

Digital Twins

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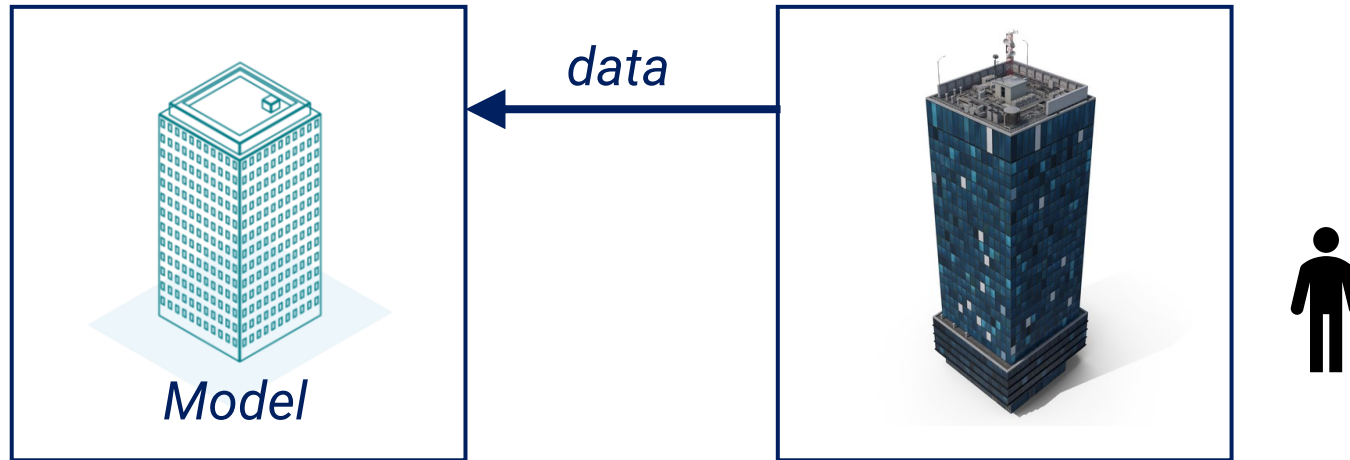
the **Networking**
Channel



