Fontys > FOR SOCIETY

A PRIMER ON DIGITAL TWINS – WHAT WHY HOW?

TEADE PUNTER

DTA-WEBINAR, 20 APRIL 2022

Interreg Euregio Meuse-Rhine
EMR DIGITAL TWIN ACADEMY
EUROPEAN UNION European Regional Development Fund

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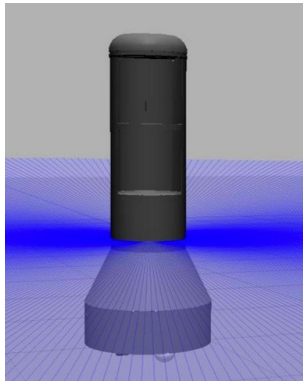


Social Distancing/Bartender robot

HTSM RIGS project

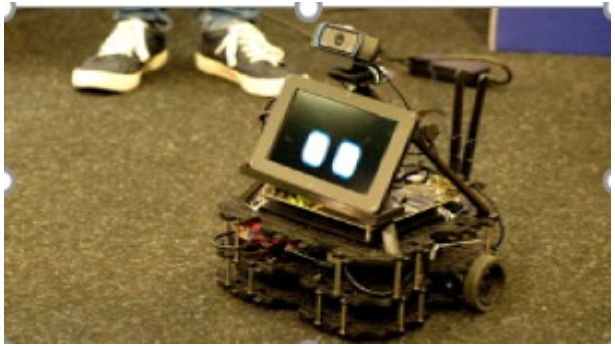
Fontys ICT, ENG, Jur, HRM

VDL ETG, TSG, Bavaria, Fourtress

Sw: Gazebo + ROS

Hw: FEng Mechatronics

https://www.ictinpractice.nl/projects/rigs/



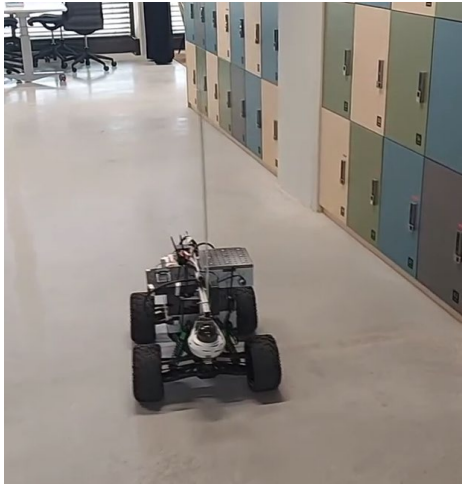
Interaction Module

RAAK CEC project

Sw: python, posenet ai

Hw: Turtlebot3 + nvidia jetson

https://www.htesfontysict.nl/humans-work-with-robots/interaction-module/



Monitoring Robot

PII HERE Technologies, Sorama, MWLC

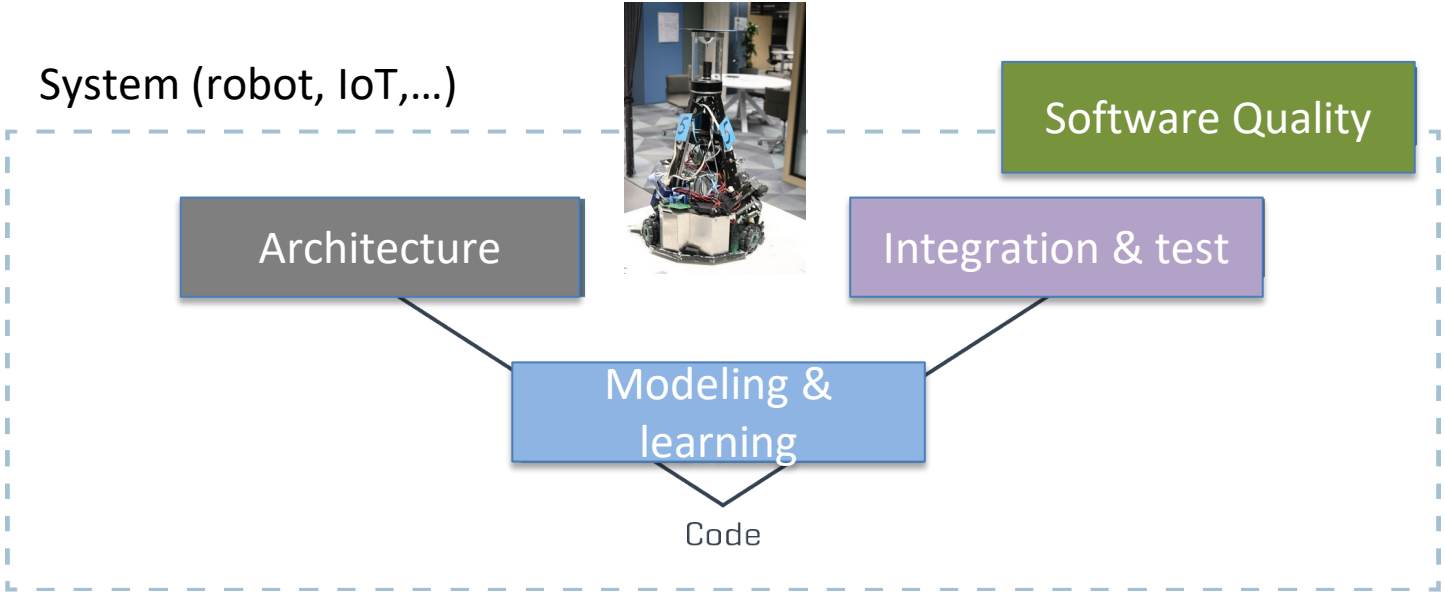
Sw: AT4 tracker, mqtt

Hw: Sound camera, MWLC robot

https://www.htesfontysict.nl/modeling-autonomous-robots/monitoring-robot/

Introduction

Research Group HTES = High Tech Embedded Software

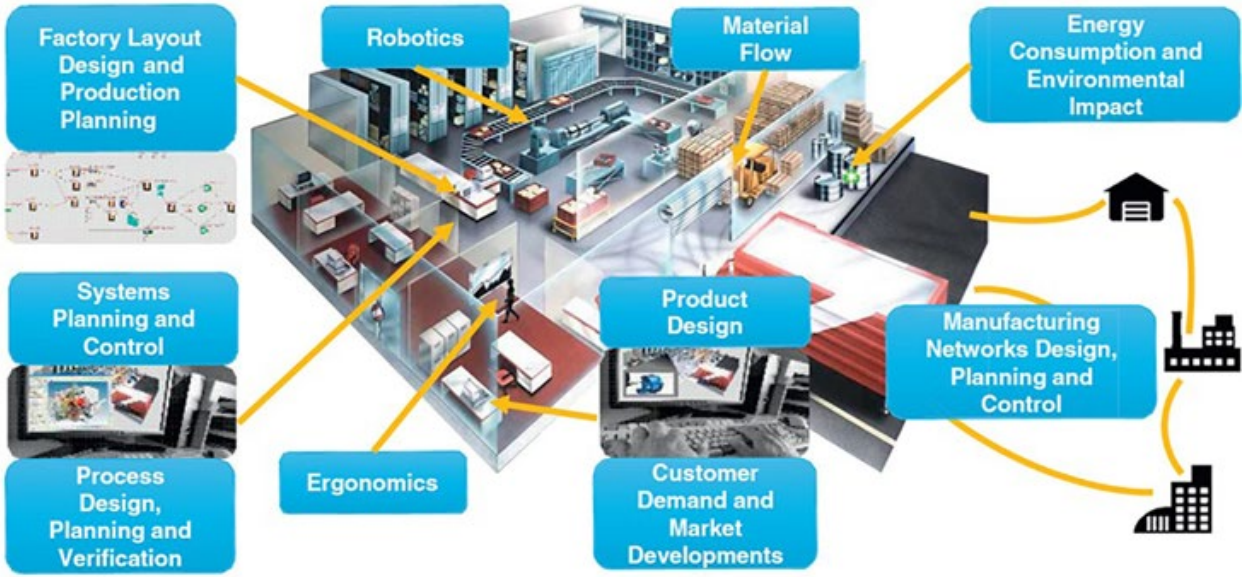


Introduction

Centre of Expertise HTSM = High Tech Systems and Materials

