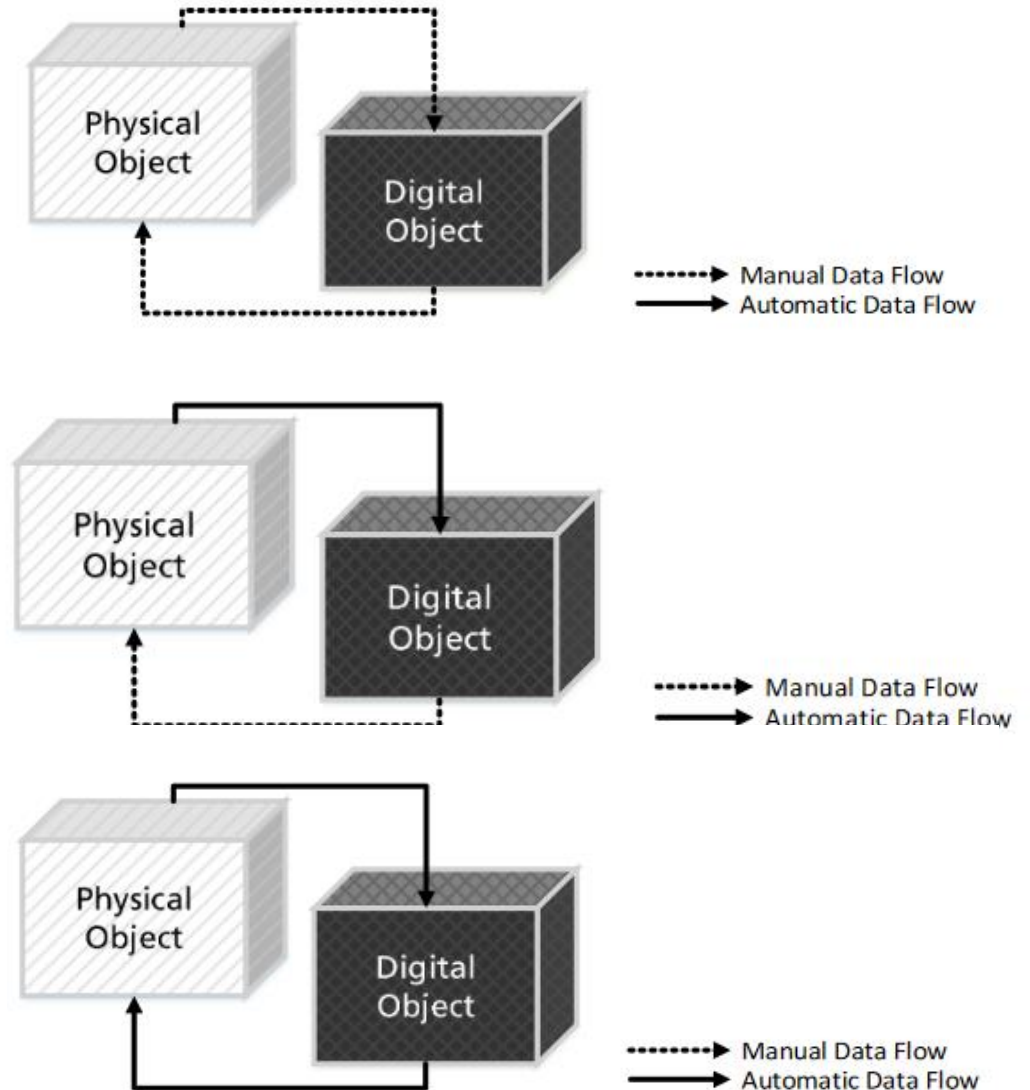# White box digital twins

Diggin Discussions on Digital Twins

Marco Molinari, Department of Energy Technology

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Digital model, digital shadow and digital twin

- **Digital model**: digital version of a pre-existing or future physical object, with no automatic exchange of data between the physical object and the digital model

- **Digital shadow**: the digital representation of an object that has only one direction of data flow: the change in the state of the physical object implies a change in the digital object

- **Digital twin**: the data flow between the existing physical object and the digital object is fully integrated in both directions.
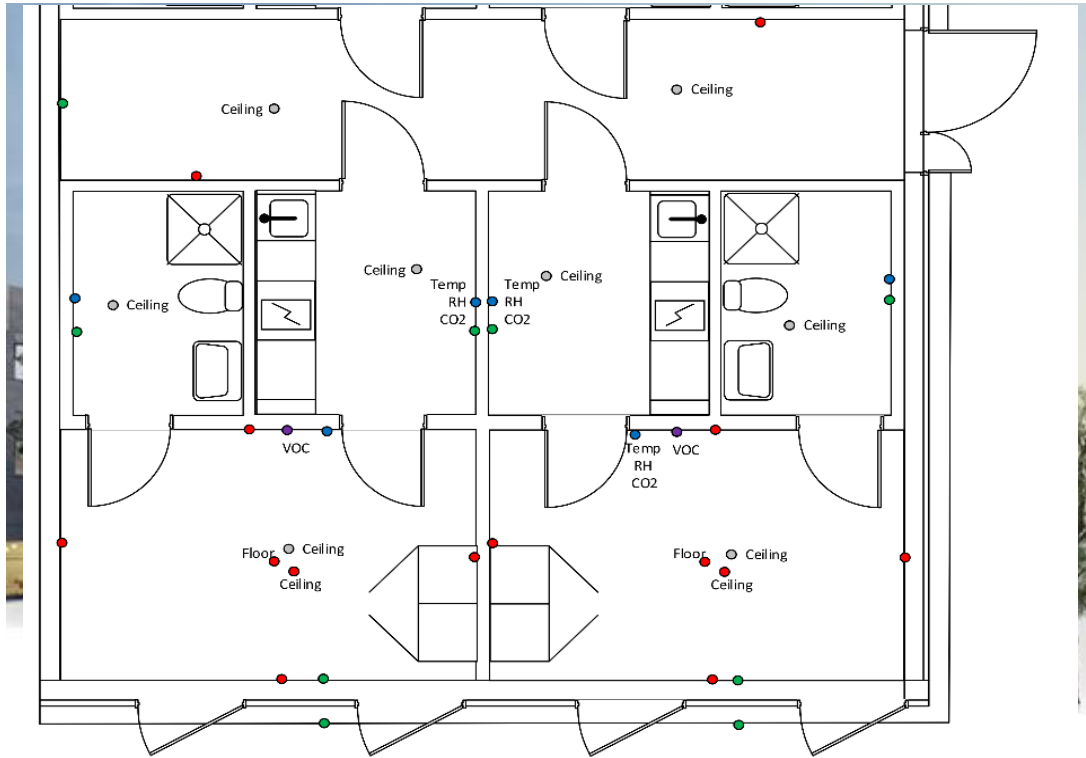
Kritzinger et al. Digital Twin in manufacturing: A categorical literature review and classification, *IFAC 2018, 10.1016/j.ifacol.2018.08.474*

