

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 a product

Optimization/decision making process

Real-time data, e.g.

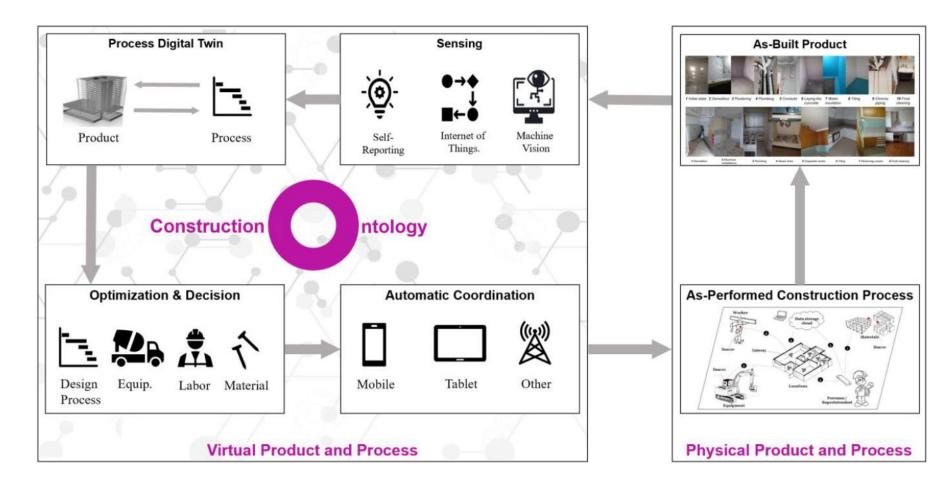
Machine vision, sensors etc.

Actual status of product or product or process

Digital model of a process or product

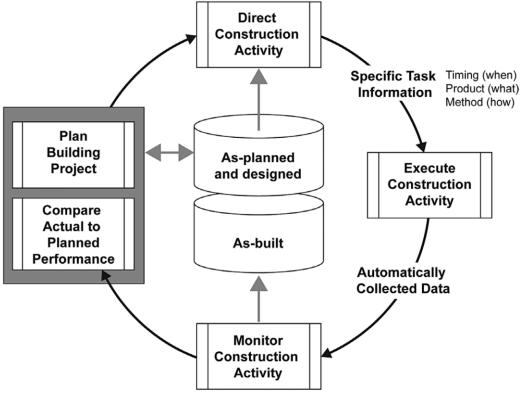
- E.g. simulation model of process, BIM of building
- The same level of detail as automatically collected actual data
- Continuously updating, supports decision making
- Real-time connection to reality

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?)

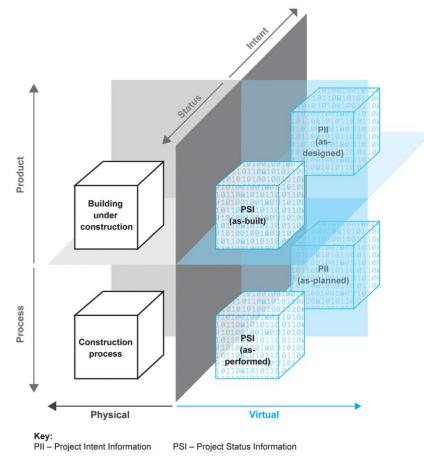


Navon R and Sacks R (2007) Assessing research issues in Automated Project Performance Control (APPC). Automation in Construction 16, 474–484. http://www.sciencedirect.com/science/article/B6V20-4M3J0RF-2/2/9a58c18f48ecb997c28b638f9dda386e



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

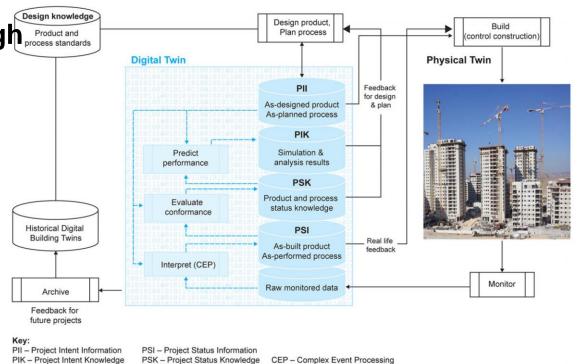


Digital Twin Construction

Raw data is not enough Product and process standards

 Al 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



- Understanding of construction proce
- impacts of changes and delays
- Higher transparency and trust

GENERAL CONTRACTOR

- Reliable schedules
- Transparency into processes of suppliers, subcontractors and designers
- Faster cycle times

BLUE COLLAR WORKER

- Less wasted time
- Easy access to right information at the right time in the right location (Materials, tools, Workplace, foreman)



<u>DESIGNER</u>

- Participation in the planning proce
- Understanding of criticality of designs, better prioritization



SUPPLIER

Right product delivery schedule

Situation picture Linked platforms

- Status of construction



SUBCONTRACTOR

- Understanding of other related work
- Ability to integrate
- . - Increased productivity