Autonomous & adaptive robots	Digital twinning & systems	Applying materials	Energy generation & storage	Quantum, photonics, sensors & IoT	Diagnostics & testing
Intelligent robots, Embodied AI	AI & data engineering, System engineering, High tech system design Industrial IoT	Metal, polymers, thin film	Batteries, Solar/Wind/(Water) fuels	Quantum sensors, Photonics Networks & IoT	Diagnostic AI System integration

Industry 4.0 / Smart Industry



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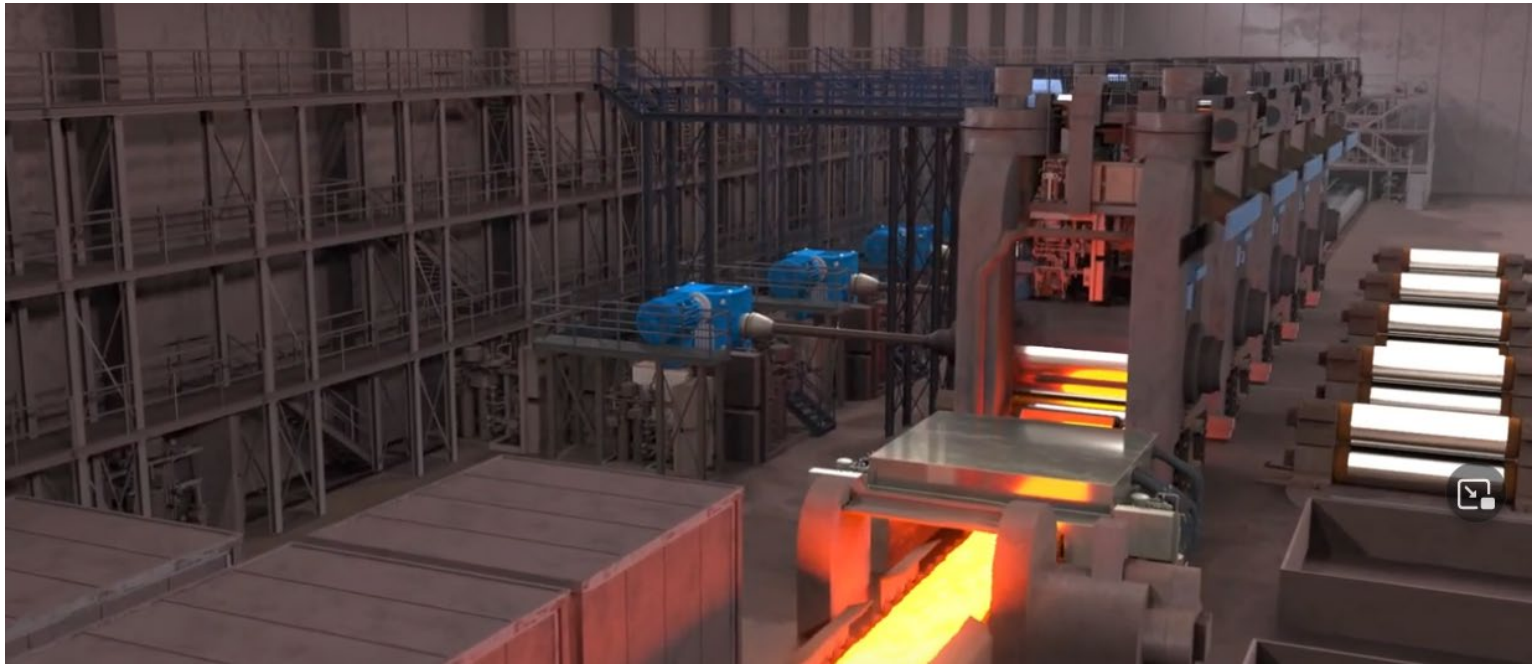
Example – condition-based monitoring



https://ru-clip.net/video/daytBSS5ifY/uptimeworks-condition-monitoring.html

Digitale Fabriek van de Toekomst

INNOVATIEPROGRAMMA FABRIEK VAN DE TOEKOMST

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Industry 4.0 / Smart Industry

Monitor early,
Conditionbased maintenance

Measure (rolls)
- Vibration
- Torsion
- Temperature

Setup process roll with sensors, Eindhoven

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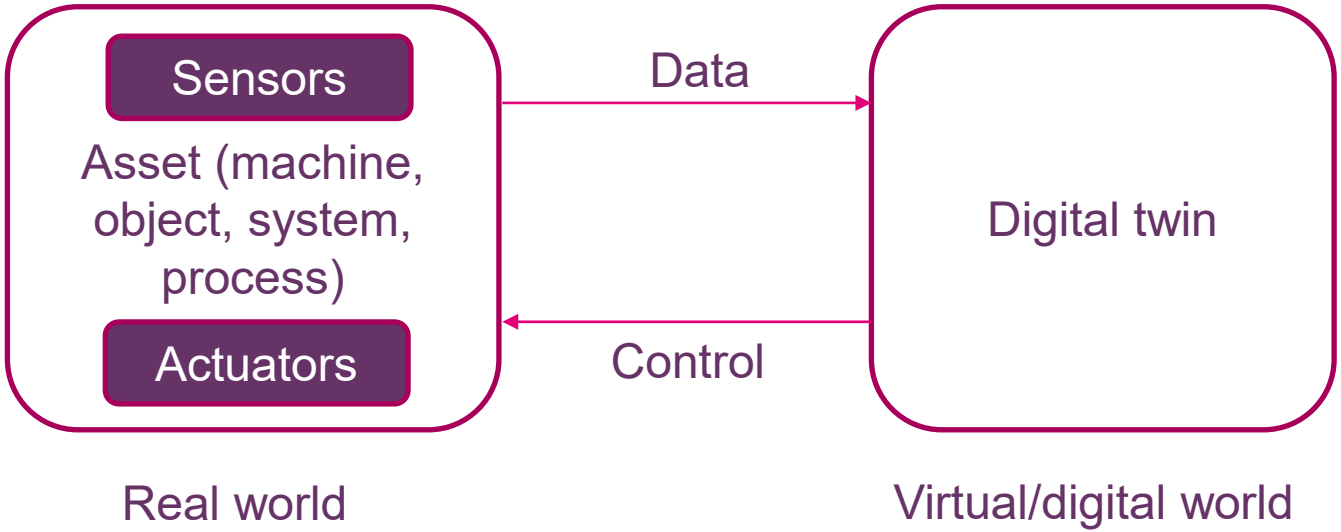
Industry X

Well-being of workers
Preservation of resources, climate change and social stability.

https://ec.europa.eu/

What is a Digital Twin?



