



Aalto University  
School of Engineering

# Operation Management in Construction

## Lecture #9

### Digital Twin Construction – Future trends

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# Topics, Lecture #8

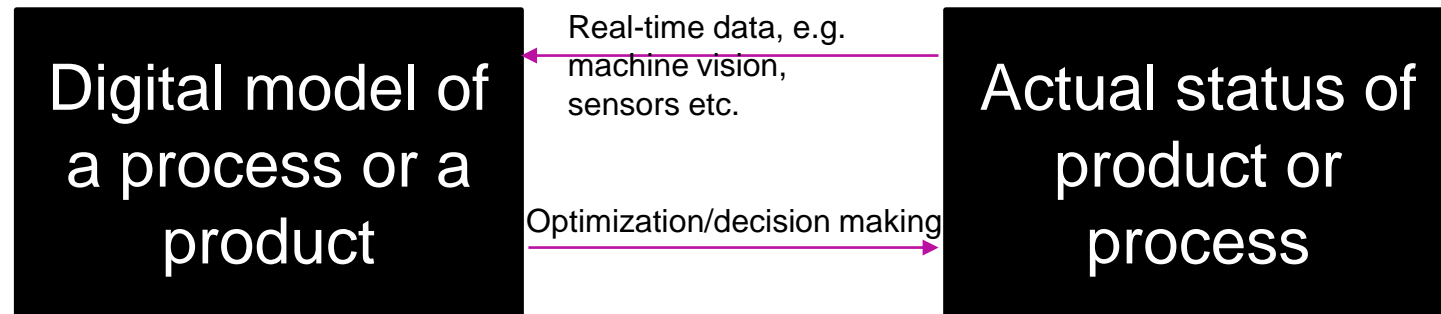
- **Learning objectives**
- **What is Digital Twin Construction?**
- **From situation picture to digital twin**