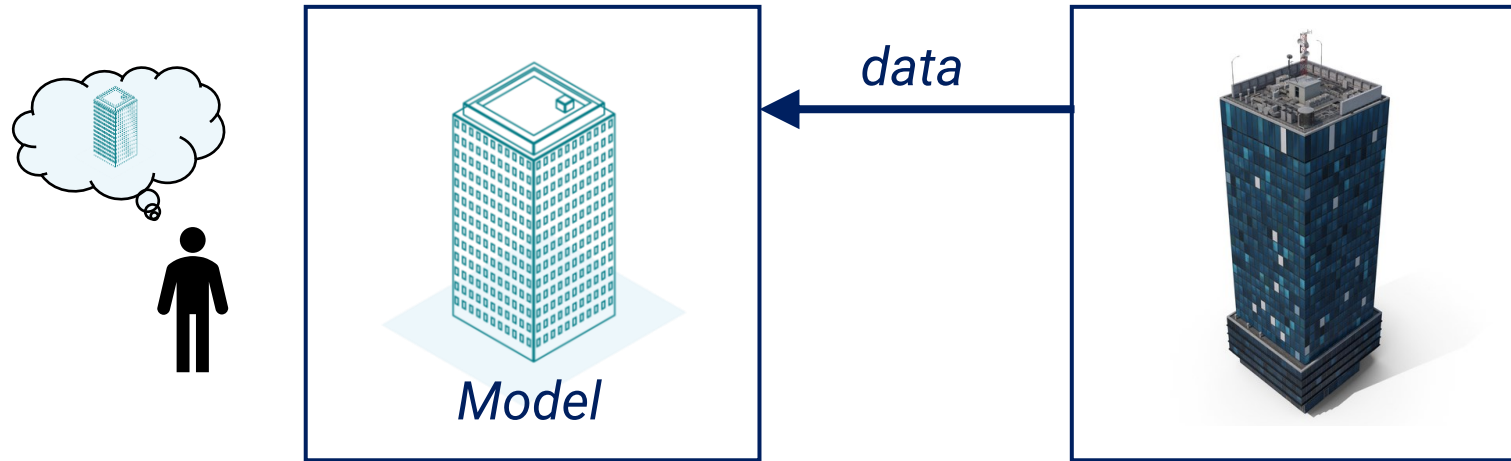
**BRIGHTER
WORLD**



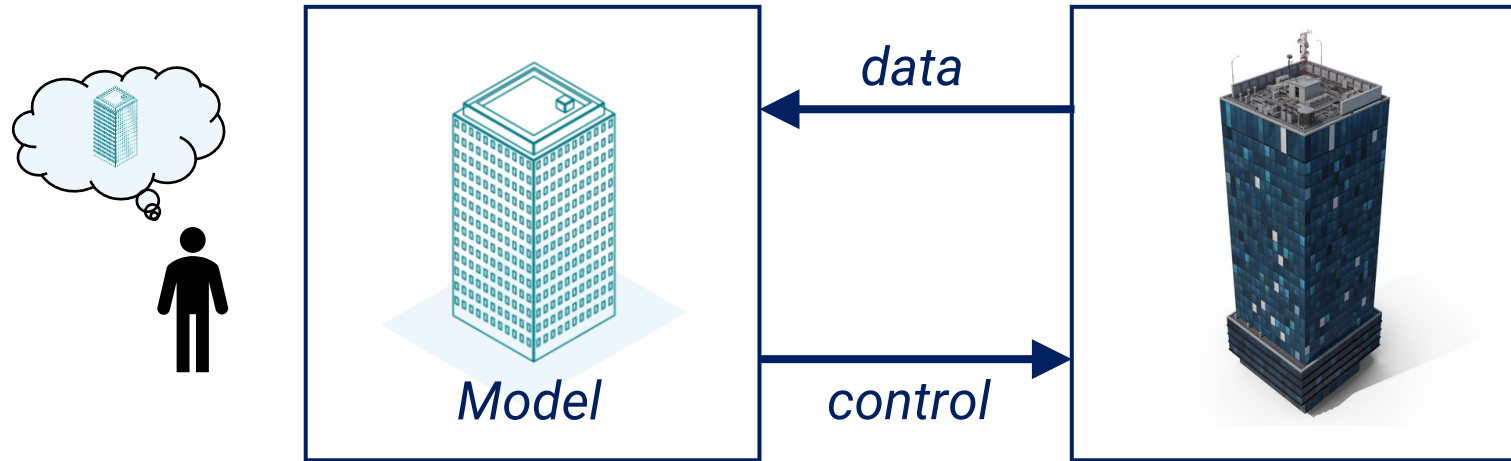
Digital twinning



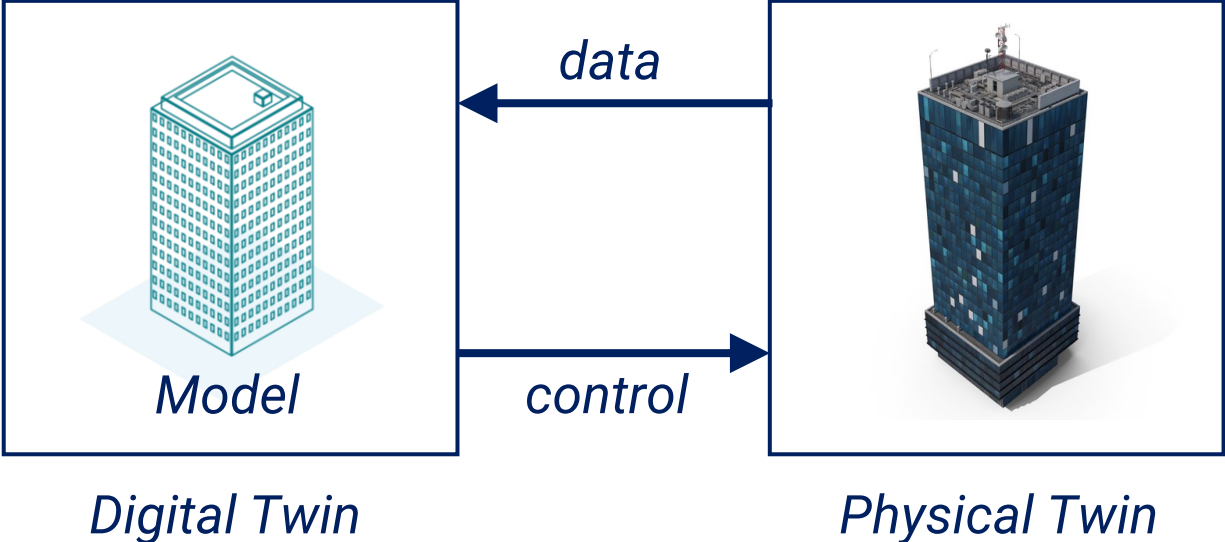
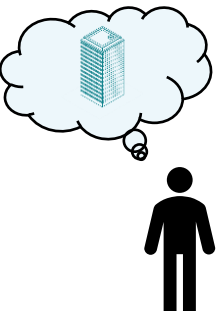
Digital twinning