Simulation & twinning

Understanding the system

- Communication with customer
- Feasibility study

Warehouse simulation, Vanderlande Industries, 2009

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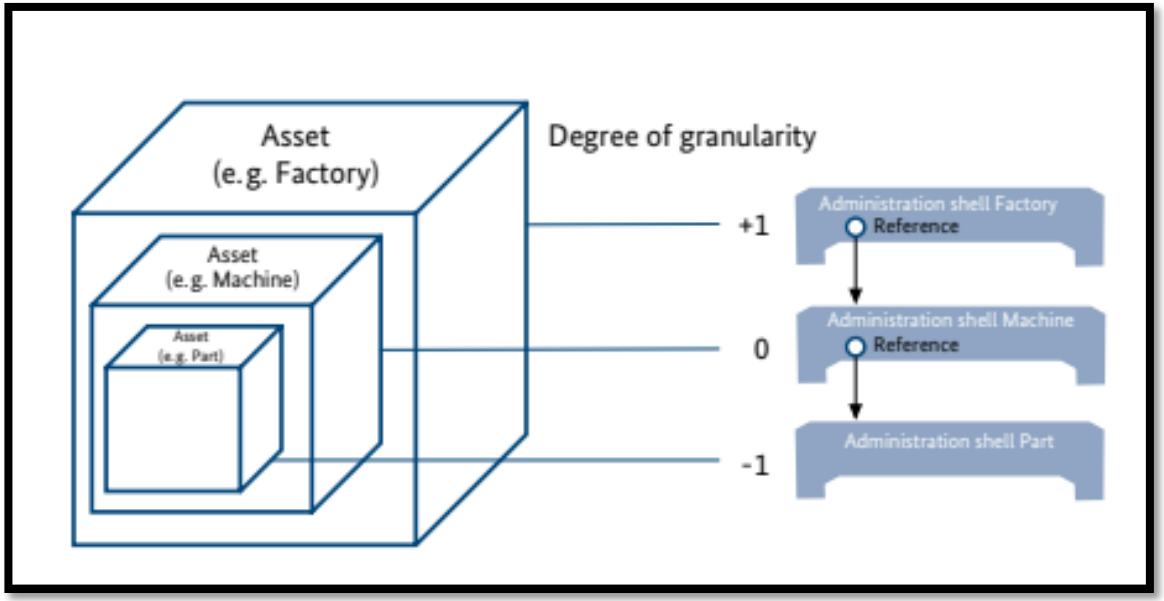
Simulation & twinning

Virtualization enables system development, software-in-the-loop

- Improved communication and understanding
- Find problems/defects early; detect anomalies
- Efficiency gain