# 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*

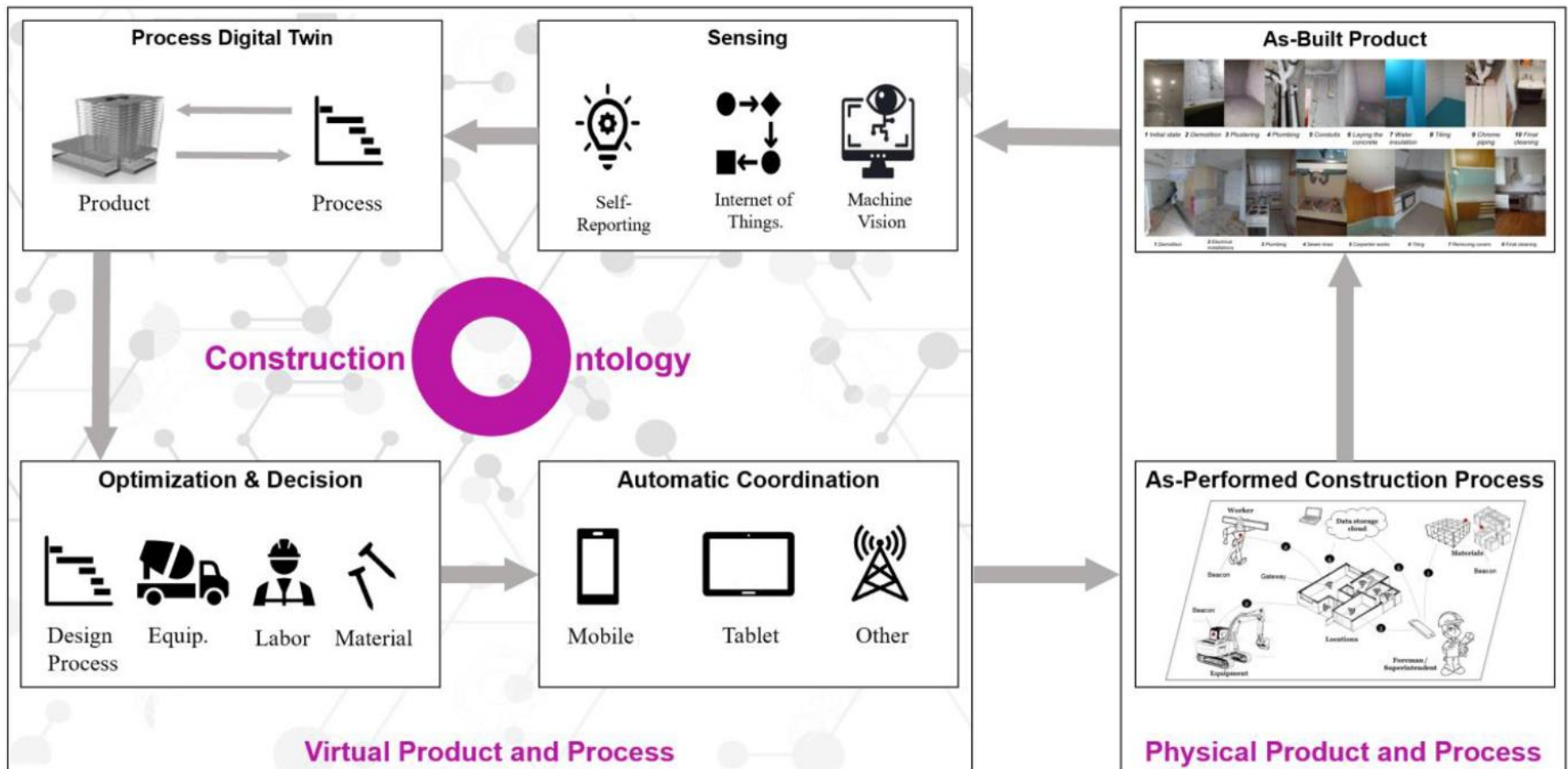
# Digital Twin Construction

# Digital twin - definition



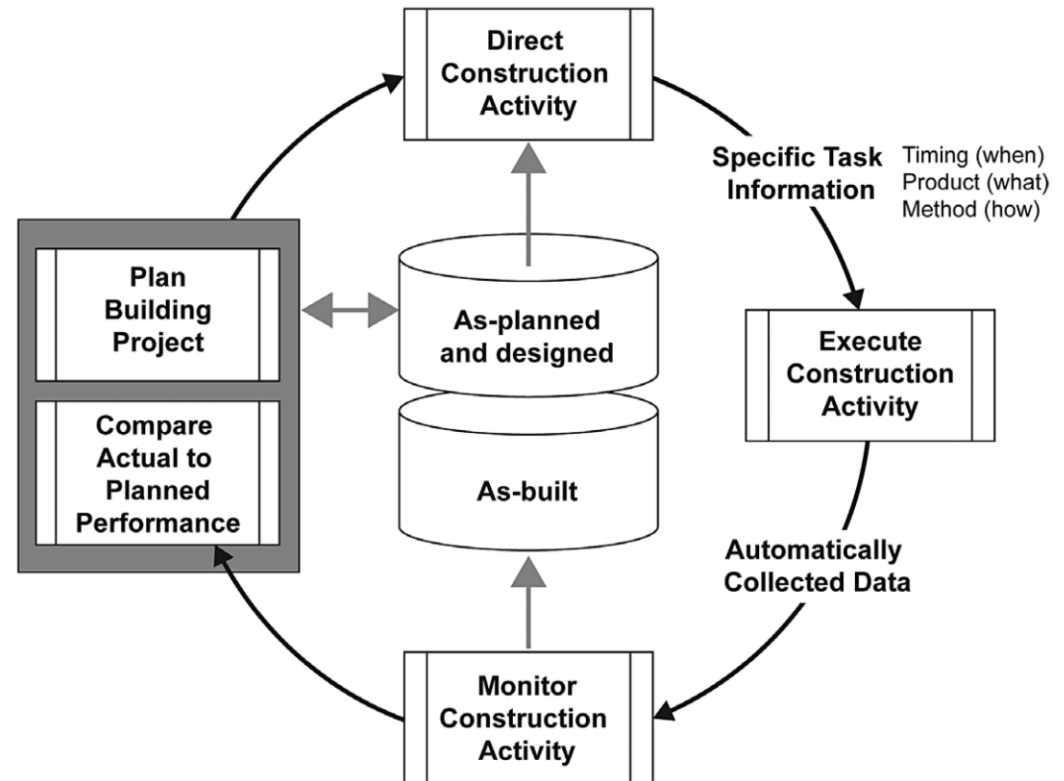
- **Digital model of a process or product**
  - E.g. simulation model of process, BIM of building
  - The same level of detail as automatically collected actual data
  - Continuously updating, supports decision making
  - Real-time connection to reality