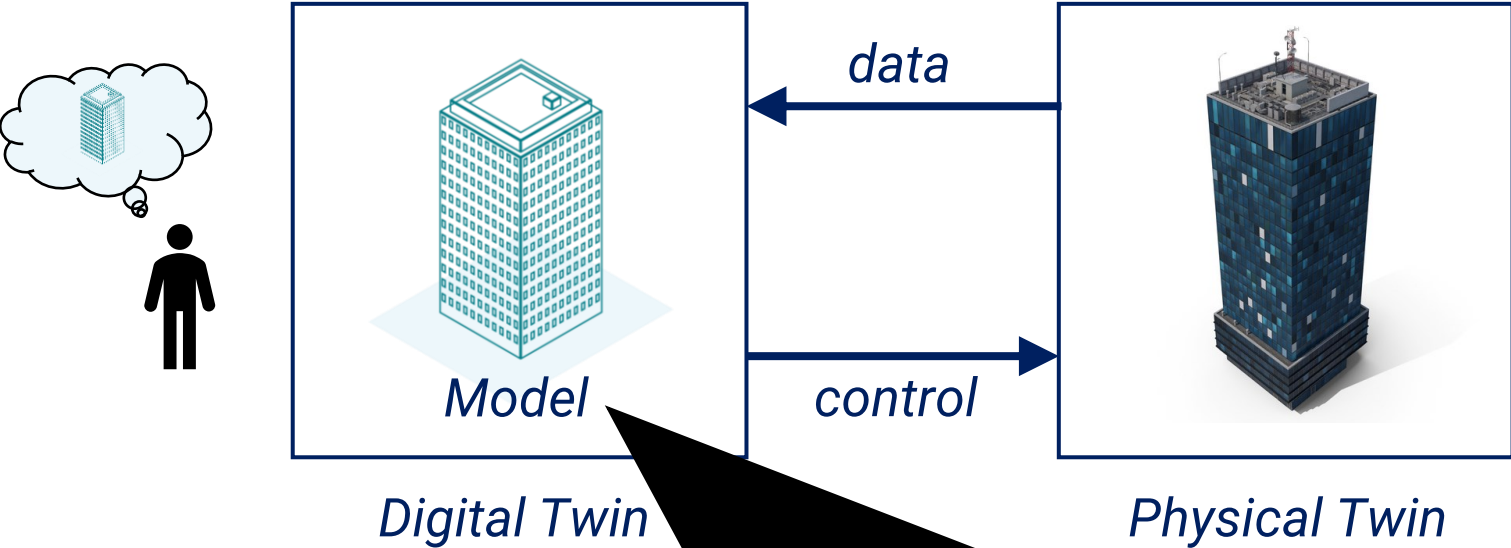
Digital twinning



Digital twinning