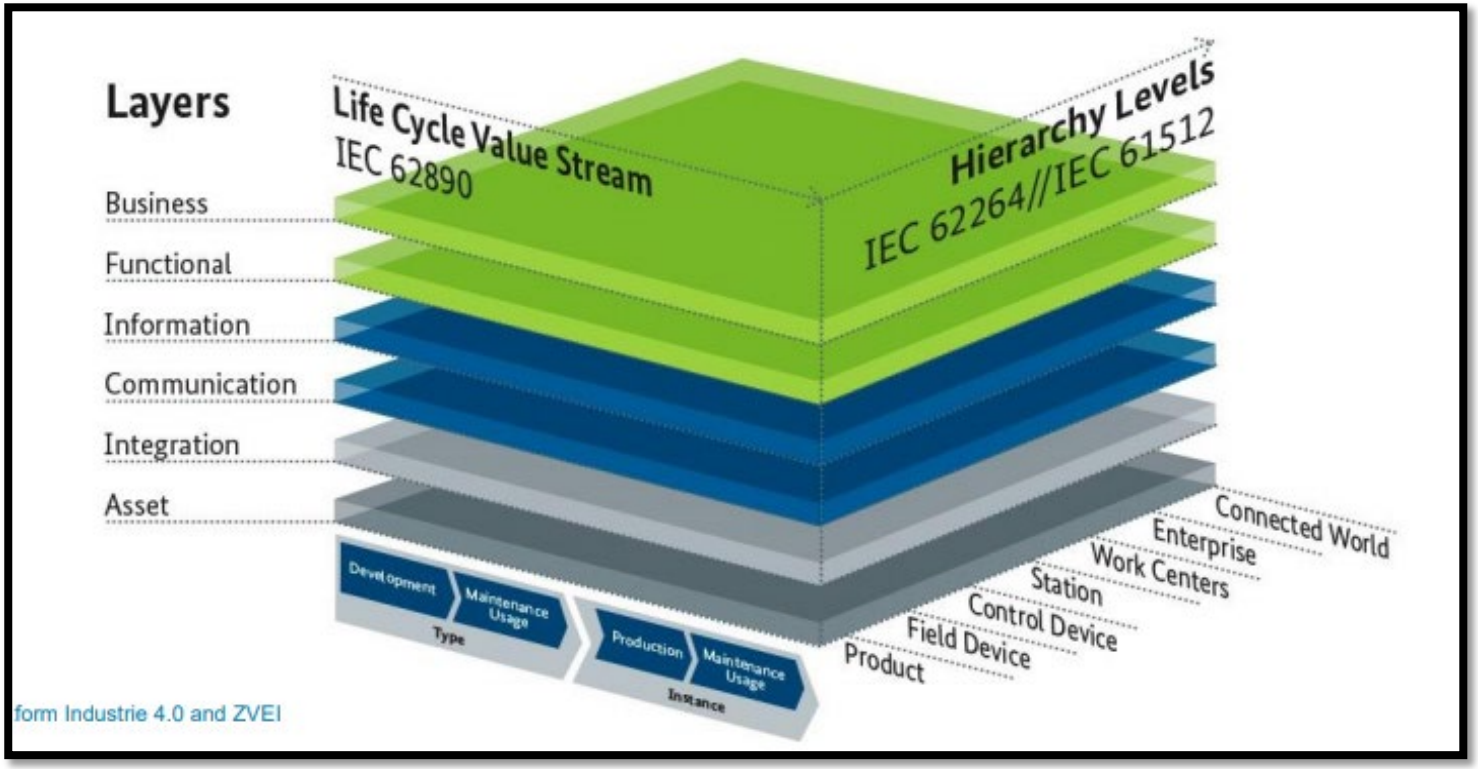
Paperpath simulation, Oce / Canon, 2009

Reality as asset

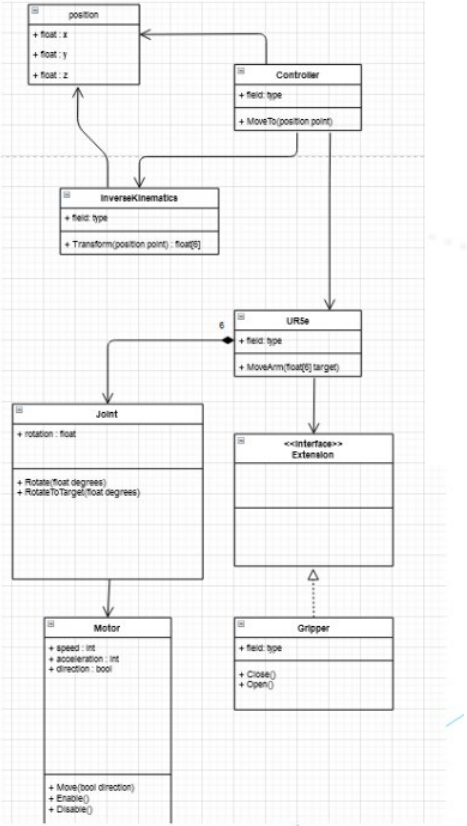


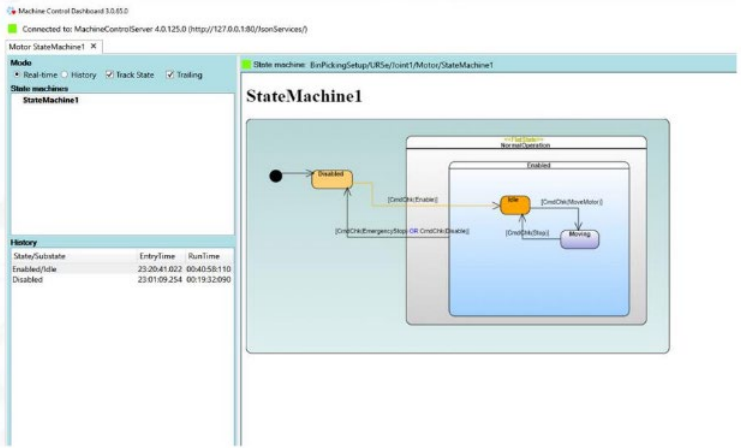
Static, IT approach

Asset, data …



Behavior





UR5 Digital Twin, Fontys with Cordis, 2020

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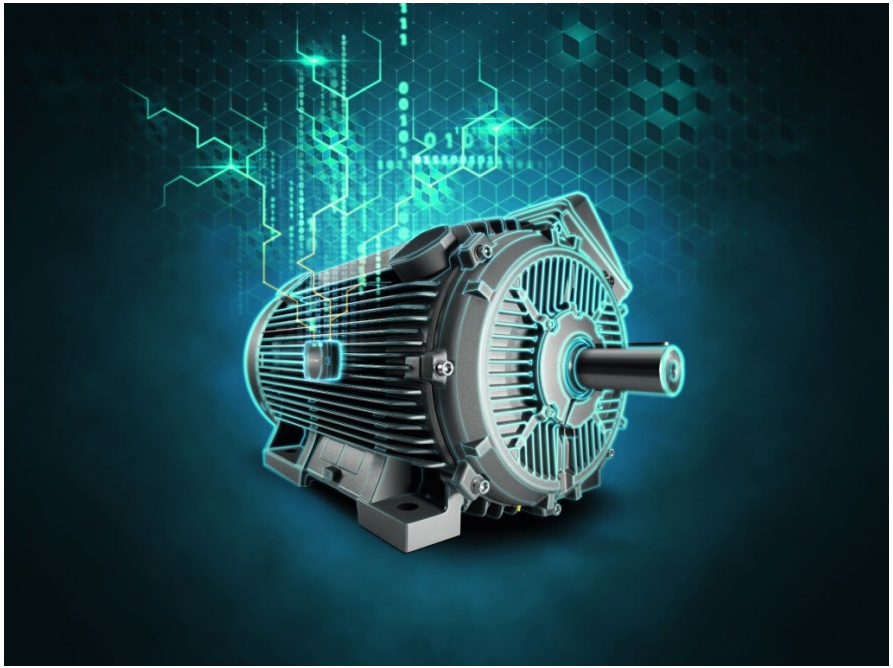
Why develop digital twins?

Why – predictive maintenance



Condition-based maintenance

Why – remote monitoring

Say you are monitoring machines around the world and you need to check and update the configuration with specialists

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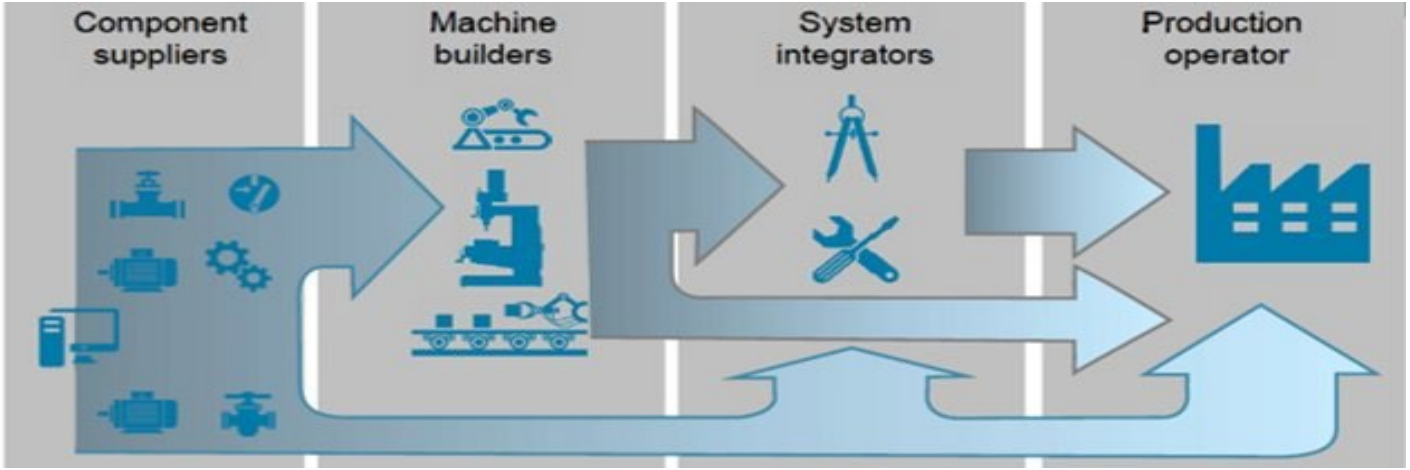
Why – cooperate in value chain



- Automated planning updates based on the availability of components.
- Suppliers watch the performance of the components and improve their quality.

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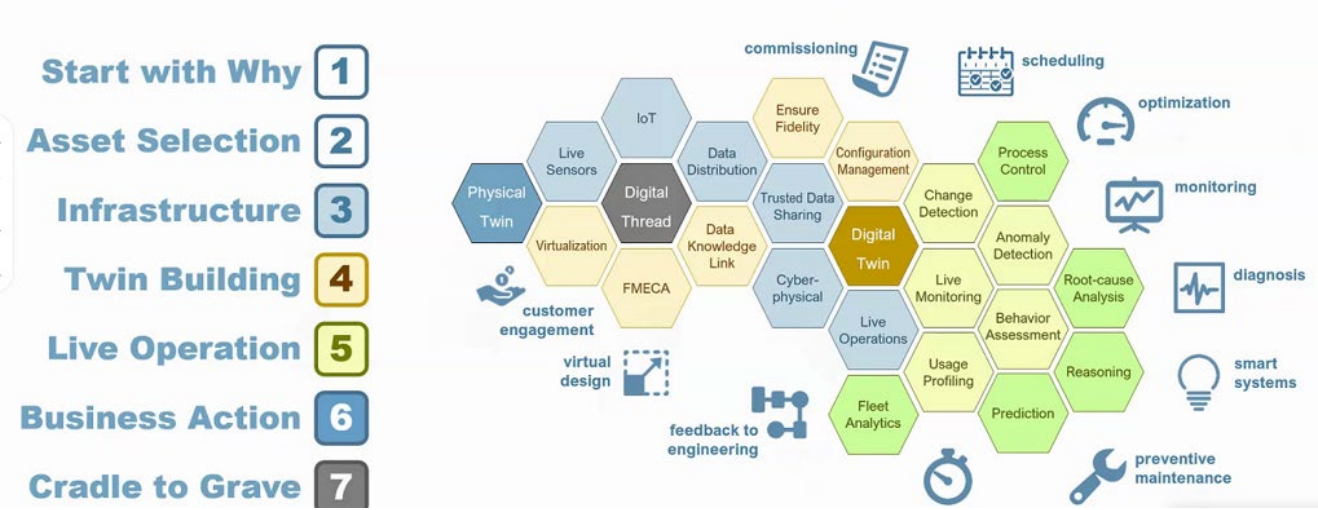
Why – improve development

both visual realism
and accurate physics

https://www.amazon.science/latest-news/at-amazon-robotics-simulation-gains-traction

How to develop a Digital Twin?

