

Enabling technologies for digital twin

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Oliver Barrowclough

SINTEF Digital

oliver.barrowclough@sintef.no

27.04.2021



What is a digital twin?

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A digital twin is a virtual representation that serves as the real-time digital counterpart of a physical object or process.

[Cyber-Physical Systems and Digital Twins in the Industrial Internet of Things / Wikipedia](#)

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A digital twin is a virtual representation that

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Cyber-Physical Systems / Wikipedia

A digital twin is a digital replica of an artefact, process or service that is so accurate that it can be the basis for decisions.

Change2Twin, EU H2020 project



What is a digital twin?

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A digital twin is a virtual representation that serves as the digital counterpart of a physical object or process.

Cyber-Physical Systems / Wikipedia

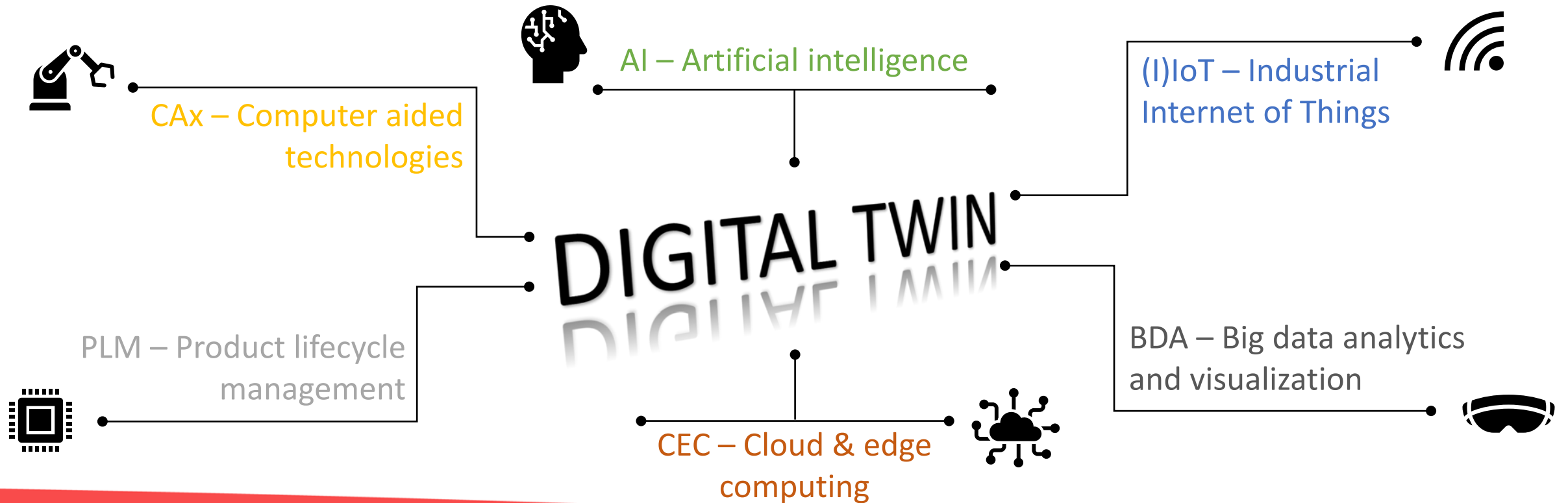
A digital twin is a digital replica of an artefact, process or system that can be the basis for simulation and analysis.