Digital twins in buildings: components and architecture

Yang et al., Digital twin and its implementations in the civil engineering sector, Automation in Construction, 2021, https://doi.org/10.1016/j.autcon.2021.103838

Testbed KTH: white box model in IDA-ICE

Building

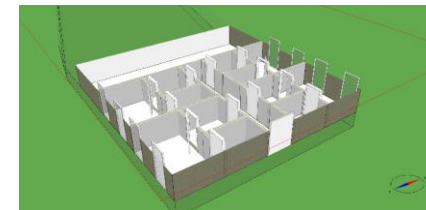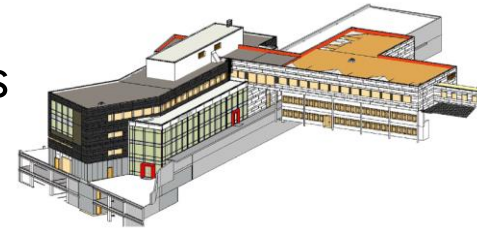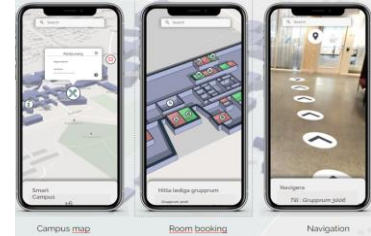**Calibrated building model in IDA-ICE**
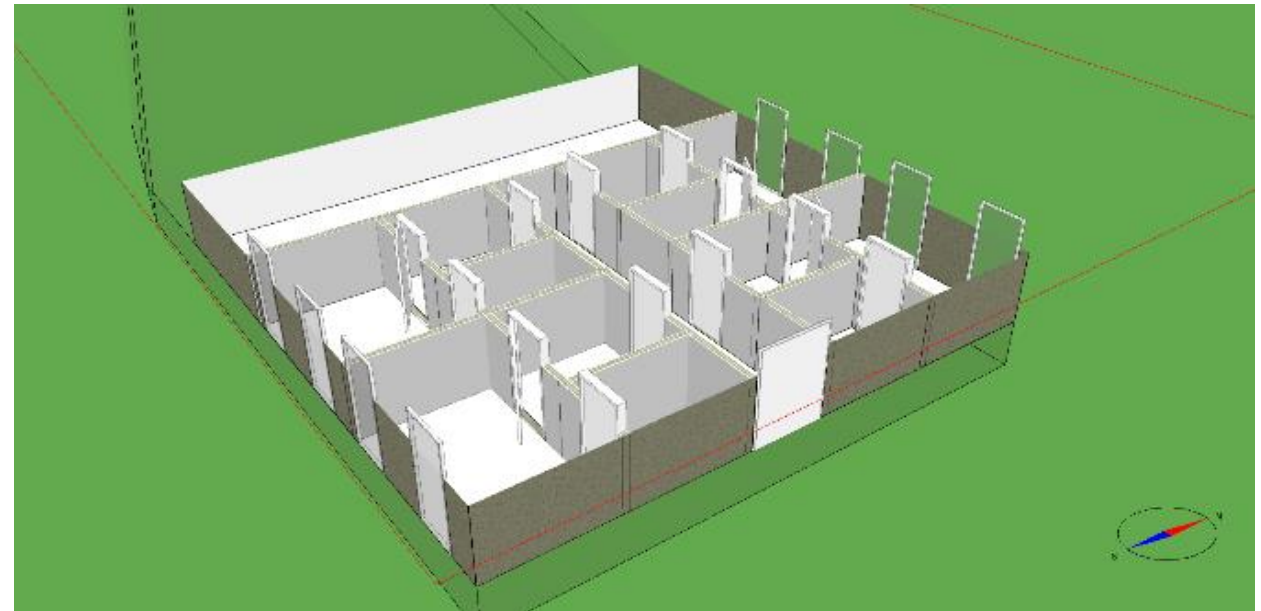
Why a digital twin? Challenges and opportunities

Challenges

- Model creation
- Real-time data integration
- Data management
- Data processing and analytics
- Visualization of results

Opportunities

- Services, e.g, room bookings, occupancy analytics
- Monitoring – use better the data
- Fault-detection – real time diagnostics
- Optimized operation
- **User interaction (e.g., feedback to users, visualization of room occupancy and comfort conditions)**
- **Tailored control with user feedback**
- Augmented reality - building operators

Thank you for your attention!