Many roads



https://www.change2twin.eu/

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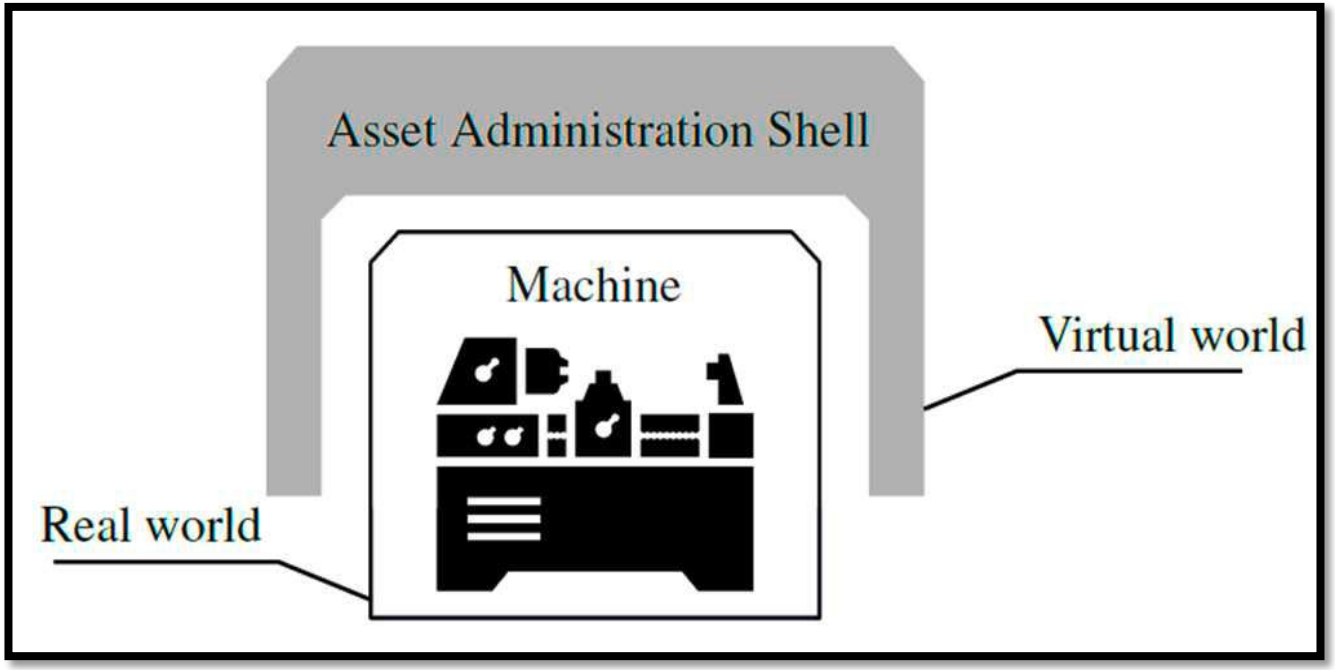
How to develop a Digital Twin?

AAS-road



How to develop a Digital Twin?

Measure (rolls)
- Vibration
- Torsion
- Temperature

Develop an AAS
- Dynamic information

Setup process roll with sensors, Eindhoven

Digitale Fabriek van de Toekomst
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How to develop a Digital Twin?

Another (Fontys) road.

Also start with existing asset

Phases:

- Data logging
- Model the asset, look at data behavior
  - process mining
- Integrate model and reality

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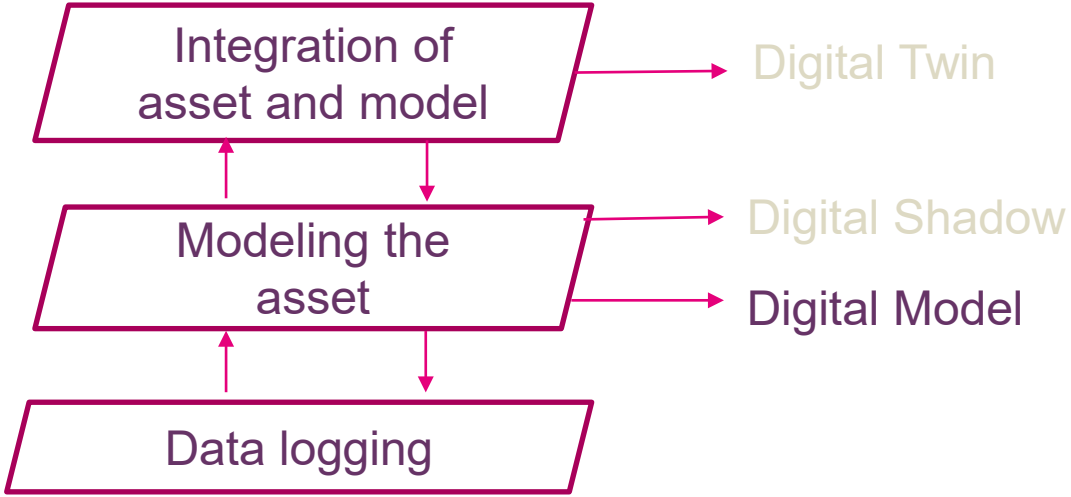
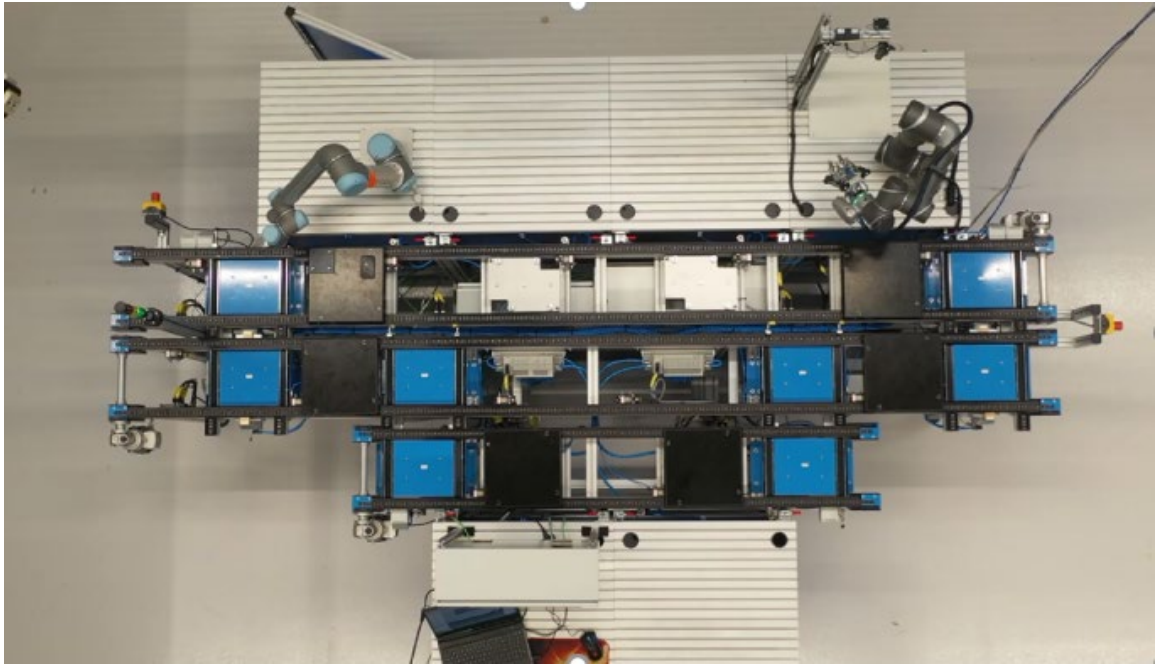
Digital Twin Development