Change2Twin

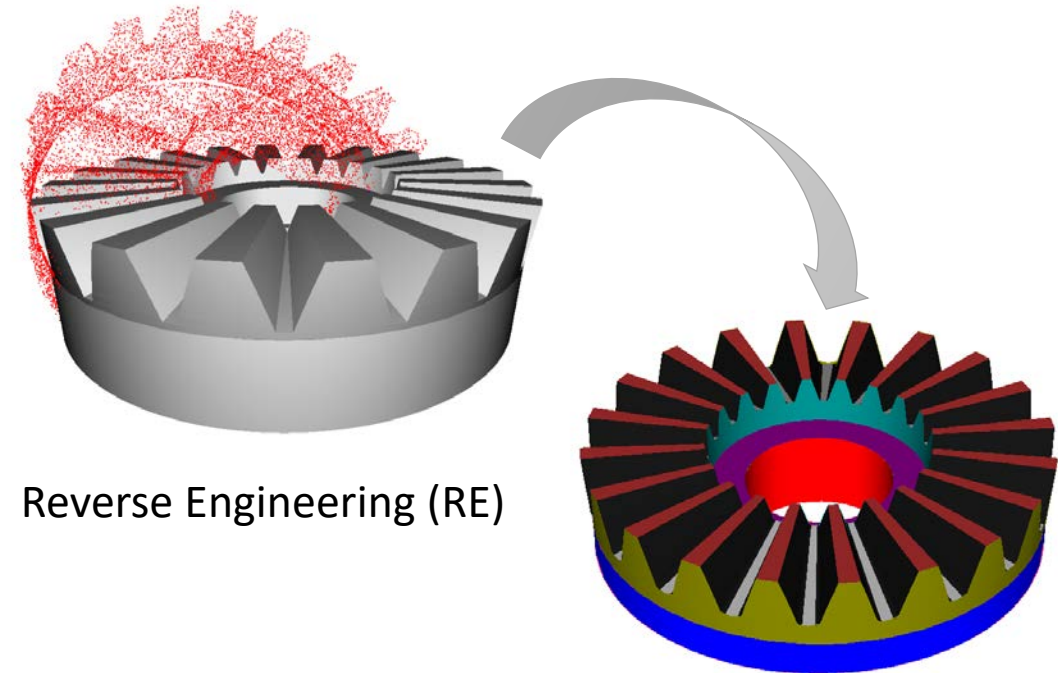
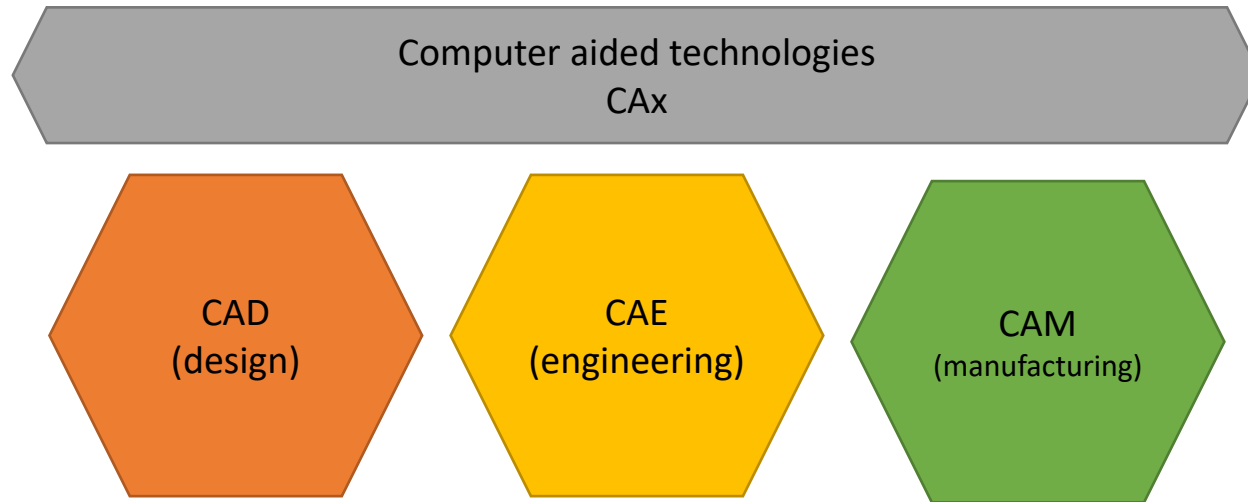
A Digital Twin (DT) is defined as a virtual representation of a physical asset enabled through data and simulators for real-time prediction, optimization, monitoring, controlling, and improved decision making.

