Aalto University
School of Engineering

Operation Management in Construction
Lecture #9
Digital Twin Construction – Future trends

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Topics, Lecture #8

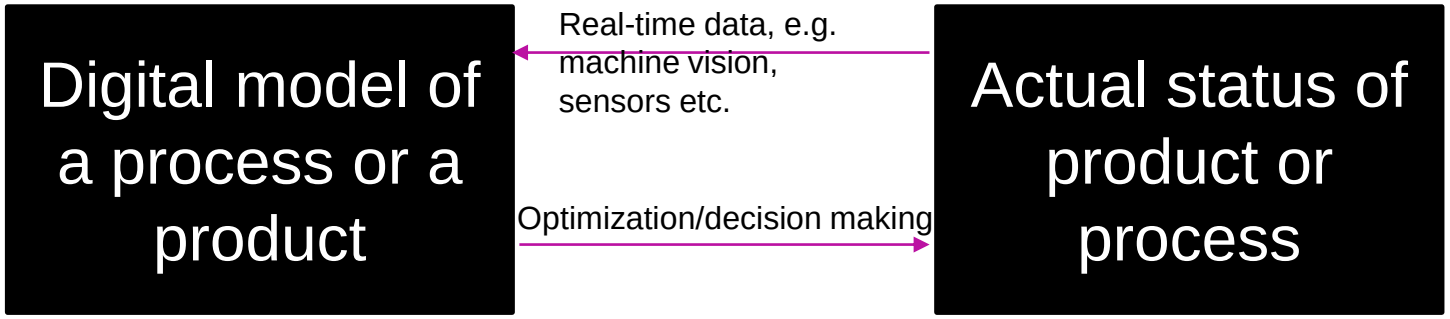
- **Learning objectives**
- **What is Digital Twin Construction?**
- **From situation picture to digital twin**

Intended learning objectives for this lecture

- ILO 5**: Students can explain** the significance of work and labor flow and how flow can be achieved in construction
  - *ILO emphasized for digitalization of flow*
- ILO 6**: Students can discuss** how digitalization can be used to guide production planning and control decisions
  - *ILO emphasized*