(Punter, 2022)

Smart Industry Case Fontys



Mechatronic Transfer System, Fontys, BIC, Eindhoven

Fontys LECTORAAT Mechatronica & Robotica

Fontys LECTORAAT High Tech Embedded Software

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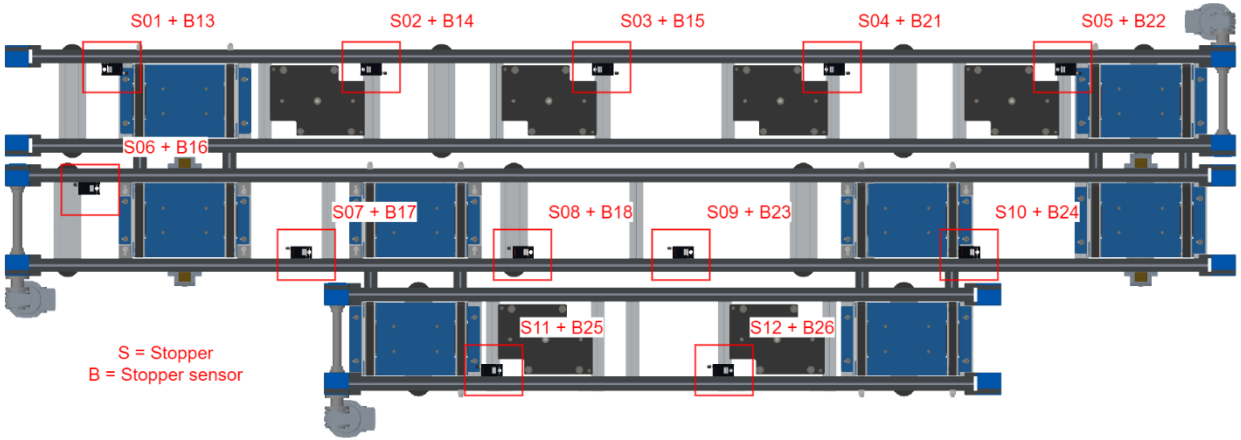
Smart Industry Case Fontys

Focus on transfer system

Stoppers (Pallet) -
Layout Transfersystem



Mechatronic Transfer System, Fontys, BIC, Eindhoven

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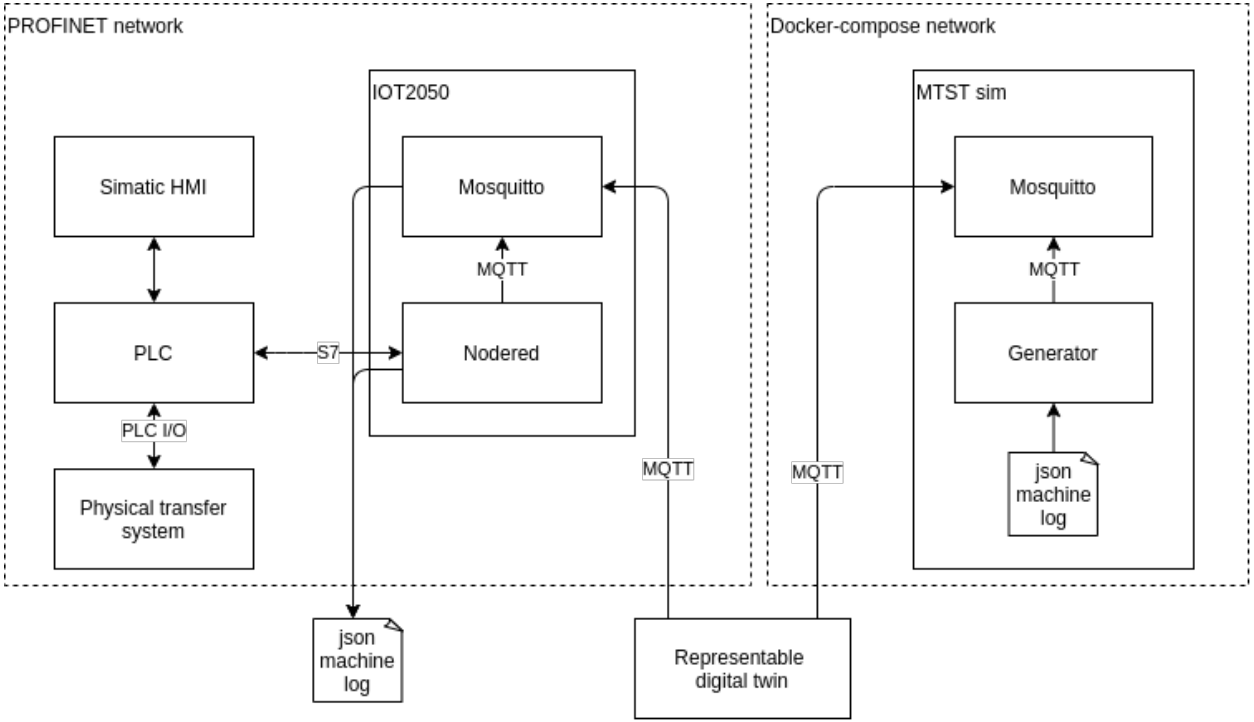
Transfer system



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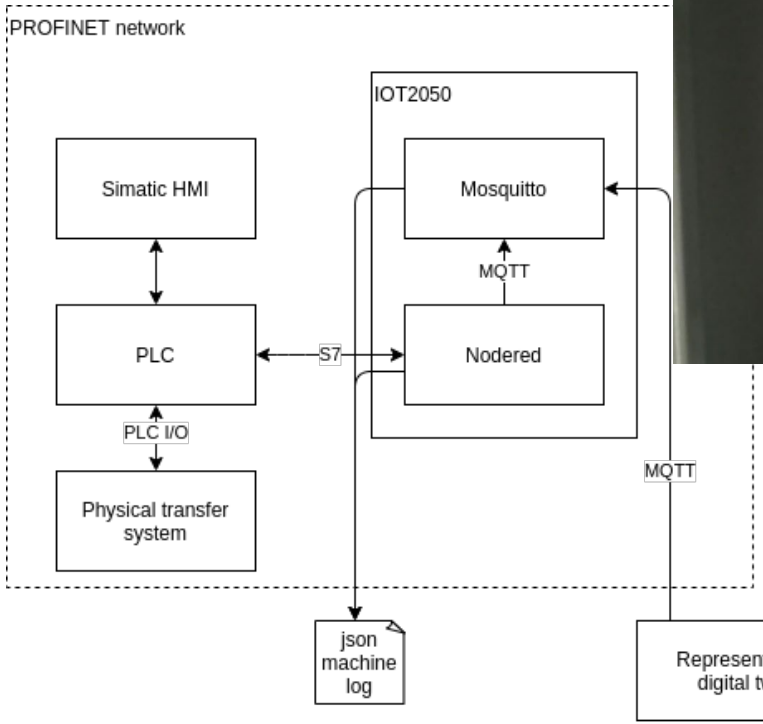
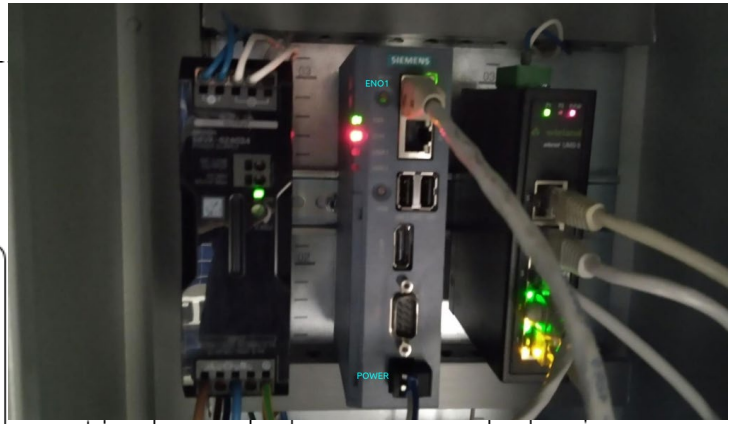
Transfer system