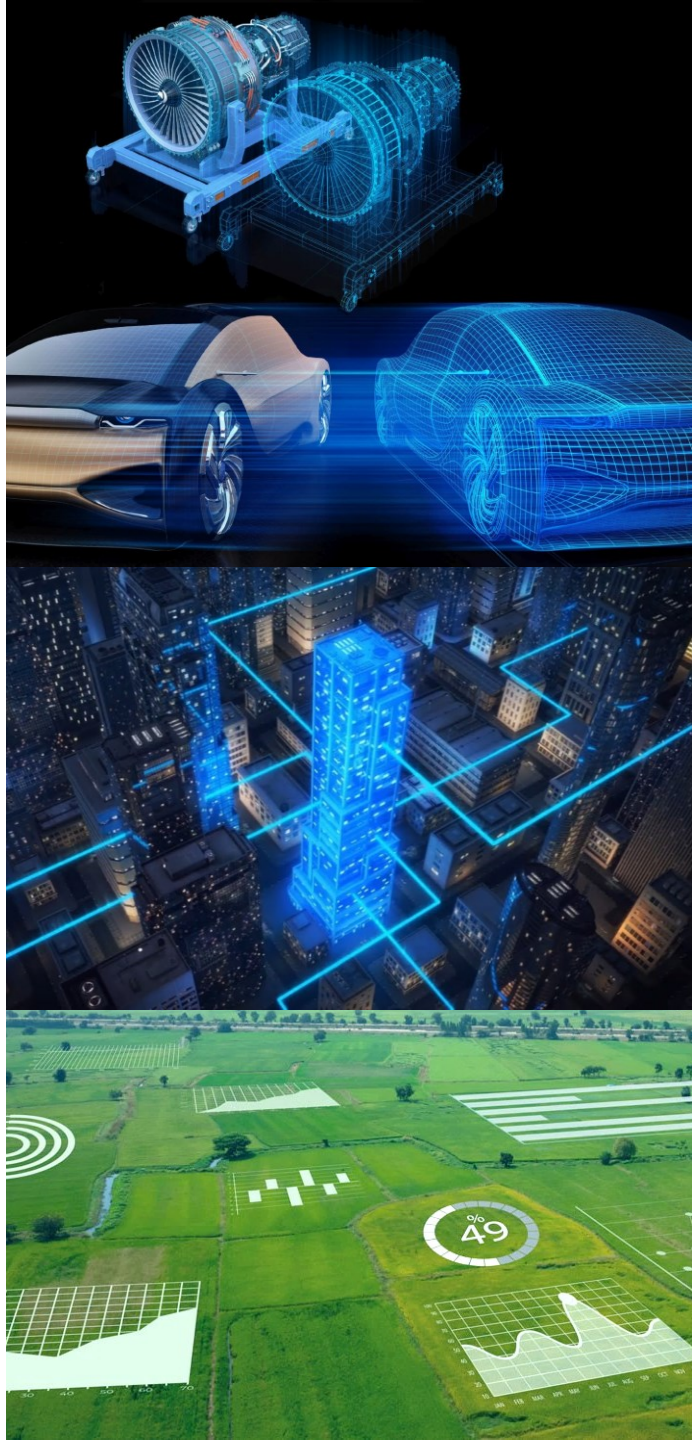
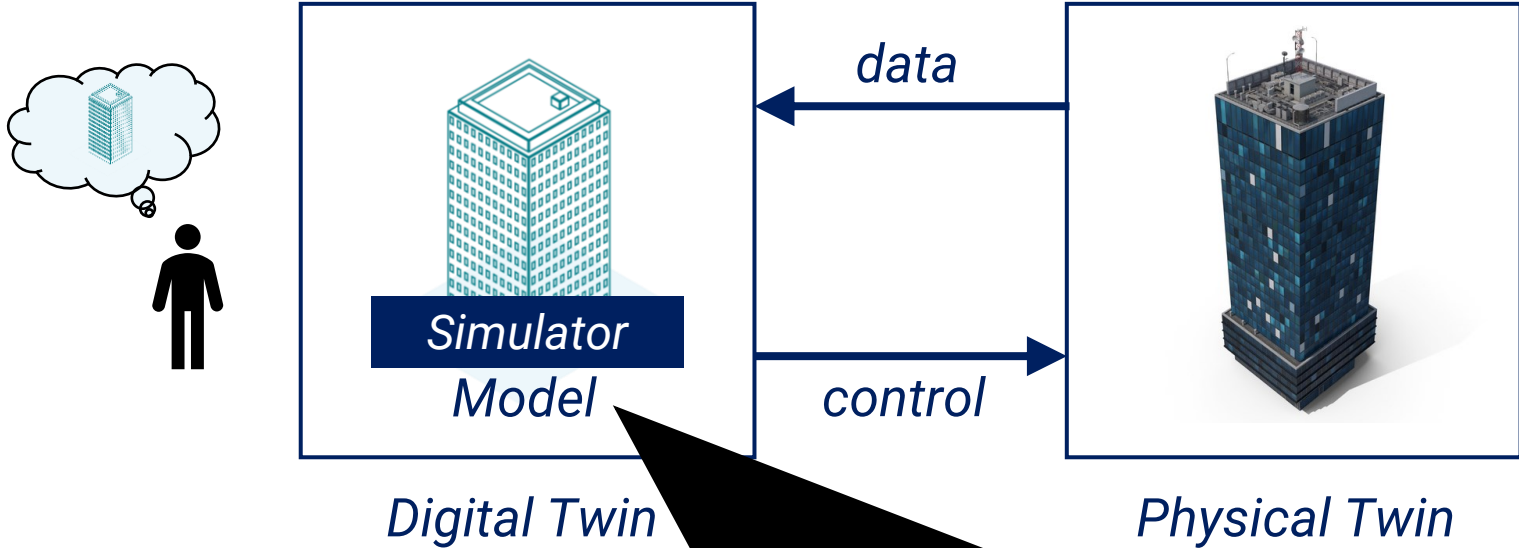
Digital twinning