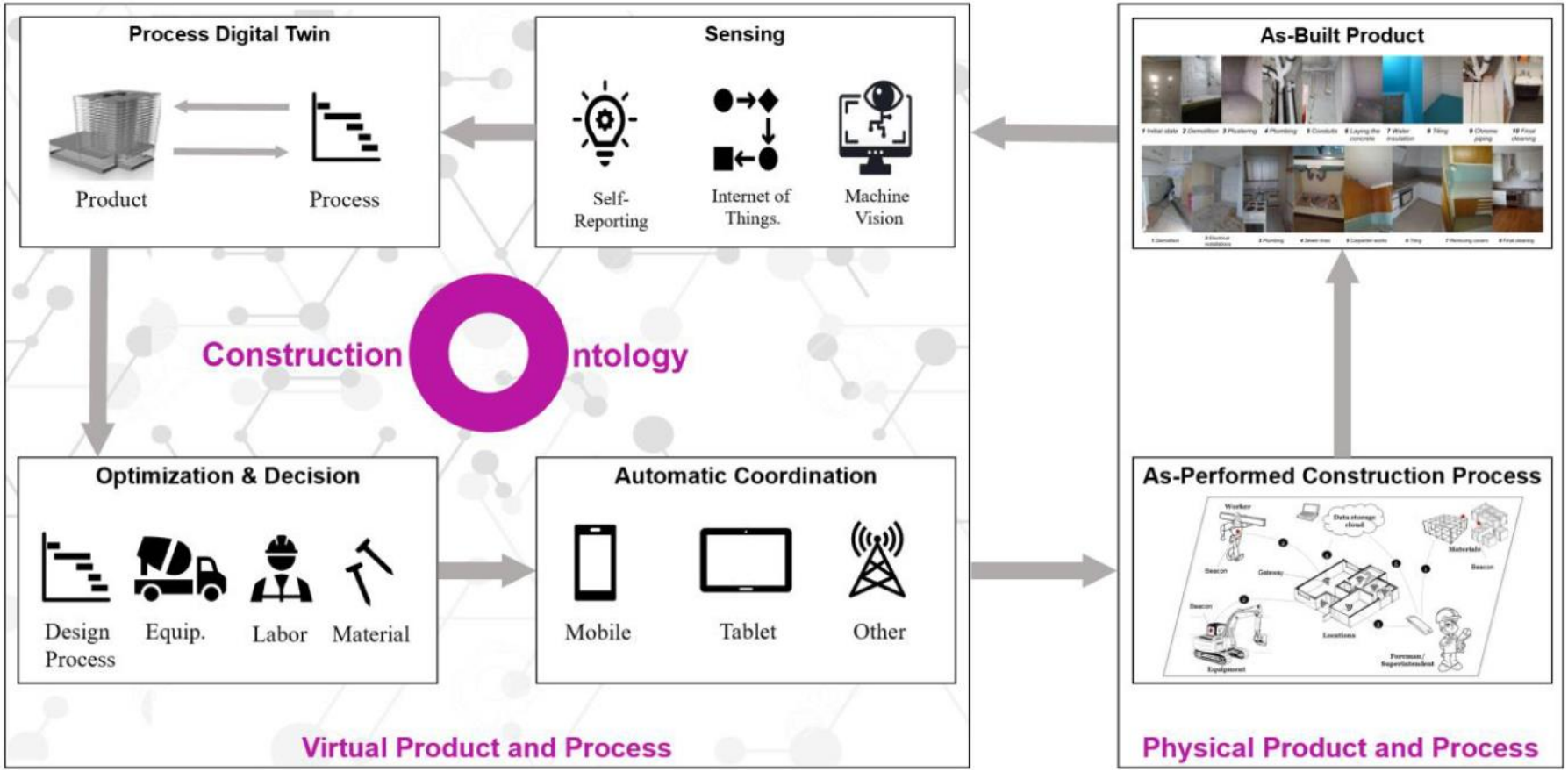
Digital Twin Construction

Digital twin - definition



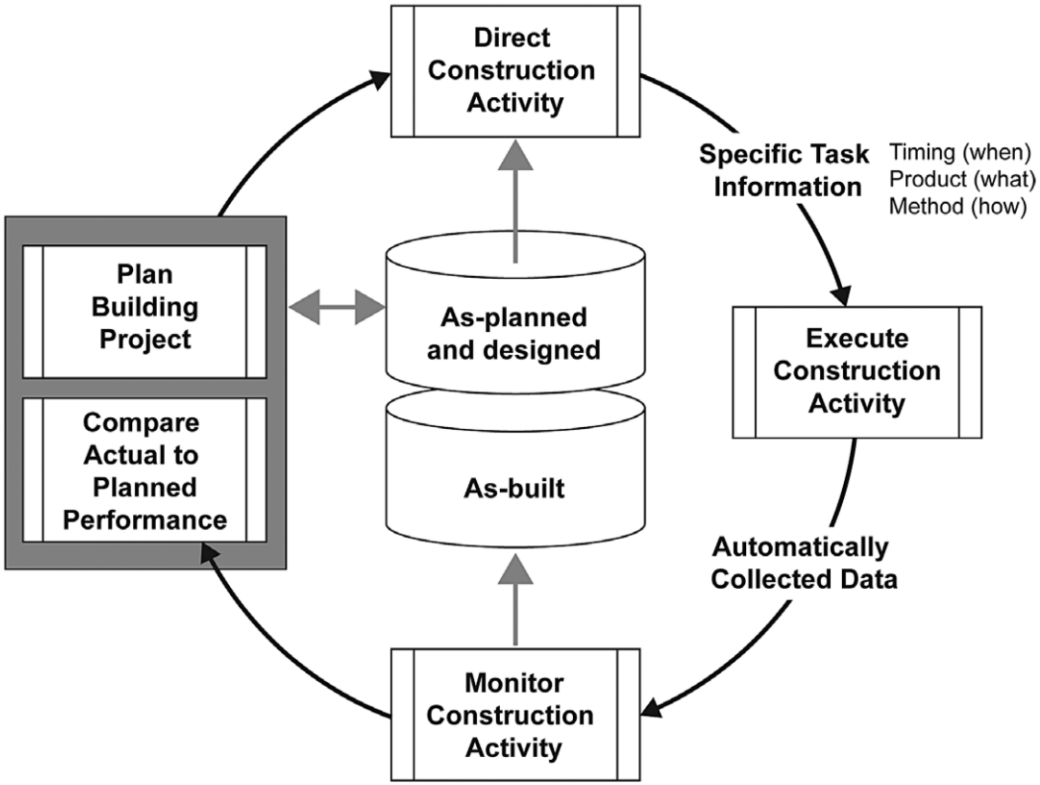
- **Digital model of a process or product**
  - E.g. simulation model of process, BIM of building
  - The same level of detail as automatically collected actual data
  - Continuously updating, supports decision making
  - Real-time connection to reality

Digital twin of process



How should Digital Twin Construction work?