# Digital twin of process



# How should Digital Twin Construction work?

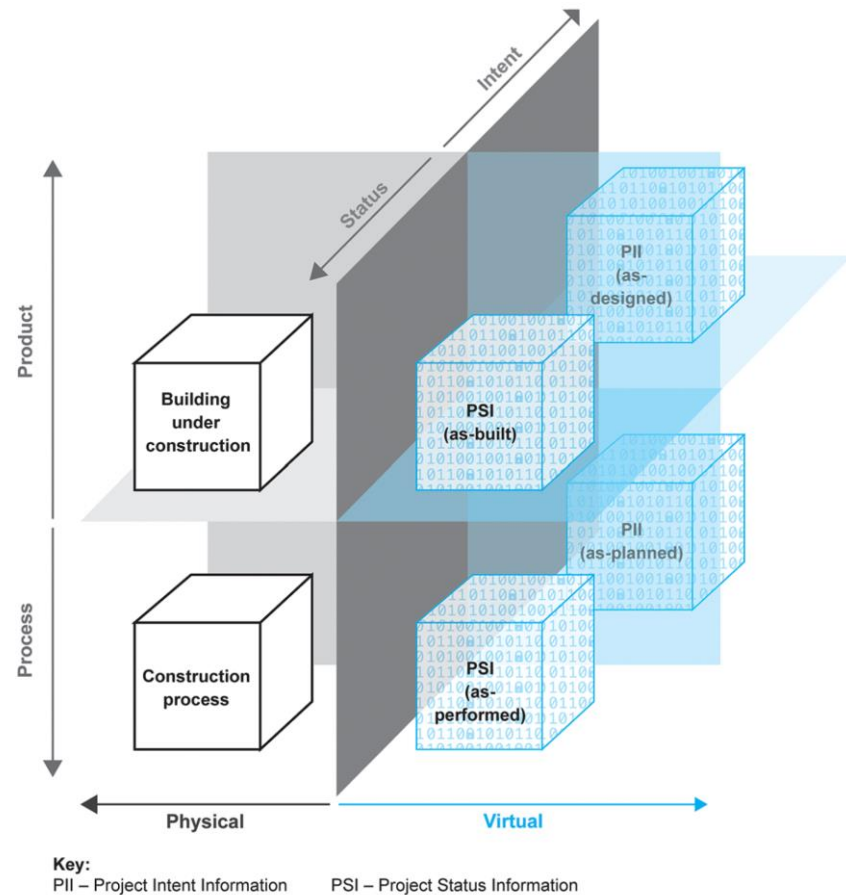
- Automatic, real-time progress data for controlling
- Real-time task information to execution (who, when, what, how?)



