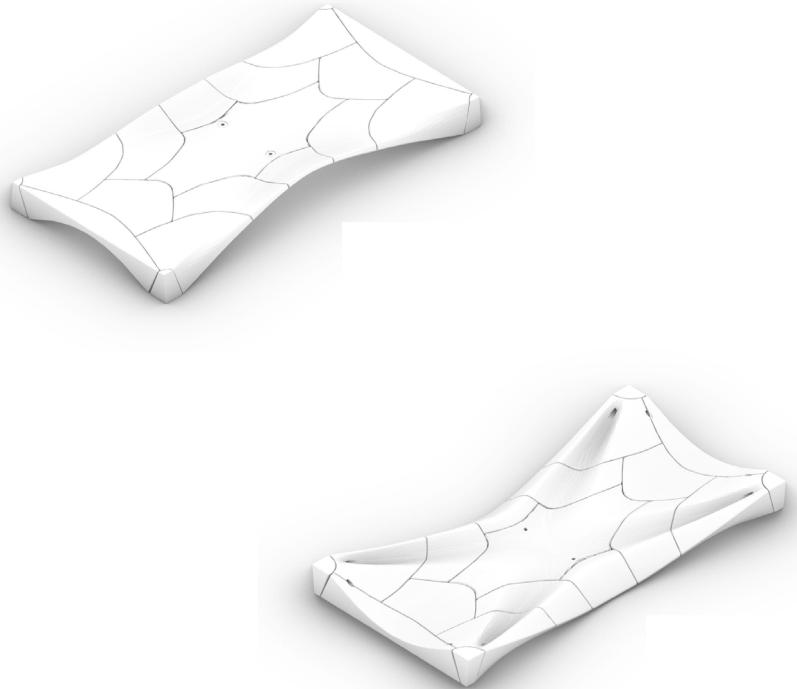
SprayOnPrint, Collaboration between the Prof. for Digital Fabrication, Prof. Structural Design (Prof. Dr. D'Acunto), and FIT AG



SprayOnPrint, Collaboration between the Prof. for Digital Fabrication, Prof. Structural Design (Prof. Dr. D'Acunto), and FIT AG



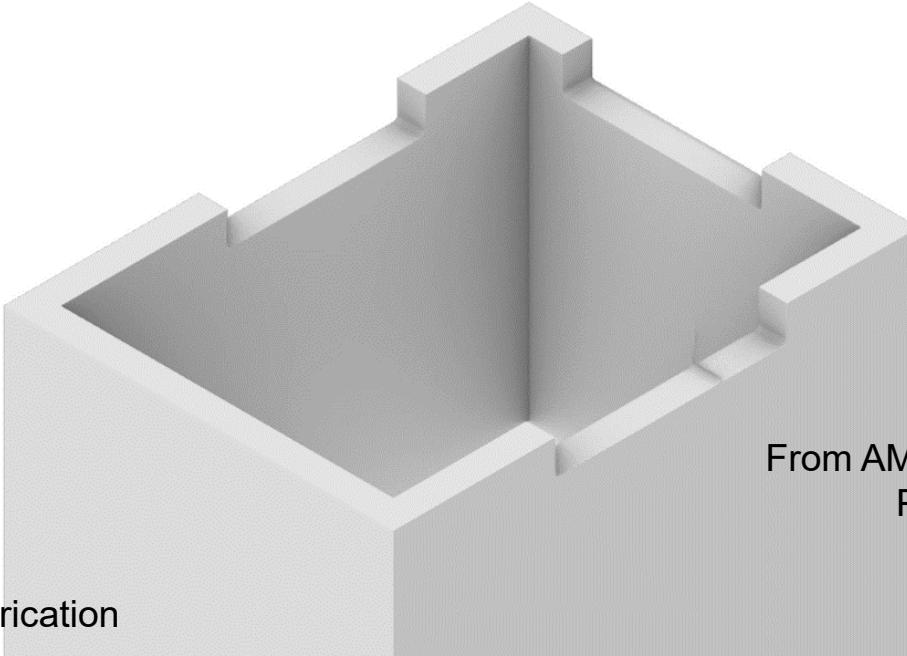
SPI Residential Bridge, Collaboration between the
Prof. for Digital Fabrication, Prof. Structural Design,
and the Centre for Building Materials



SPI Residential Bridge, Collaboration between the Prof. for Digital Fabrication, Prof. Structural Design, and the Centre for Building Materials



SPI Residential Bridge, Collaboration between the Prof. for Digital Fabrication, Prof. Structural Design, and the Centre for Building Materials



From AM to AR, AMC Design Studio (Prof. Dr. Dörfler,
Prof. Nagler, Prof. Dr. Hack, Prof. Blocksdorf),
Amber Alvarez | Elke Meiresonne

Conclusion

- **Alternative vision of a fully automated production in architecture**
 - **Hybrid human-robot work teams that complement each other**
 - **Increased flexibility, freedom of design, areas of application & social sustainability**

Questions?