Digital Twin: Values, Challenges and Enablers From a Modeling Perspective

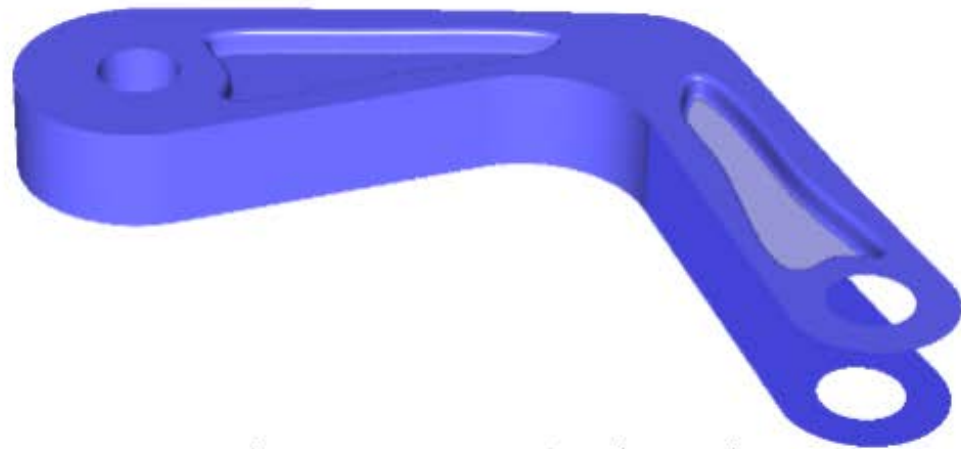
Digital twin combines new and mature tech



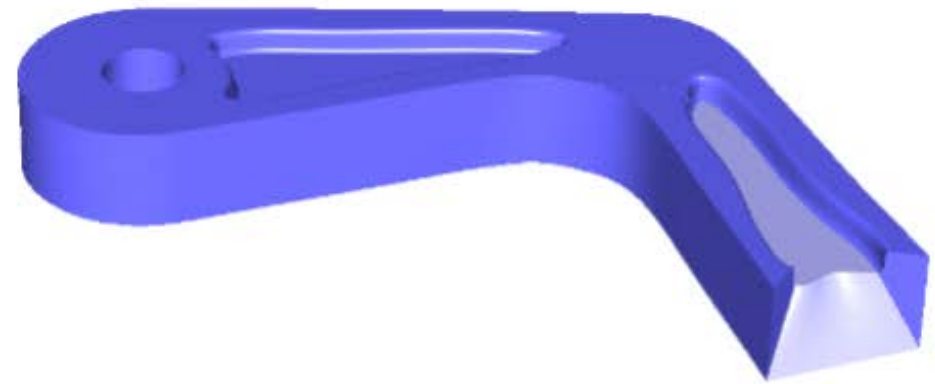
Modelling the digital twin – CAx/RE



Modelling the digital twin – CAx



Boundary representation (B-rep)