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

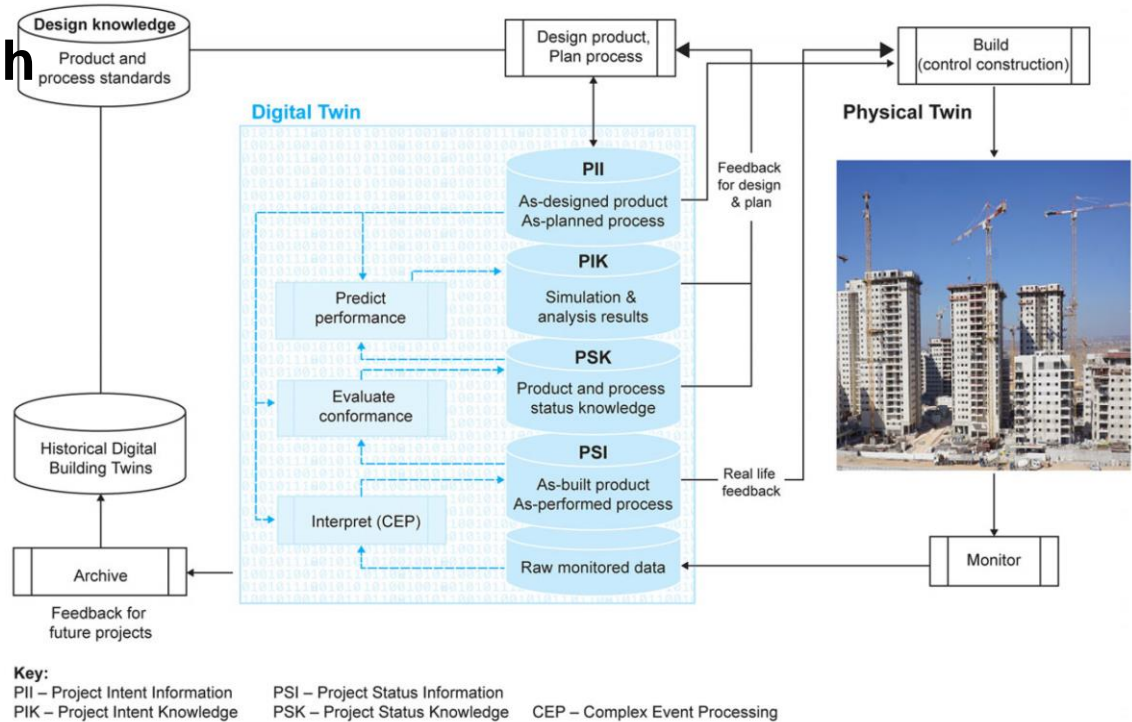


Sacks R, Brilakis I, Pikas E, Xie H. S and Girolami M (2020). Construction with digital twin information systems. *Data-Centric Engineering*, 1: e14. doi:10.1017/dce.2020.16