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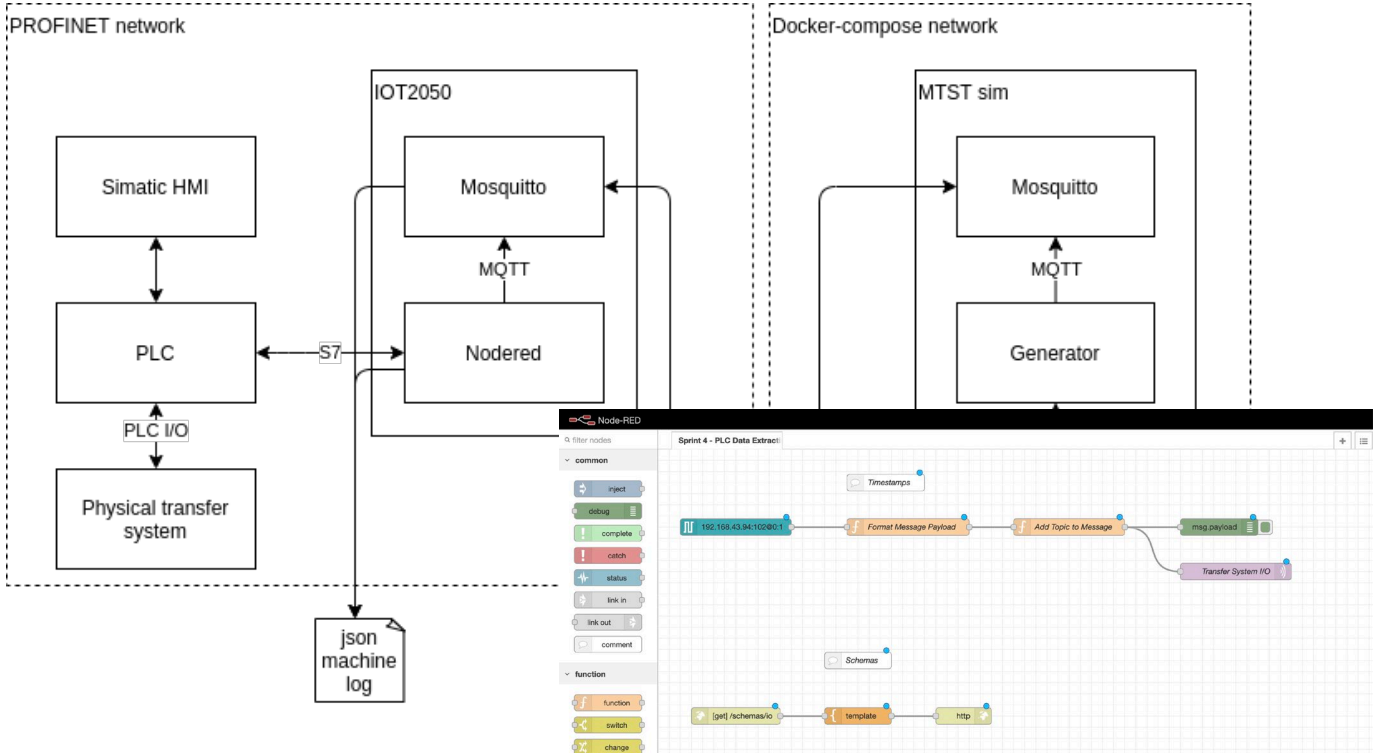
Transfer system



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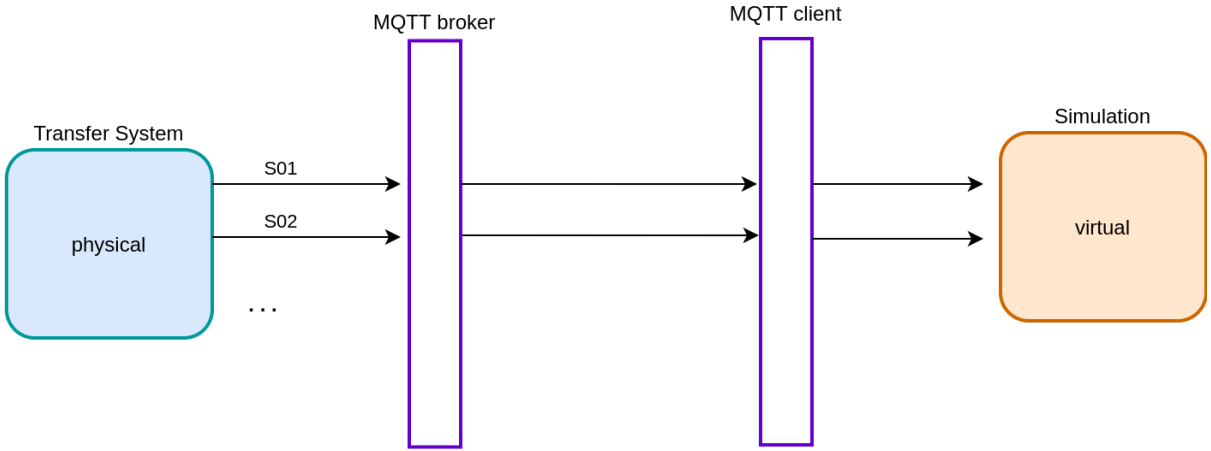