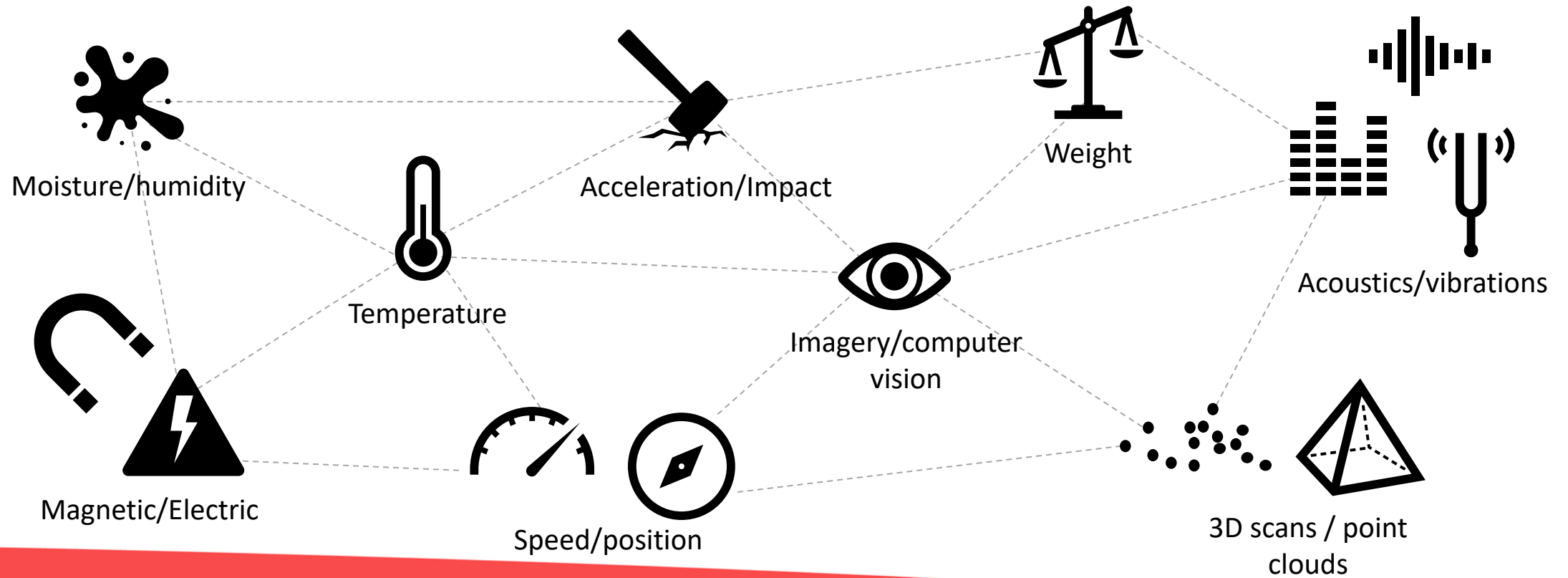
Volume representation (V-rep)

Keeping the digital twin updated - IIoT

- Digital twin uses IIoT to monitor the status of the physical twin in real-time.
- IIoT consists of interconnected "things" that collect and transfer data over a network.
- Sensors, instruments and other devices are fully automated.
- 5G enables higher speeds, ultra low-latency, better reliability and increased capacity.



Keeping the digital twin updated - IIoT



Embedding knowledge in the twin –AI/ML

- Artificial intelligence
 - Machine Learning
 - Deep Learning
- AI can solve a wide range of tasks:
 - Object detection, classification, localization & segmentation.
 - Generative modelling
 - Clustering & visualization
 - Control and planning



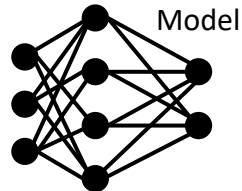
Embedding knowledge in the twin – AI/ML

Supervised learning

0 0 0 0 0 0 0 0
 1 1 TRAINING DATA
 2 2
 3 3 3 3 3 3 3 3
 4 4 4 4 4 4 4 4

Training

(back propagation)



Model

0 0 0 0 0 0 0 0
 LABELS 1 1 1 1
 2 2 2 2
 3 3 3 3 3 3 3 3
 4 4 4 4 4 4 4 4

0 0 0 0 0 0 0 0
 1 1 \ 1 1 \ 1 1
 2 2 2 2 NEW DATA
 3 3 3 3
 4 4 4 4 4 4 4 4

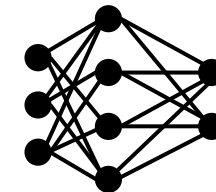
Inference

0 0 0 0 0 0 0 0
 PREDICTED LABELS 1 1 1
 2 2 2
 3 3 3
 4 4 4

Unsupervised learning

UNLABELLED DATA

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 1 1 1 \ 1 1 / 1 / 1 \ 1 1 \ 1 / 1
 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
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CLUSTERS