# Digital Twin Construction

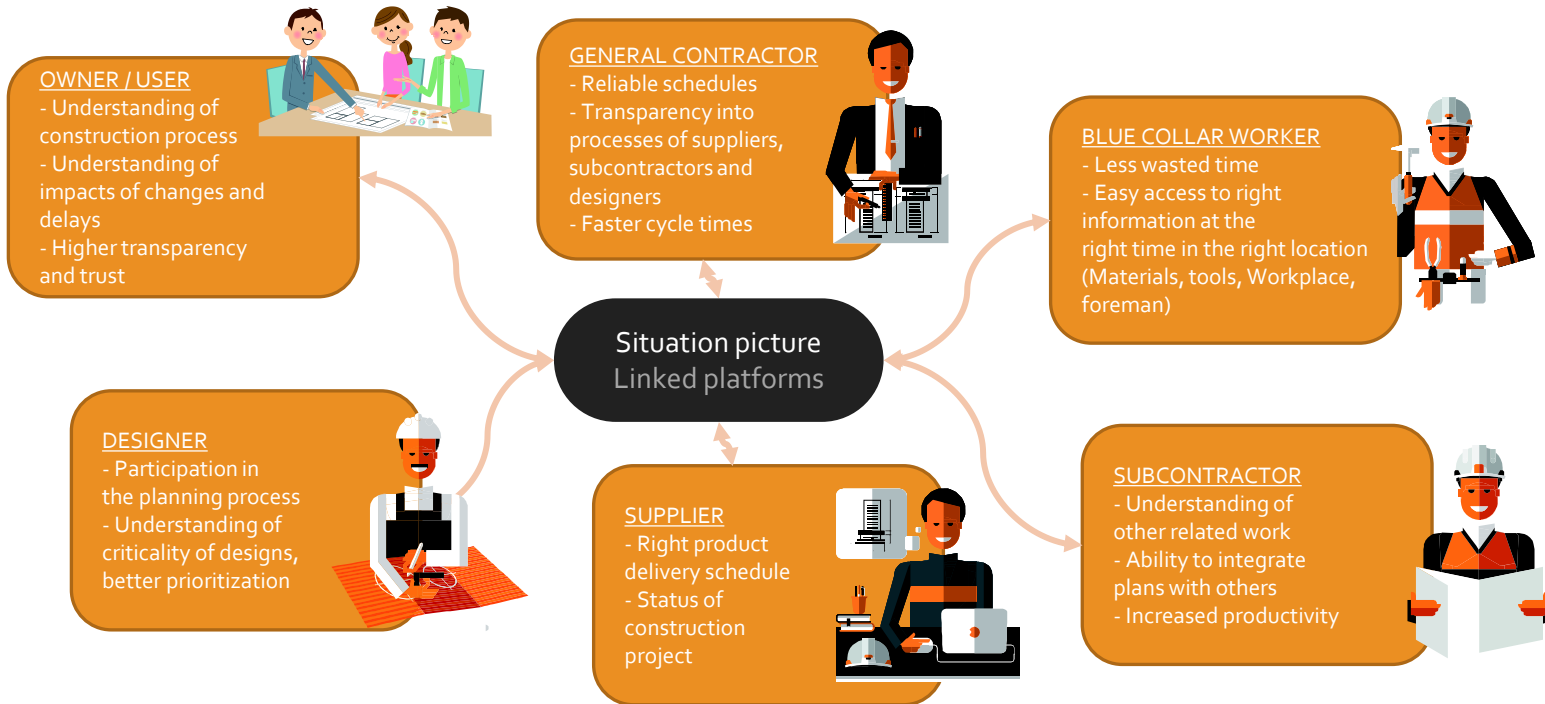
- Raw data is not enough
- AI needed for interpretation and forecasting
- Enables continuous learning and improvement of plans and designs