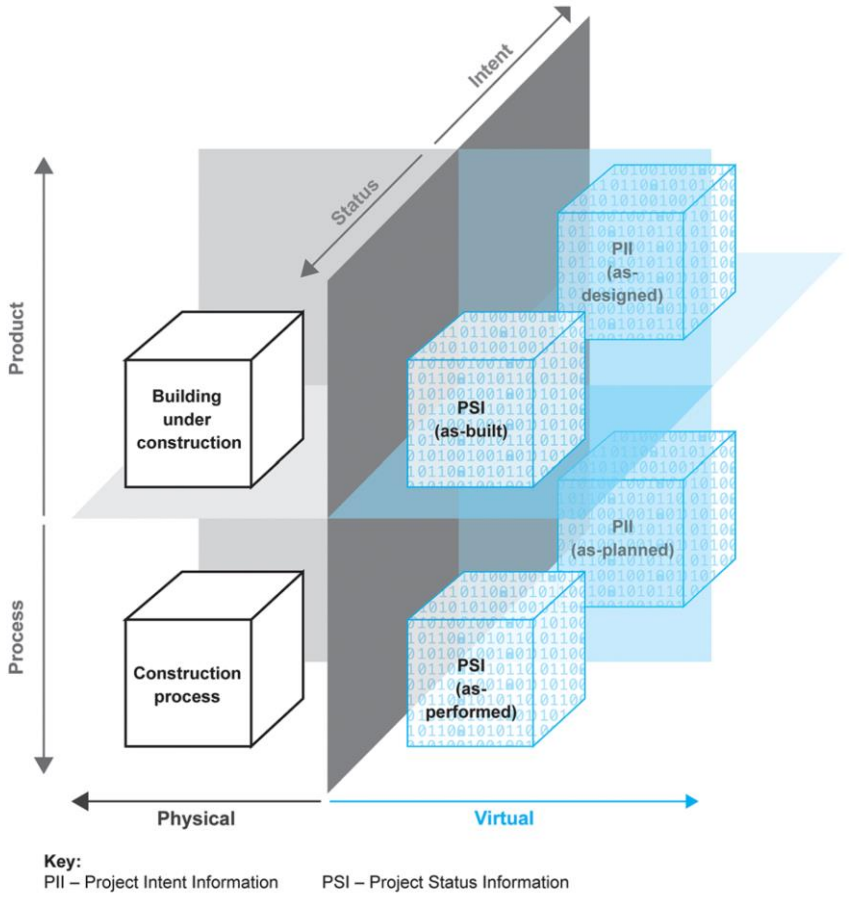
- **Automatic, real-time progress data for controlling**
- **Real-time task information to execution (who, when, what, how?)**



Navon R and Sacks R (2007) Assessing research issues in Automated Project Performance Control (APPC). Automation in Construction 16, 474–484. http://www.sciencedirect.com/science/article/B6V20-4M3J0RF-2/2/9a58c18f48ecb997c28b638f9dda386e

Dimensions of digital twins

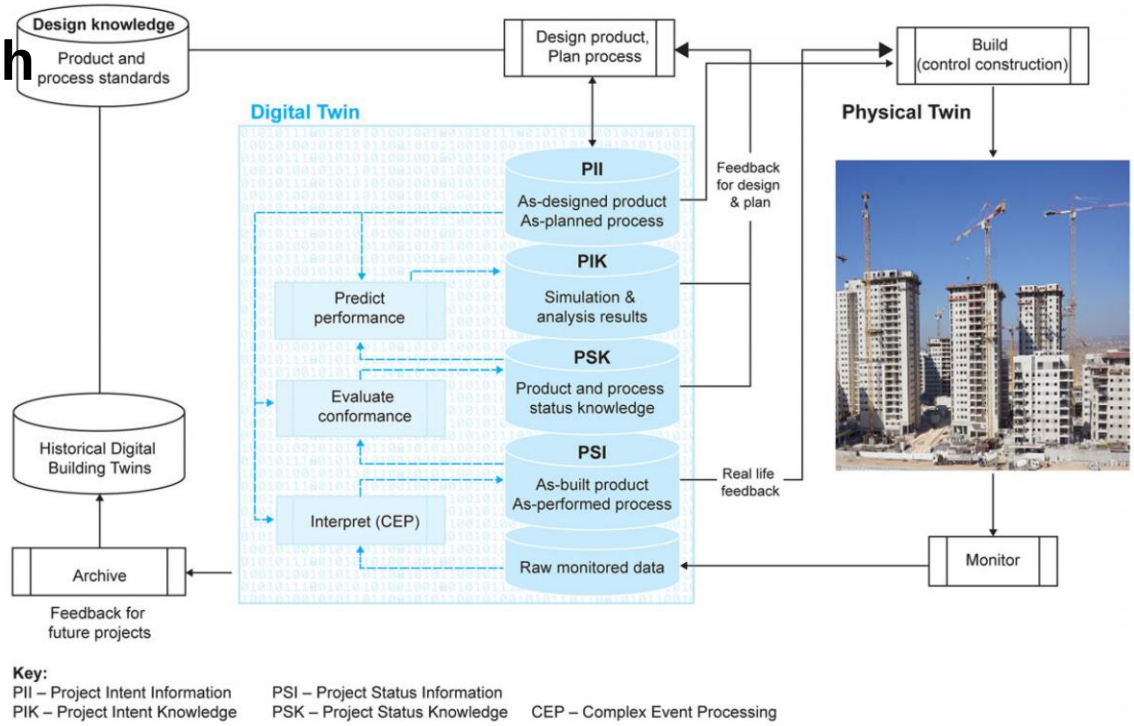
- Process vs. product
- Physical vs. virtual
- Status vs. intent