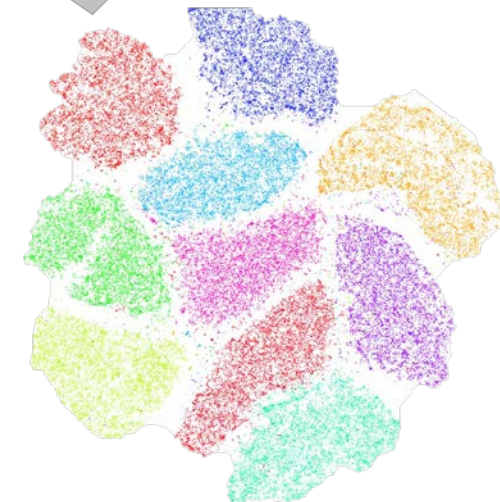
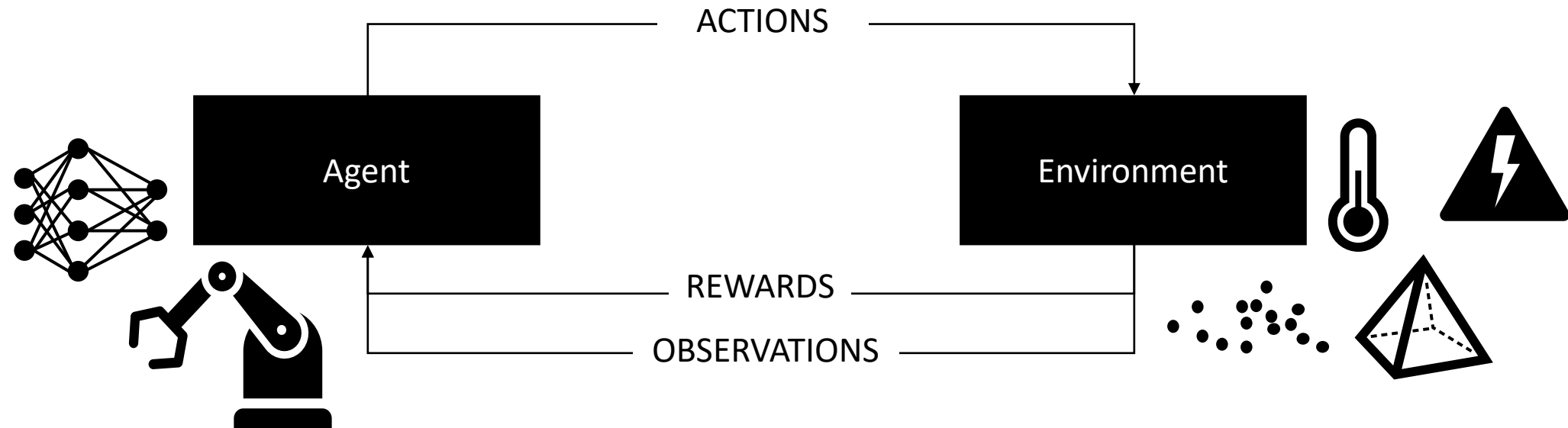


Image: [Kyle McDonald](#)