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

# Current state: Real-time situation picture

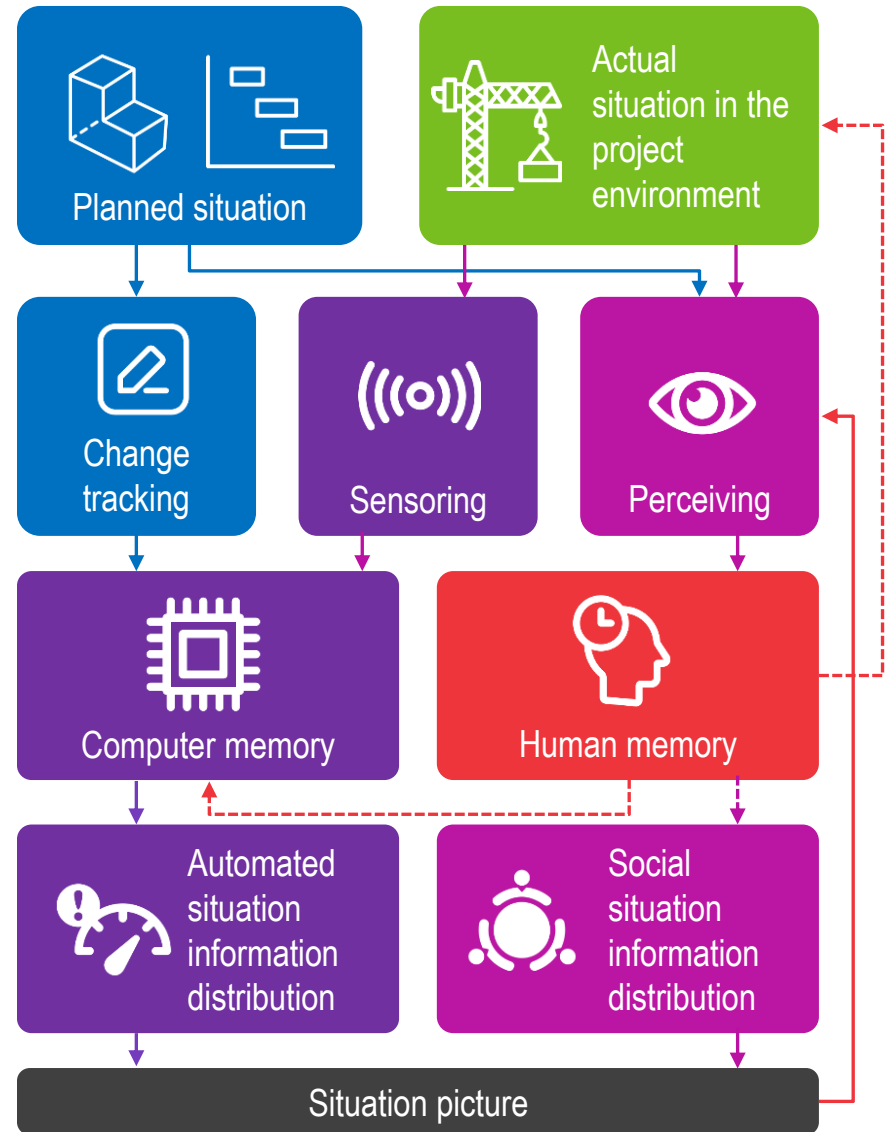
# Real time situation picture



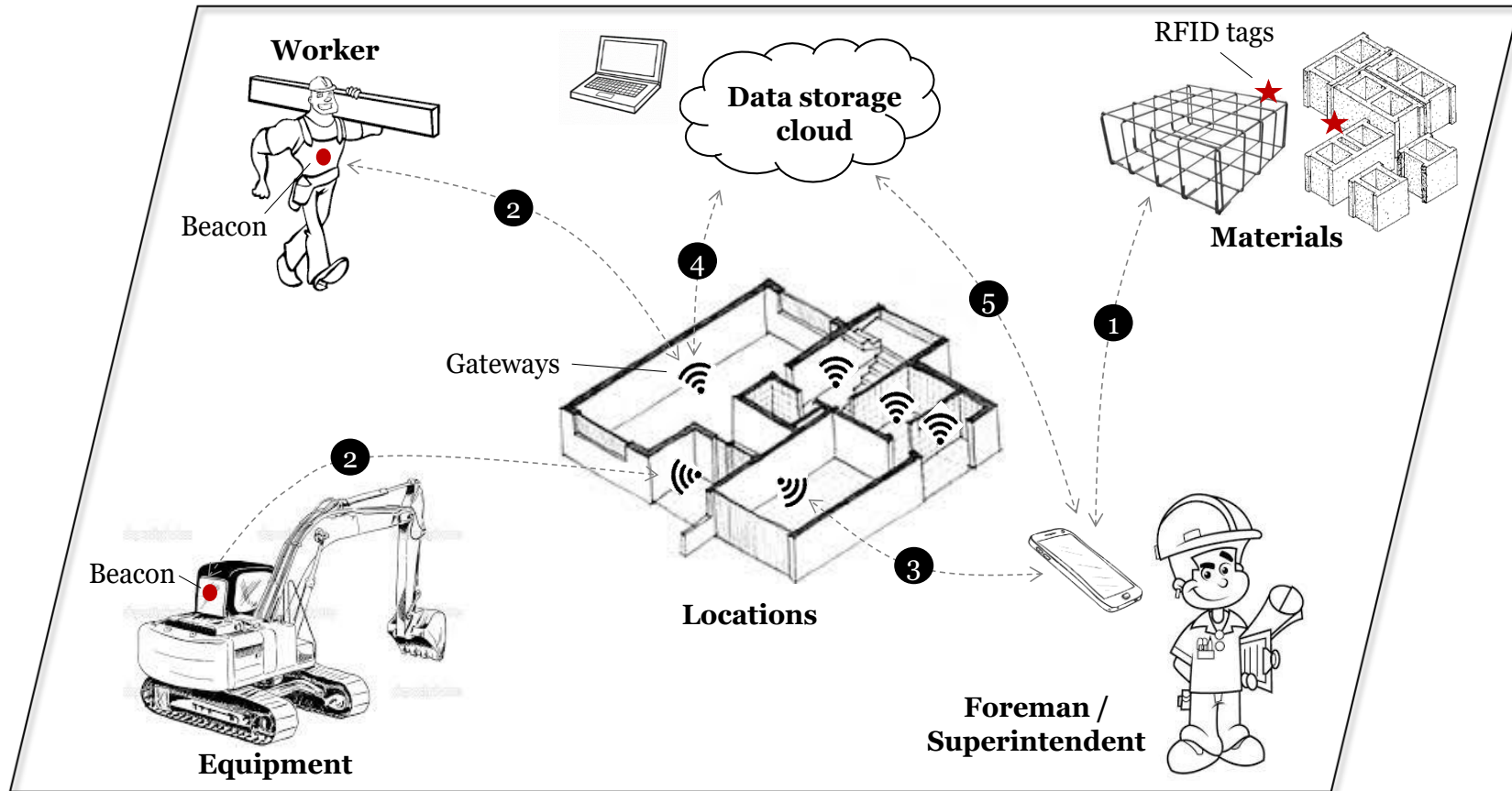