Sacks R, Brilakis I, Pikas E, Xie H. S and Girolami M (2020). Construction with digital twin information systems. Data-Centric Engineering, 1: e14. doi:10.1017/dce.2020.16

Digital Twin Construction

- **Raw data is not enough**
- **AI needed for interpretation and forecasting**
- **Enables continuous learning and improvement of plans and designs**



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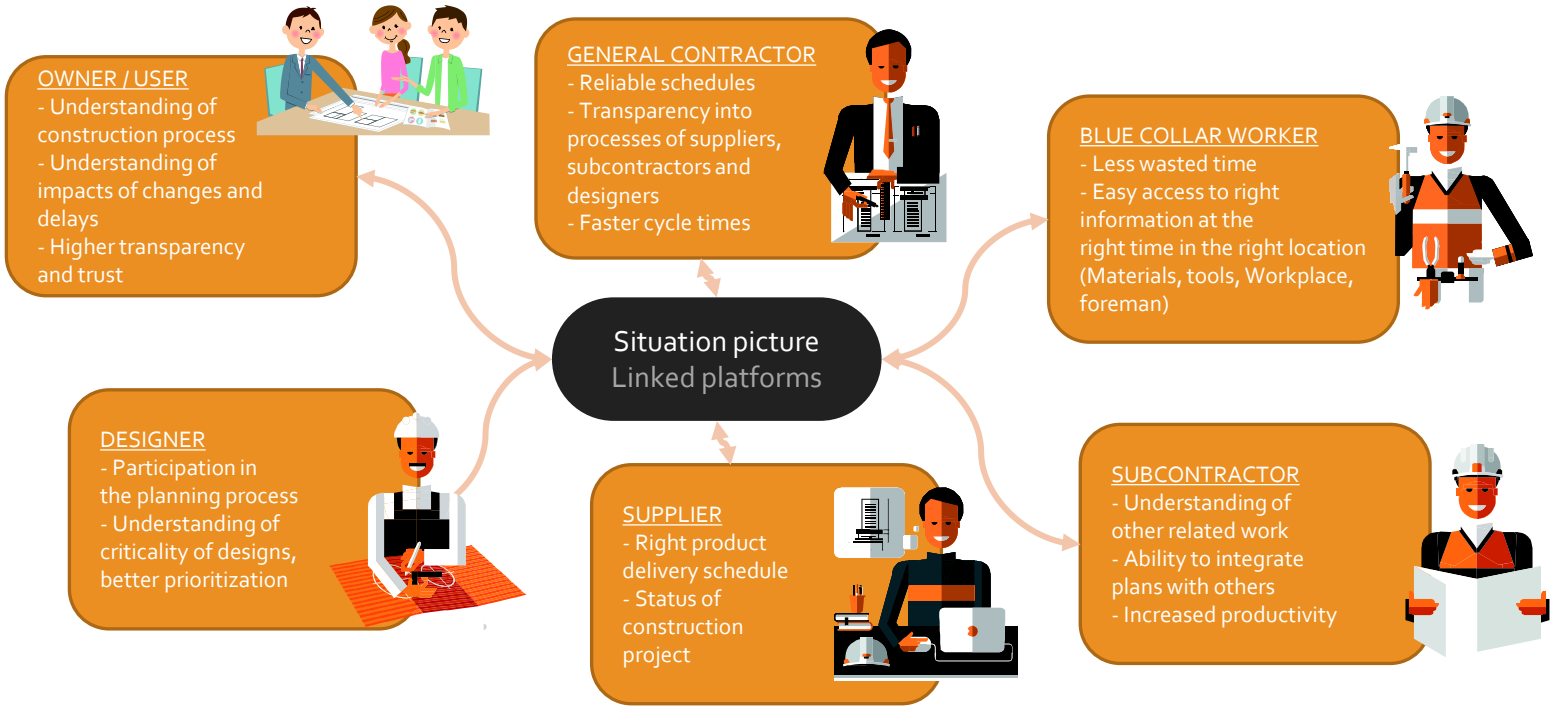
Current state: Real-time situation picture