This section contains several hand-drawn diagrams on a black background:

- Mass-Spring-Damper System:** A schematic of a mass m on a horizontal surface with a spring k and damper b . A force F is applied to the mass, and its displacement is x . A temperature T is indicated near the damper.
- Heat Conduction Equation:** The partial differential equation $\frac{\partial T}{\partial t} = \alpha \nabla^2 T$.
- 3D Surface Plot:** A 3D plot showing a surface with a color gradient from blue (low) to red (high).
- Control Block Diagram:** A block labeled $1/s$ with an input F_e and outputs $C: 1/k$, $R: b$, and $I: m$.
- State Transition Diagram:** A diagram with two nodes labeled 1 and 2, connected by arrows in a cycle.
- Flowchart:** A hierarchical flowchart with a diamond-shaped decision node and several rectangular process nodes.

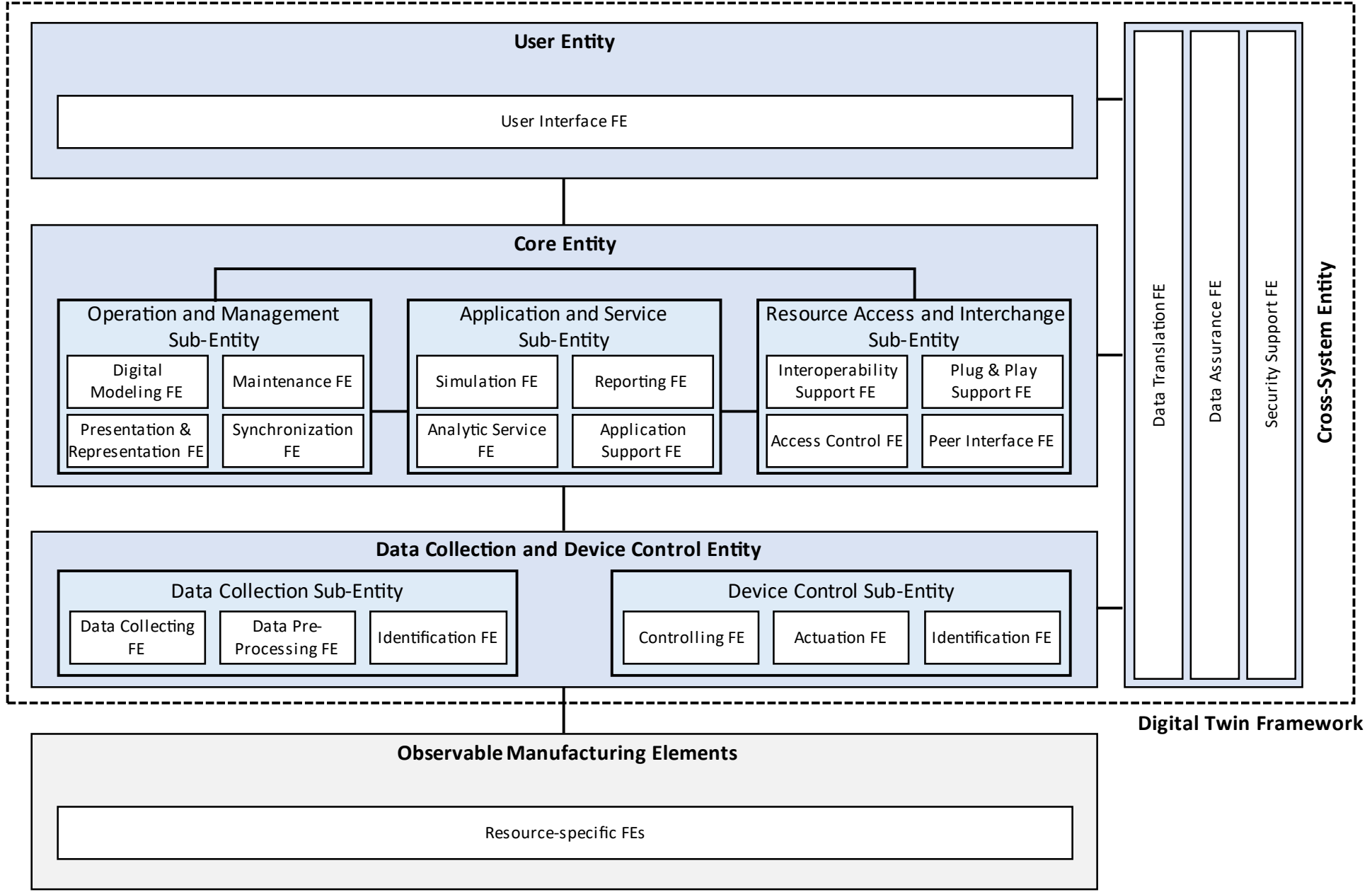
Digital twinning



A collection of hand-drawn diagrams on a black background:

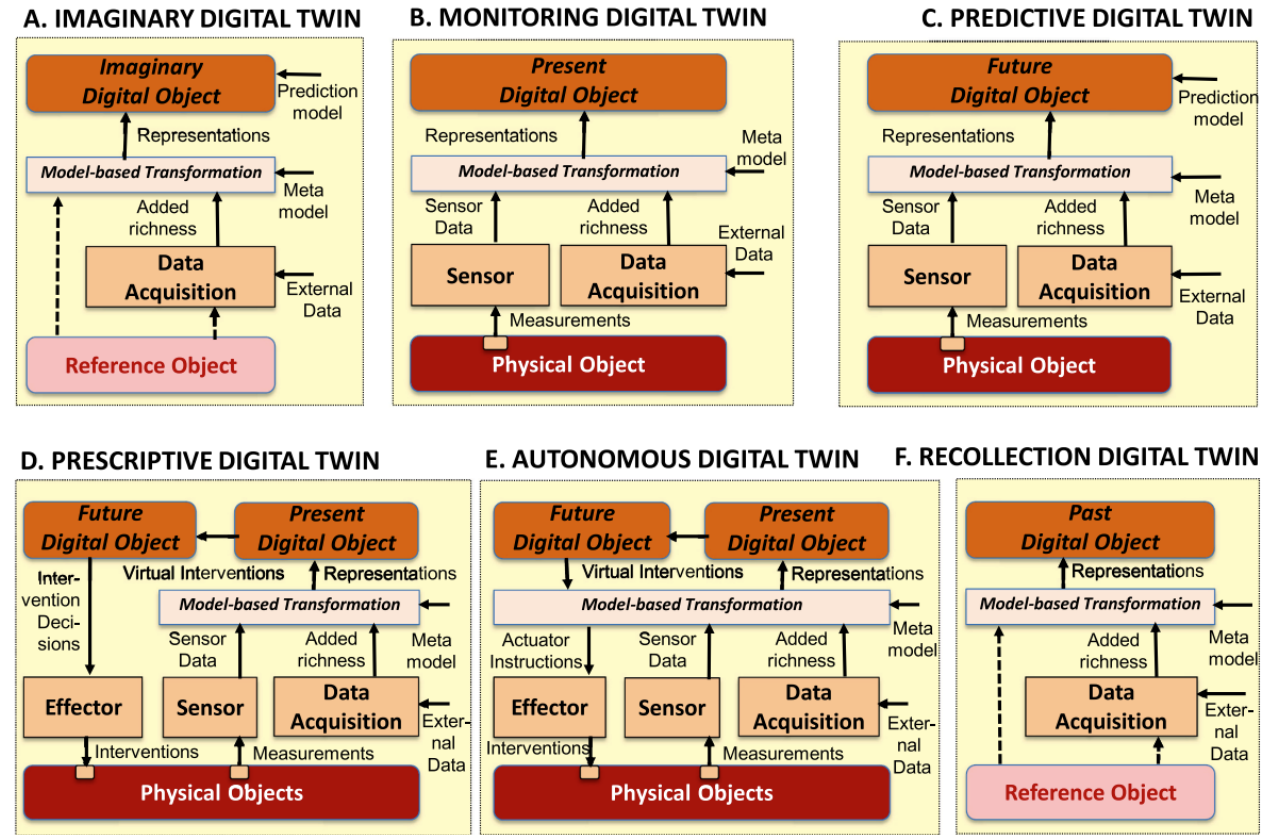
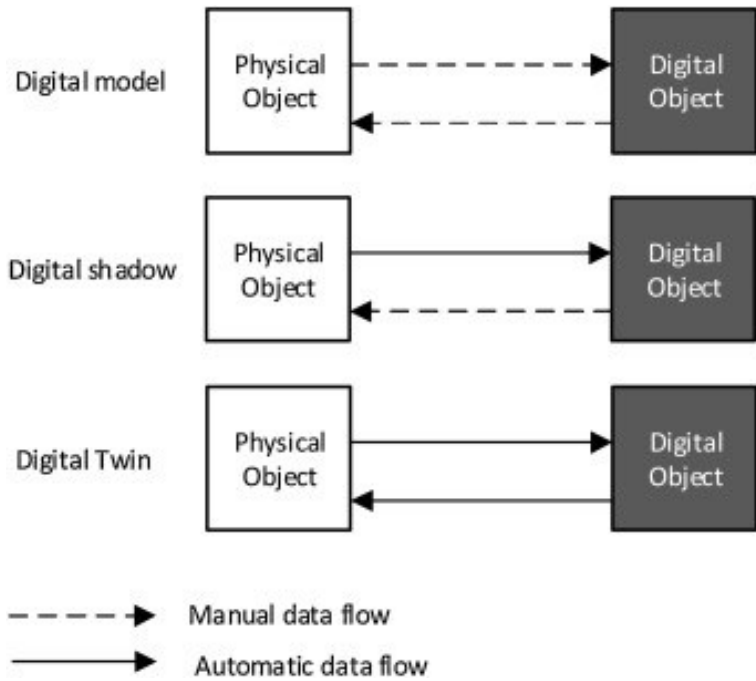
- Top left: A mass-spring-damper system diagram with mass m , spring constant k , and damper coefficient b . A force F is applied to the mass.
- Top center: The heat conduction equation $\frac{\partial T}{\partial t} = \alpha \nabla^2 T$ next to a 3D surface plot representing temperature distribution.
- Bottom left: A state transition diagram with two states labeled 1 and 2, connected by arrows.
- Bottom center: A control block diagram showing a block labeled $1/x$ receiving an input F and producing outputs $C: 1/k$, $R: b$, and $I: m$.

ISO 23247 Reference architecture



Digital "X"