Embedding knowledge in the twin – AI/ML

Reinforcement learning

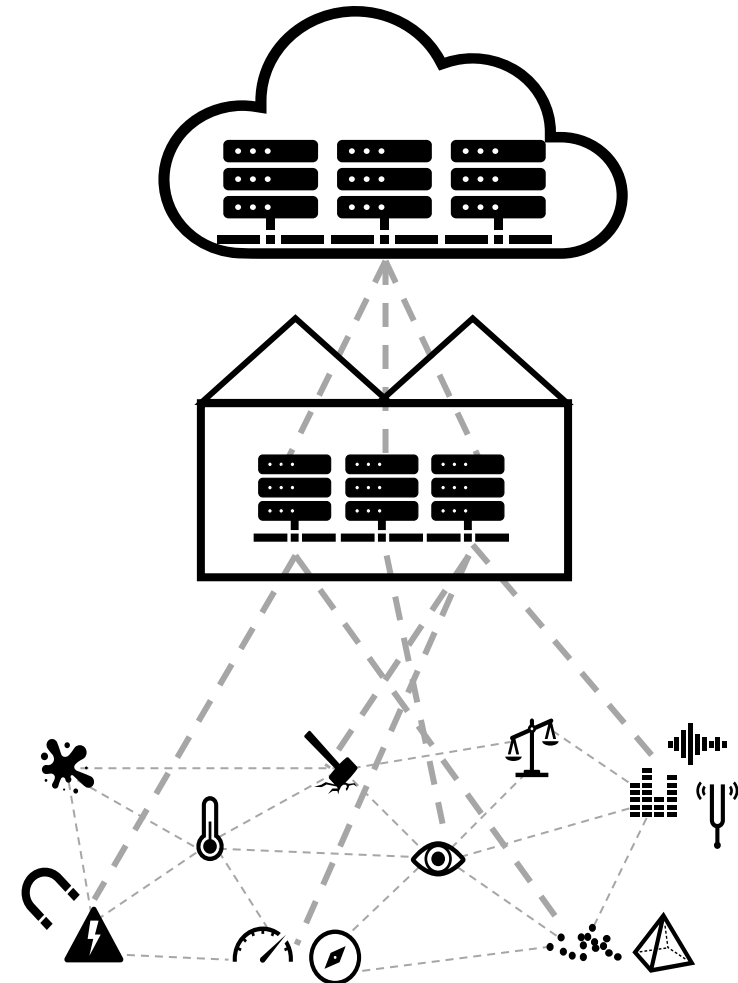


Processing the twin – cloud/edge

Cloud: *computational power and storage provided on-demand ("as a service") in remote data centres*

Edge: *compute and storage capacity provided locally*

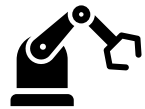
IoT devices: *minimal on-board processing*



Interacting with the twin



Bringing it all together



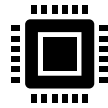
CAX – Computer aided technologies



AI – Artificial intelligence



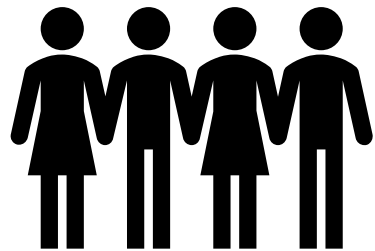
(I)IoT – Industrial Internet of Things



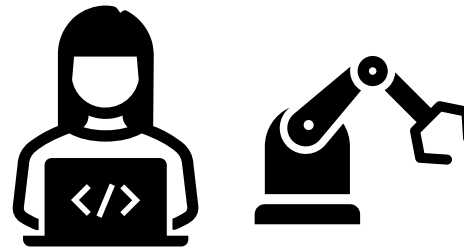
CEC – Cloud & edge computing



BDA – Big data analytics and visualization



Involvement of all stakeholders



High level of automation / low code



Product lifecycle management & standards

More about Change2Twin

A horizontal line of red dots, consisting of several groups of dots of varying lengths, located below the title.

- Change2Twin is a European project which supports manufacturing SMEs in their digitalization process by providing Digital Twin solutions.
- Assessment Open Call (up to € 10.000 / project)
- Deployment Open Call (up to € 90.000 / project)
- Website: www.change2twin.eu
- Position paper: <https://lnkd.in/eCvyE8E>



CHANGE2TWIN