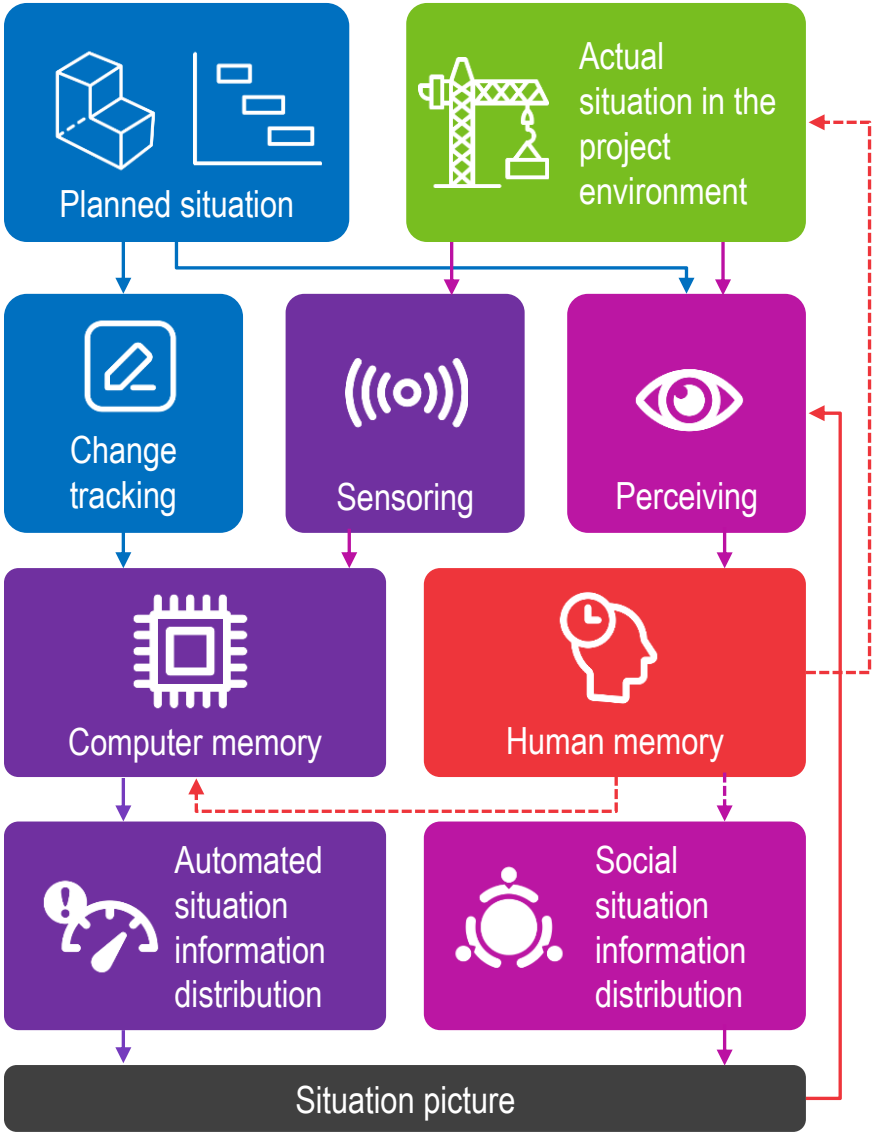
Real time situation picture



Forming situation picture

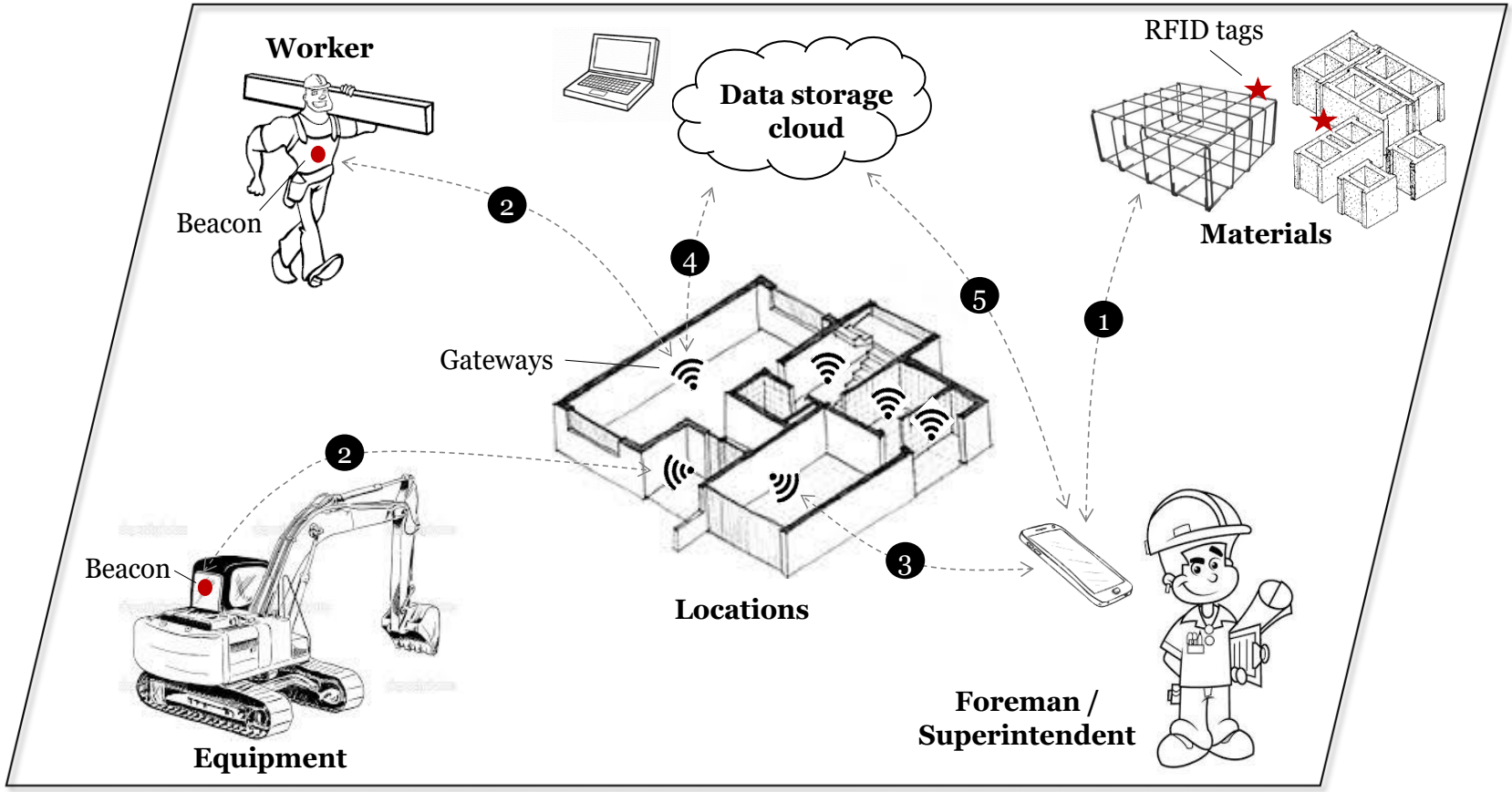
Digital situation picture can be achieved:

- **Sensors and positioning are in use**
- **Process has been simplified (e.g. takt production / prefabrication)**
- **Digi-engineers collect digital data**



Kärkkäinen et al. (2019)