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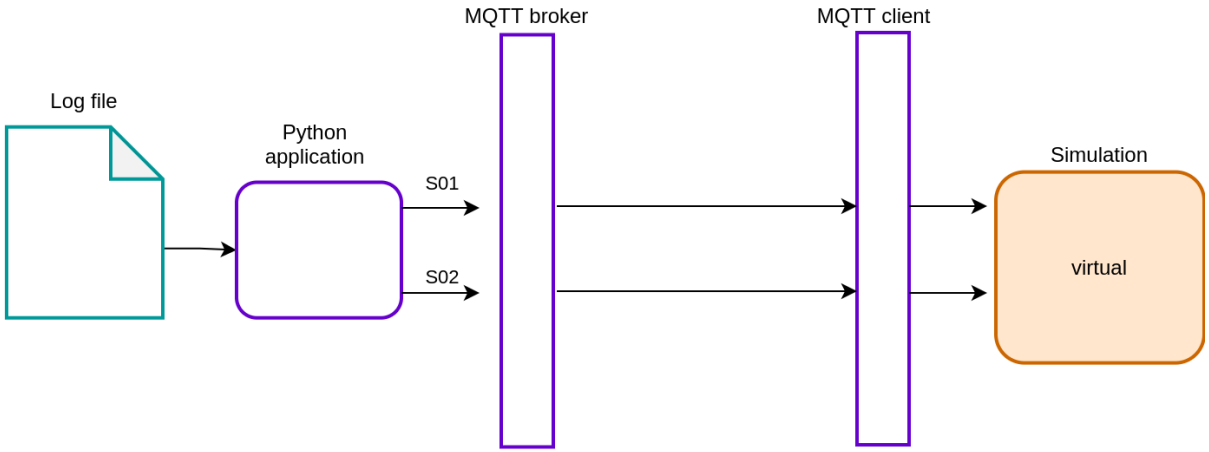
Transfer system

Replay system, from a log



Transfer system

Twin V1.0

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Modeling

Process mining

ProductId	Timestamp	Activity	Comment
Product1	2022-04-14T08:19:45.235	>>Line	Enter production line
Product2	2022-04-14T08:19:55.846	>>Line	Enter production line
Product1	2022-04-14T08:20:01.745	>>StationA	Enter assembly station A
Product2	2022-04-14T08:21:01.987	>>StationB	Enter assembly station B
Product1	2022-04-14T08:21:05.245	StationA>>	Exit assembly station A
Product2	2022-04-14T08:21:07.087	StationB>>	Exit assembly station A
Product1	2022-04-14T08:21:08.243	>>StationB	Enter assembly station B
Product2	2022-04-14T08:21:10.319	>>StationC	Enter assembly station C
Product1	2022-04-14T08:21:12.162	StationB>>	Exit assembly station B
Product2	2022-04-14T08:21:14.255	StationC>>	Exit assembly station C
Product1	2022-04-14T08:21:15.305	>>StationC	Enter assembly station C
Product2	2022-04-14T08:21:20.746	Line>>	Exit production line
Product1	2022-04-14T08:21:23.005	StationC>>	Exit assembly station C
Product1	2022-04-14T08:21:30.664	Line>>	Exit production line

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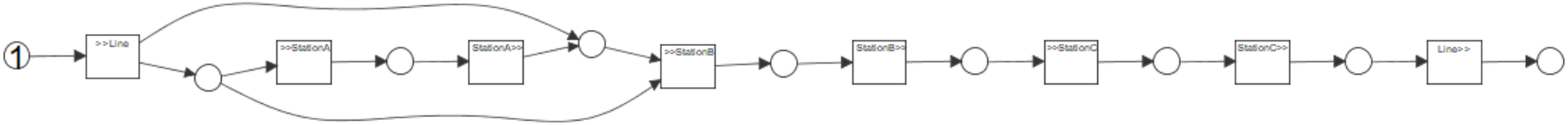
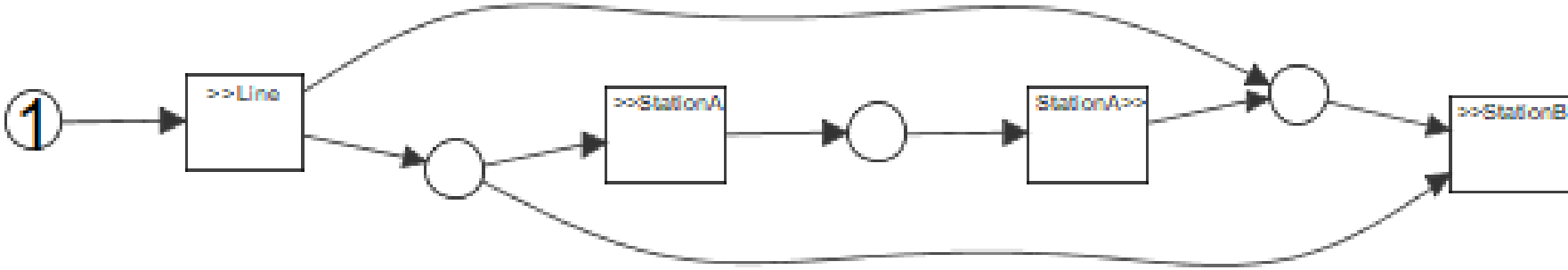
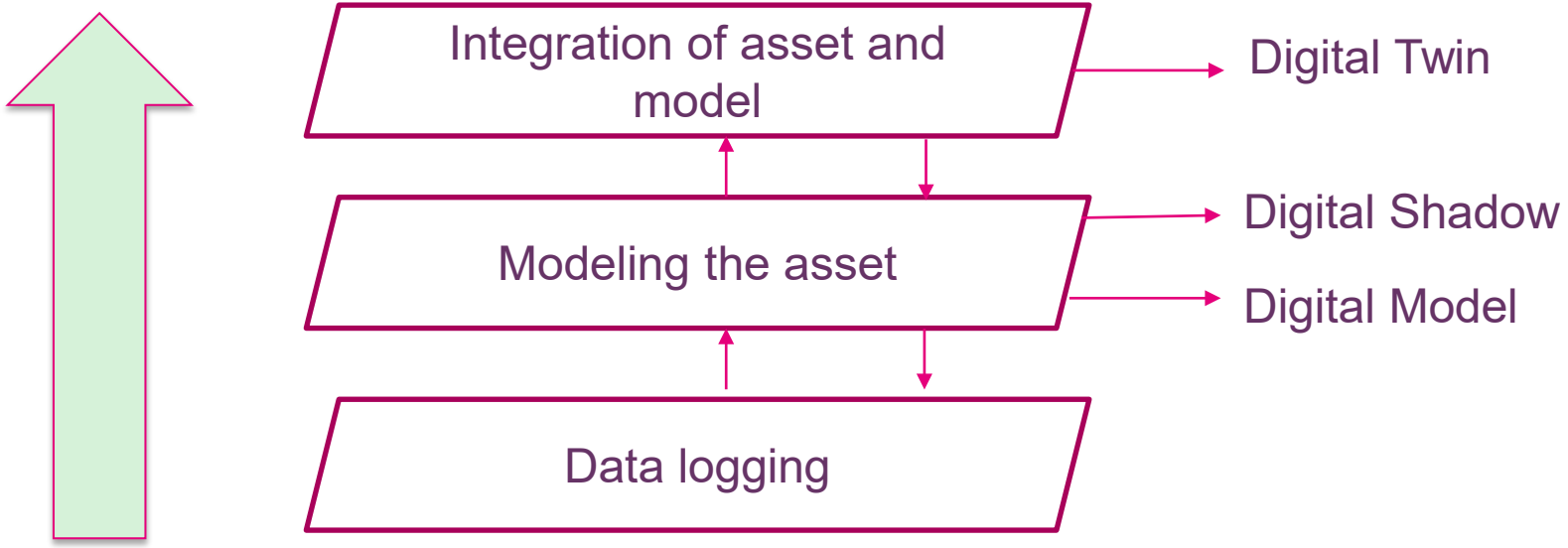
Modeling



Rebuild the model by process mining, find workflows



Summary



(Punter, 2022)

Thank you

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Remy Bos, Samual Jarvis, Casper Metsemakers, Arjan Vreugdenhil

https://www.htesfontysict.nl/digital-twin-academy/

https://www.youtube.com/watch?v=g2KI-XiXRZU

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