# Forming situation picture

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

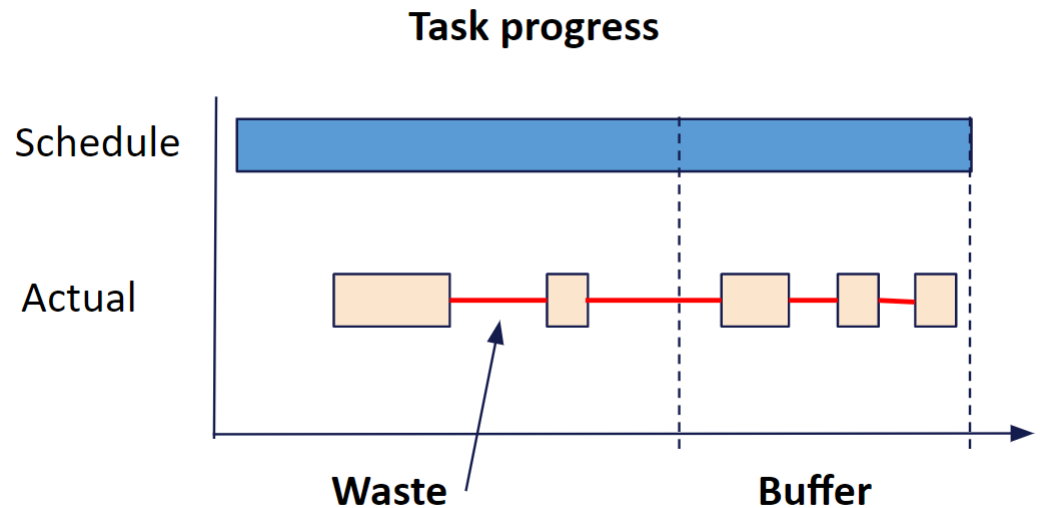


# Real-time position of resources