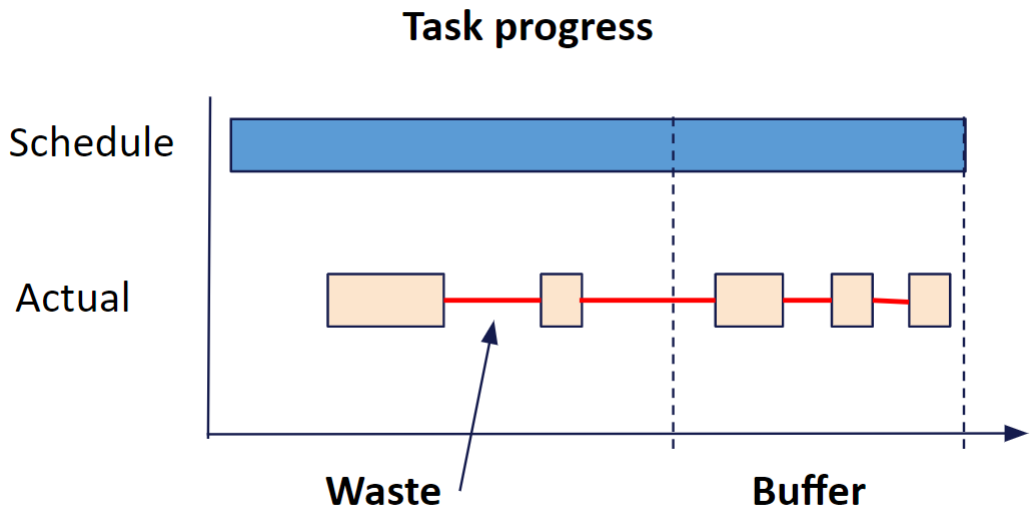
Real-time position of resources



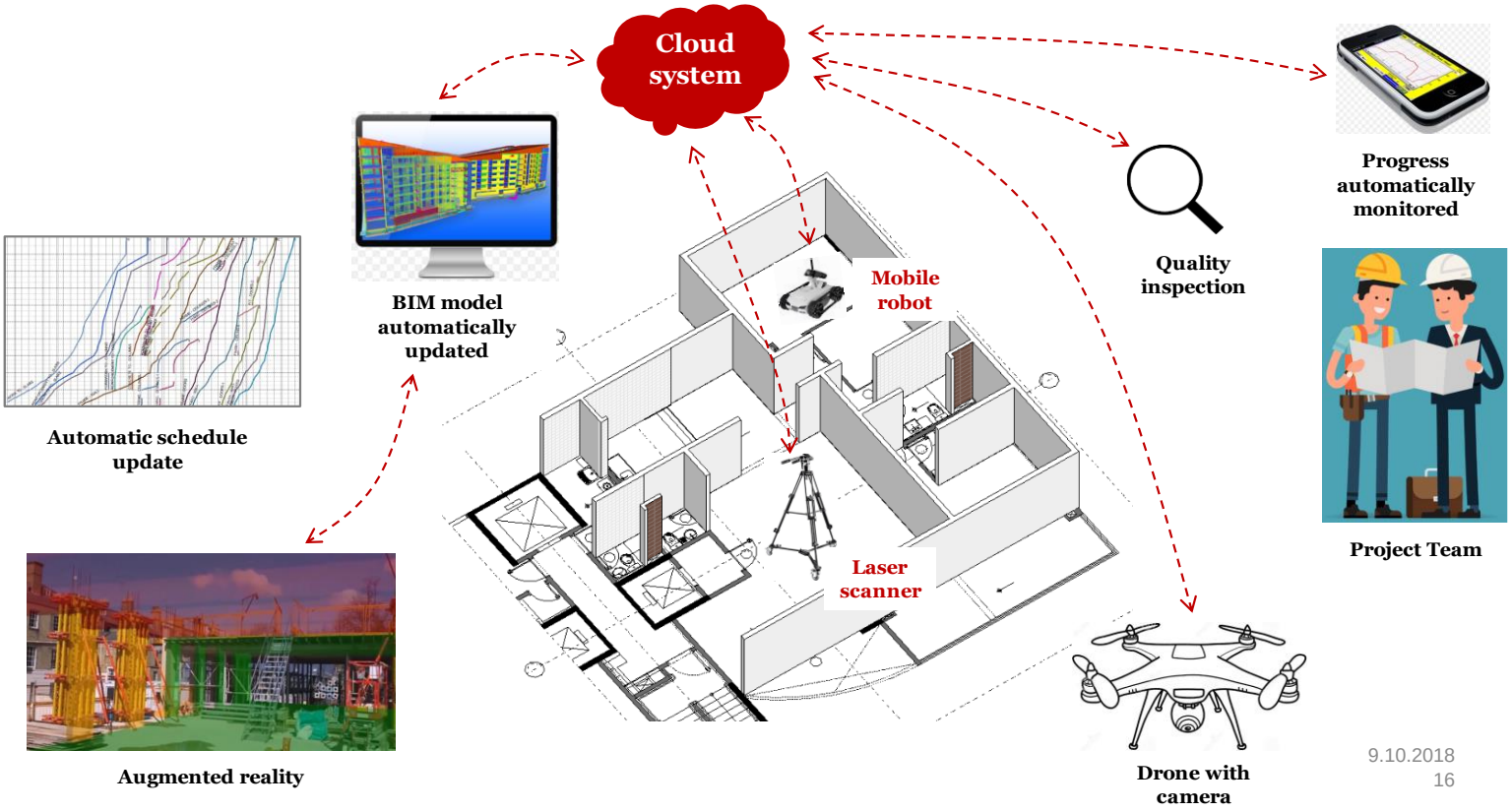
Positioning reveals waste

1. **Presence Index, PI**
   Uninterrupted presence / actual duration
   Measured average 34.5%, large variation