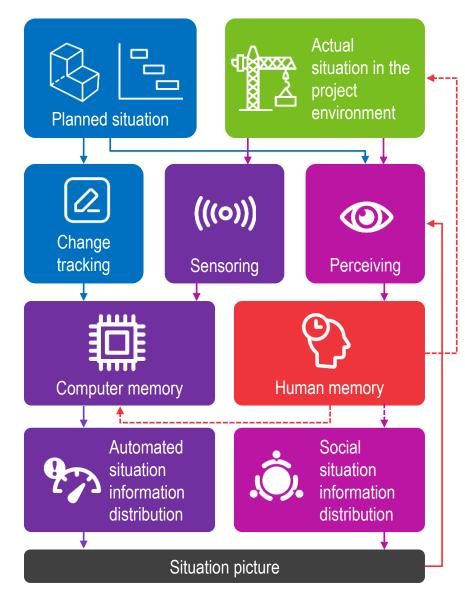




Forming situation picture

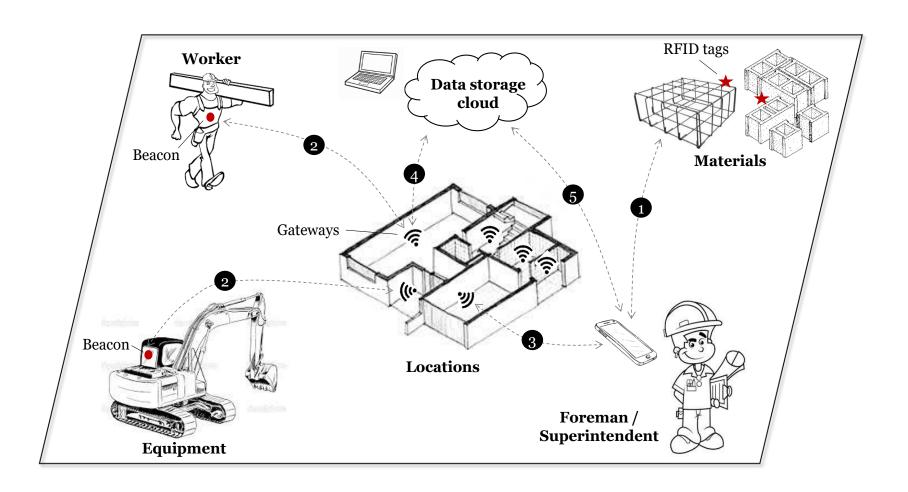
Digital situation picture can be achieved:

- 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





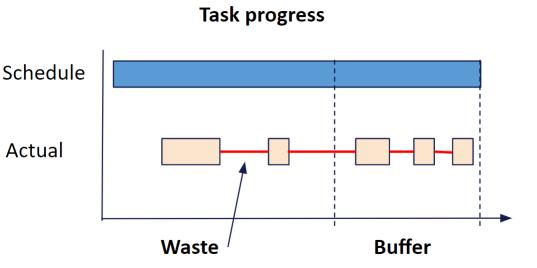
Positioning reveals waste

Presence Index, PI
 Uninterrupted presence / actual duration

Measured average 34.5%, large variation

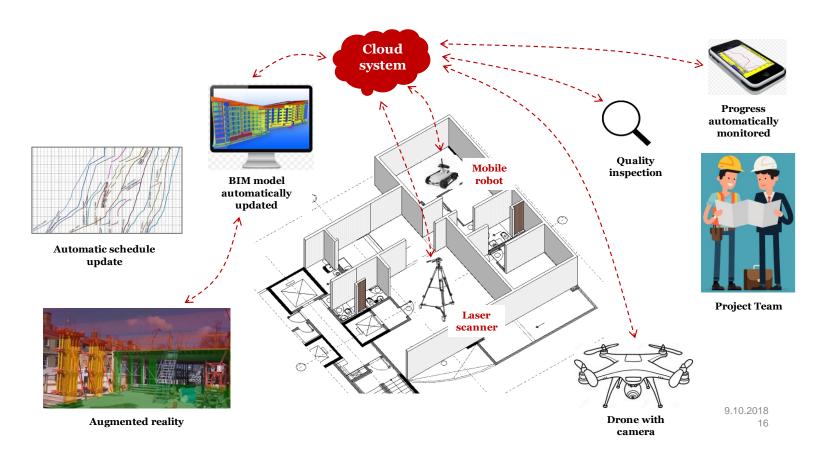
2. Presence-to-plan, PP
Uninterrupted presence / planned
duration

Measured average 33.8%



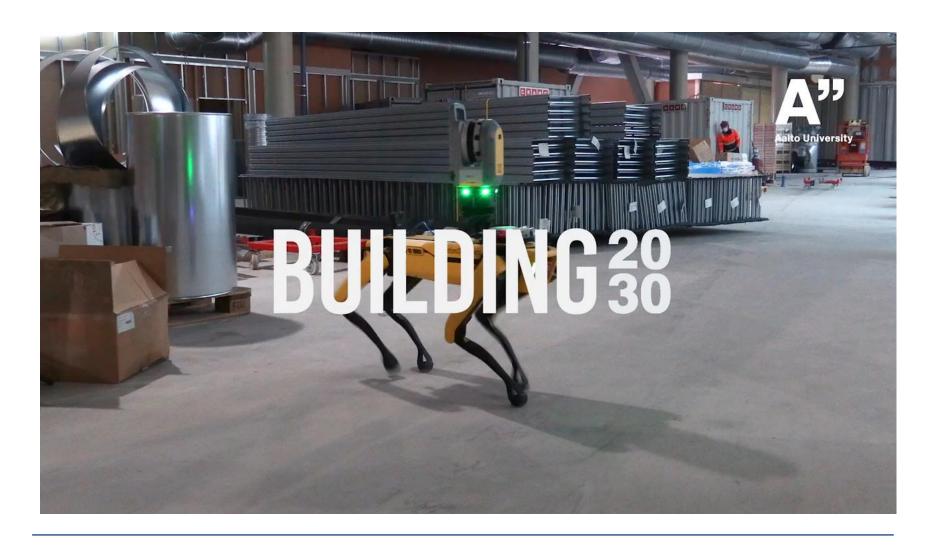


Automated progress through images





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