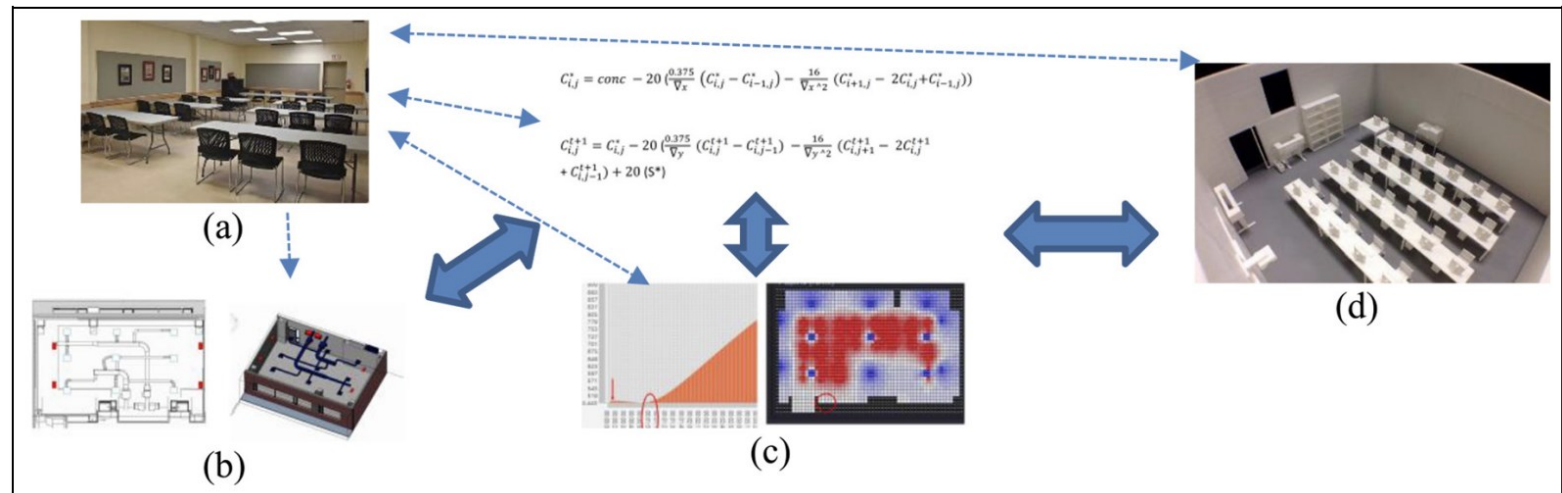
Verdouw et al., 2021



Kritzinger et al., 2018

A DEVS-based engine for building digital quadruplets

Daniella Niyonkuru and Gabriel Wainer



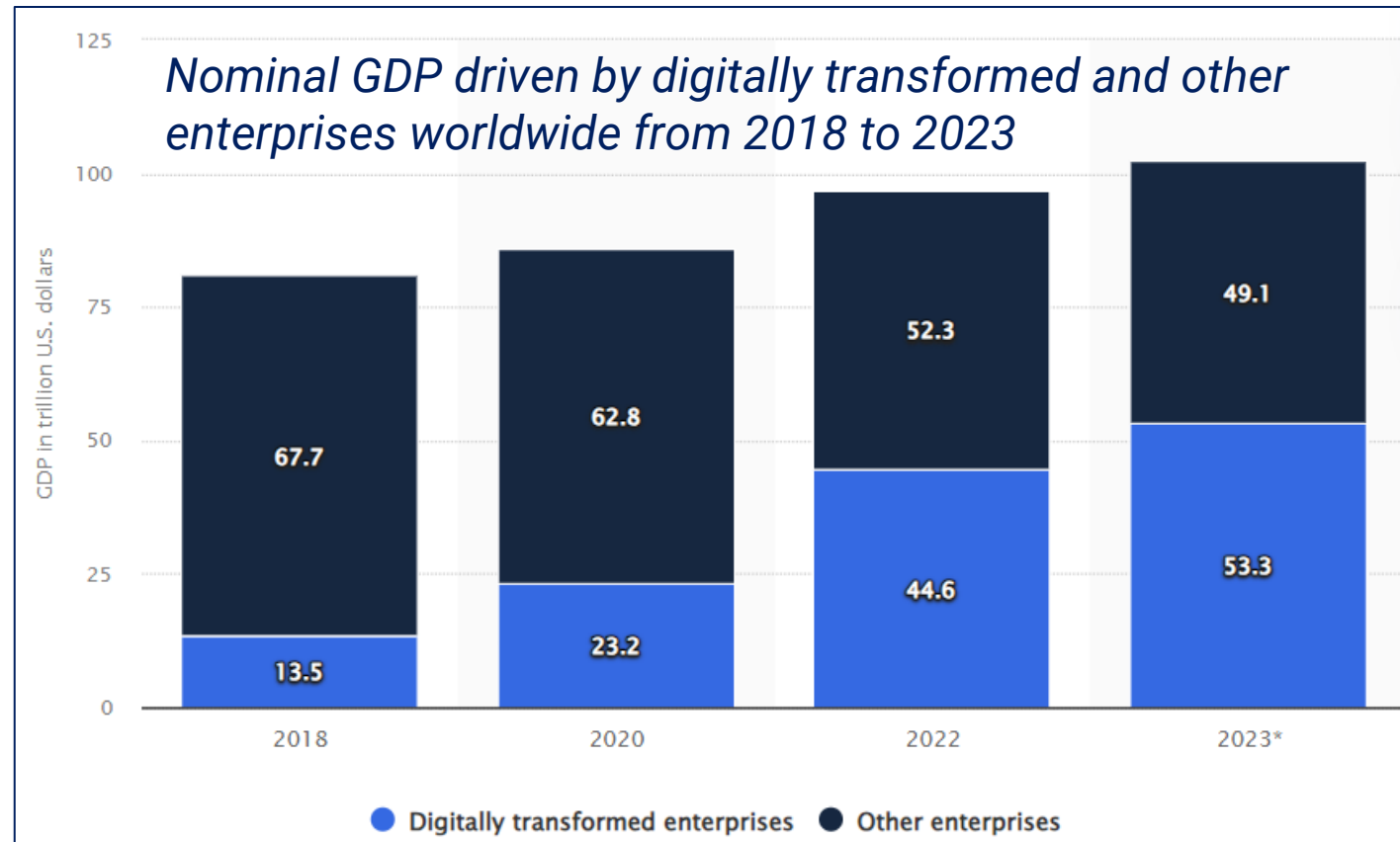
Digitalization and digital transformation

Industry 4.0 and 5.0

I5.0 complements the existing I4.0 approach by specifically putting research and innovation at the service of the transition to a **sustainable, human-centric and resilient European industry**