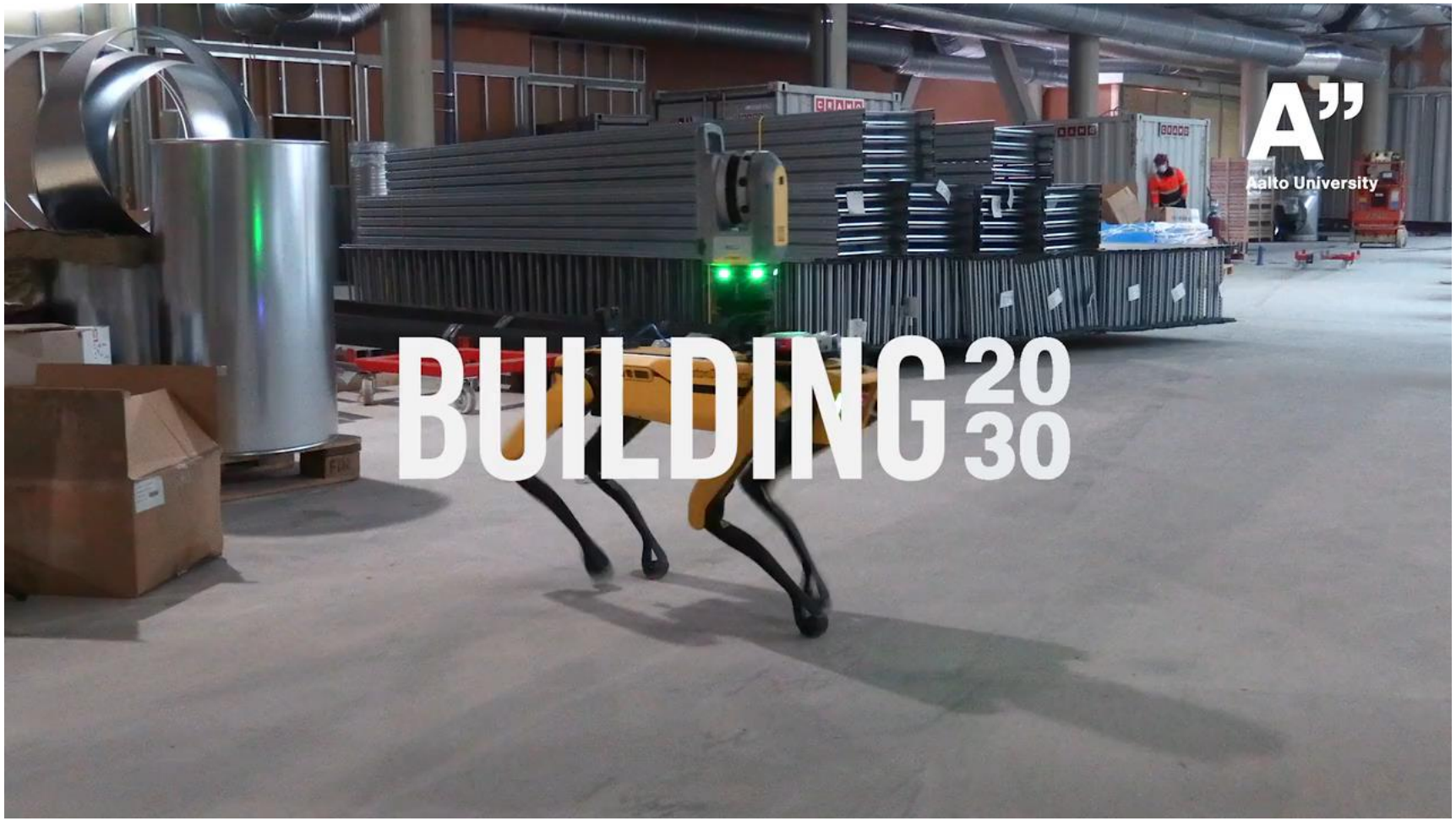
2. **Presence-to-plan, PP**
   Uninterrupted presence / planned duration
   Measured average 33.8%



Automated progress through images



Automatic data collection in the future?



Reality Capture current state

- **Already now it is possible to automatically evaluate progress and find quality issues from images**
- **The problem is getting enough data to train the algorithms**
  - Images
  - Massive data collection

- **Images form an important part of situational awareness in construction**

End of video 1