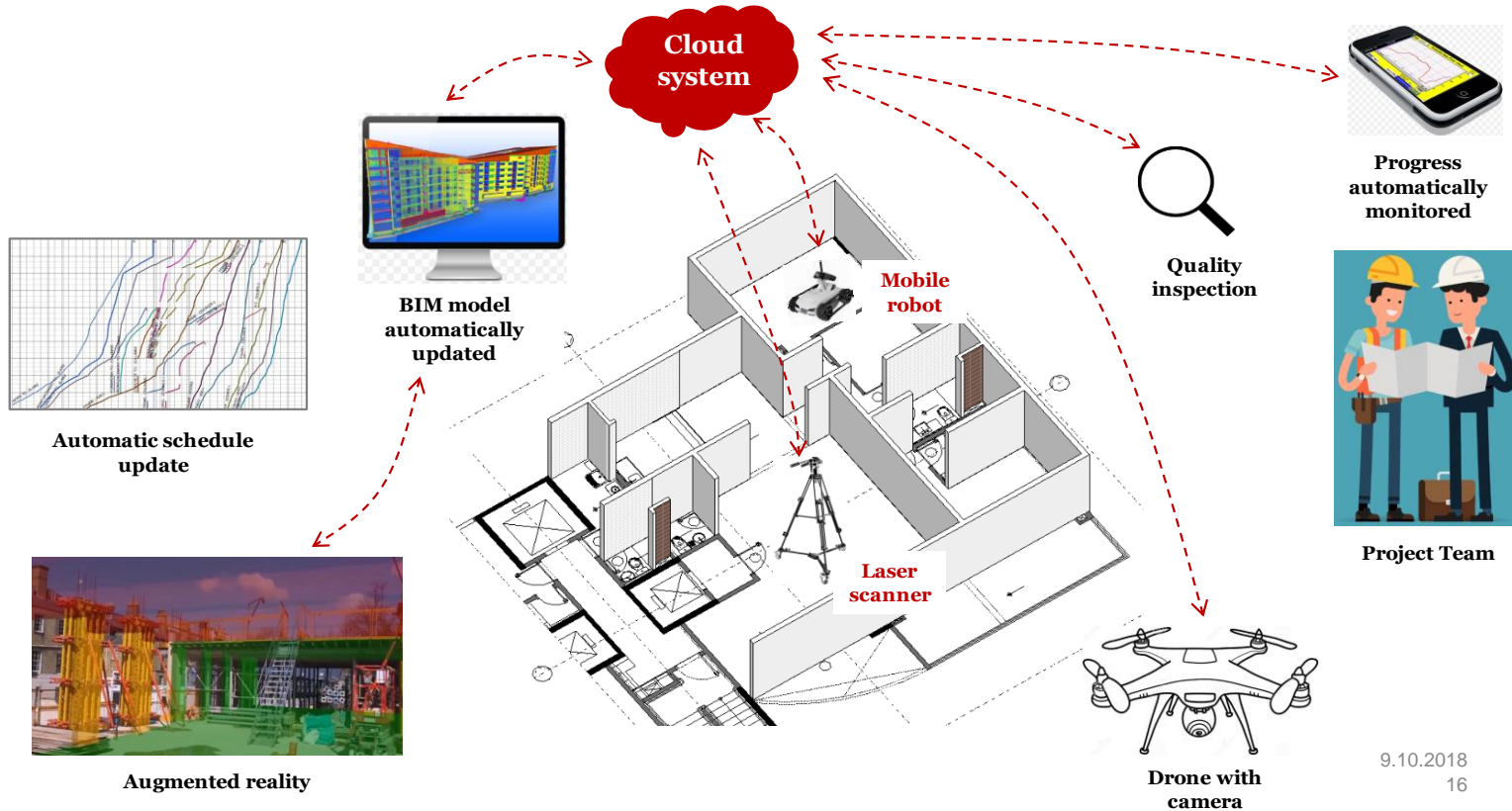


# Positioning reveals waste

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



9.10.2018  
16

# 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**