Digital Transformation Pyramid



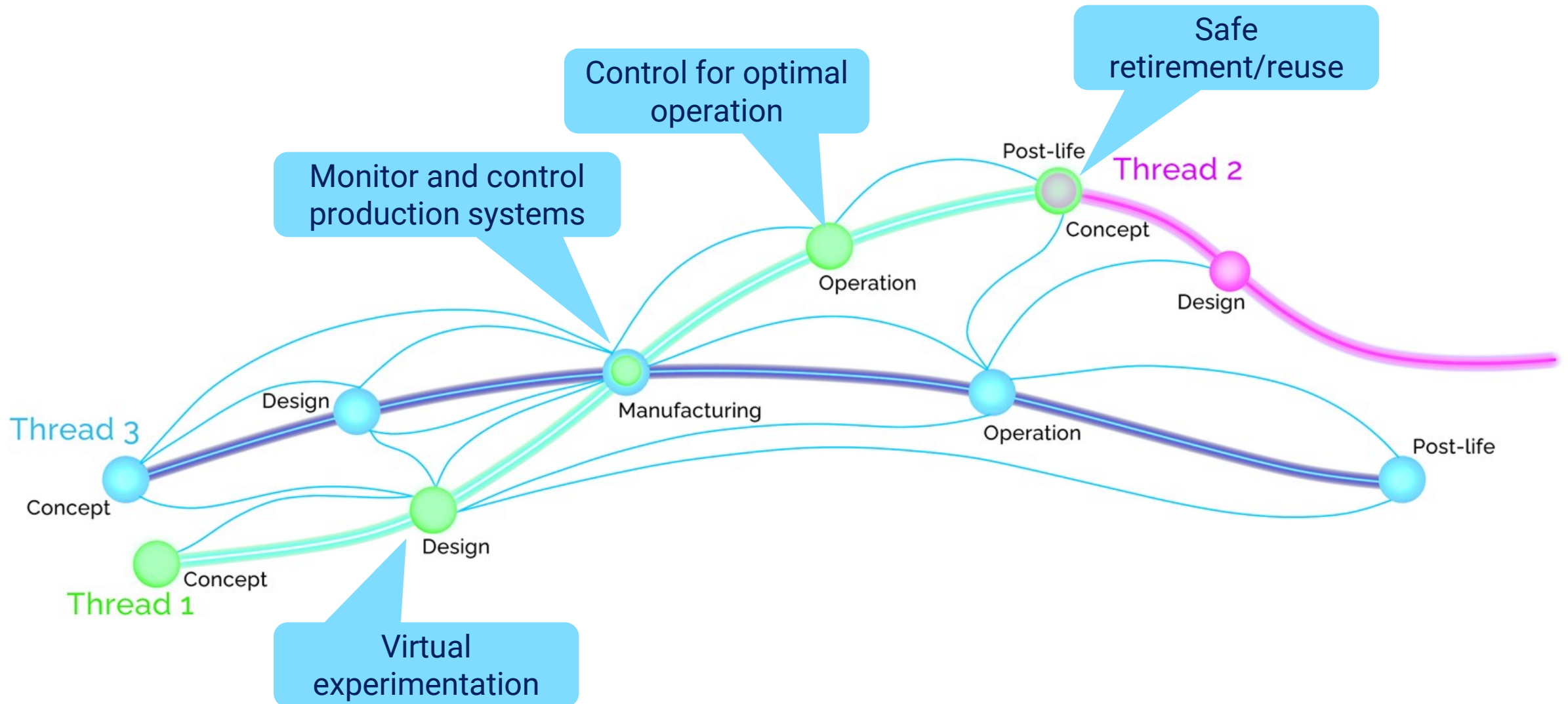
<https://www.statista.com/statistics/1134766/nominal-gdp-driven-by-digitally-transformed-enterprises/>



VISION, EXPERIENCE, ANSWERS FOR INDUSTRY, INFRASTRUCTURE & CITIES

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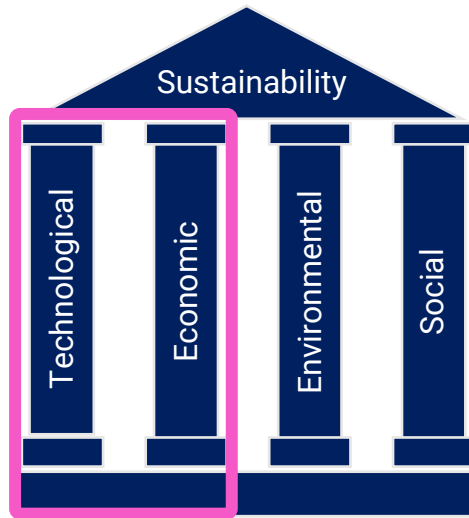
Digital Twins along the Systems Engineering process



Digital Twins for Sustainable Design

60% of organizations believe Digital Twin technology is critical to improving sustainability efforts.

(CapGemini, 2022)



Systems Engineering



Sustainable
Systems and Methods

ENGINEERING
Computing & Software

