howest
university of applied sciences

Interreg
Vlaanderen-Nederland

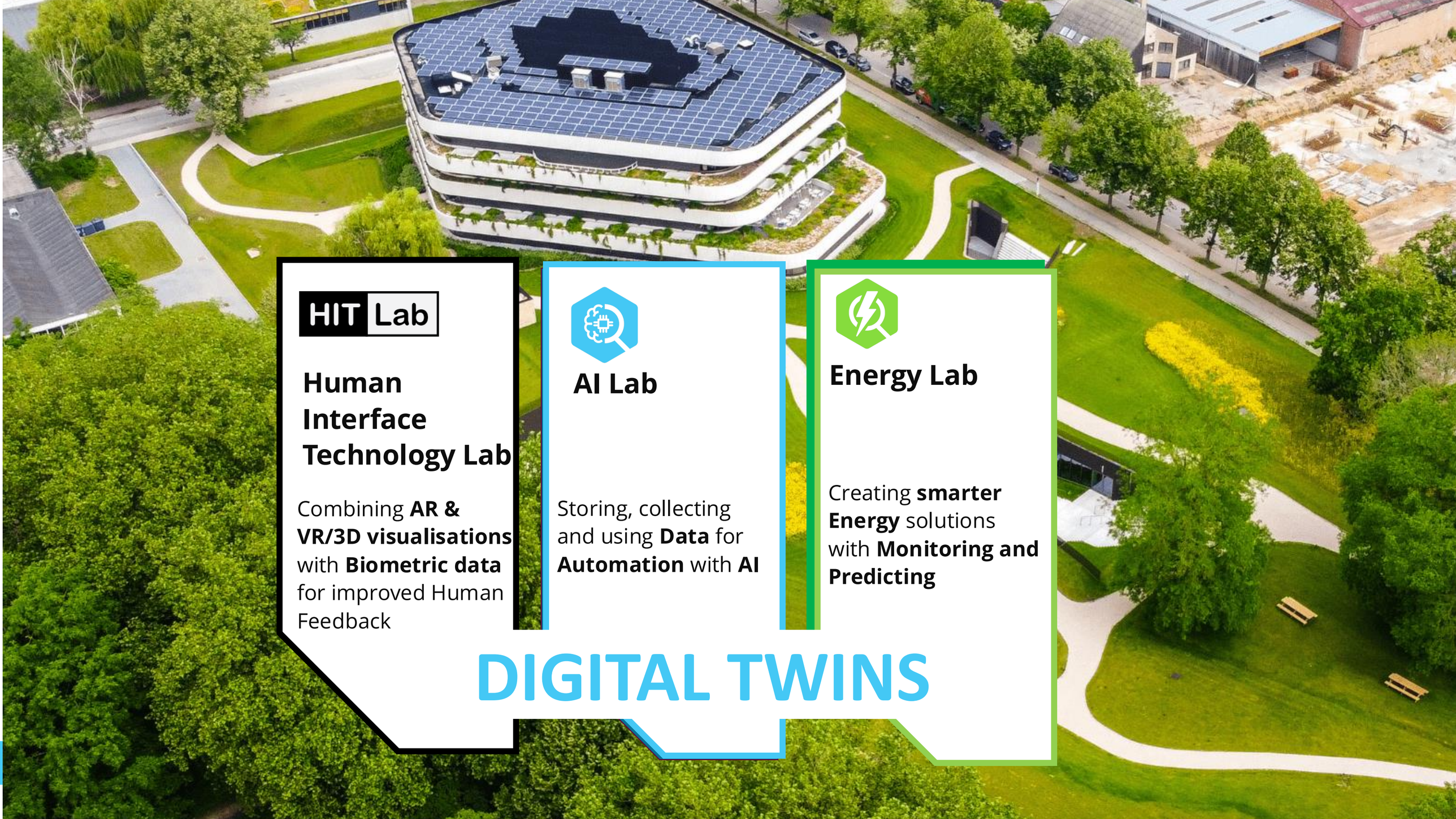
Gefinancierd door
de Europese Unie

Offshore for Sure

Introduction to Digital Twins

A practical decision-support tool across the full lifecycle of systems.

Dr. Charlotte Larmuseau
Smart Technology Research coordinator



HIT Lab

Human Interface Technology Lab

Combining **AR & VR/3D visualisations** with **Biometric data** for improved Human Feedback

AI Lab

Storing, collecting and using **Data** for **Automation** with **AI**

Energy Lab

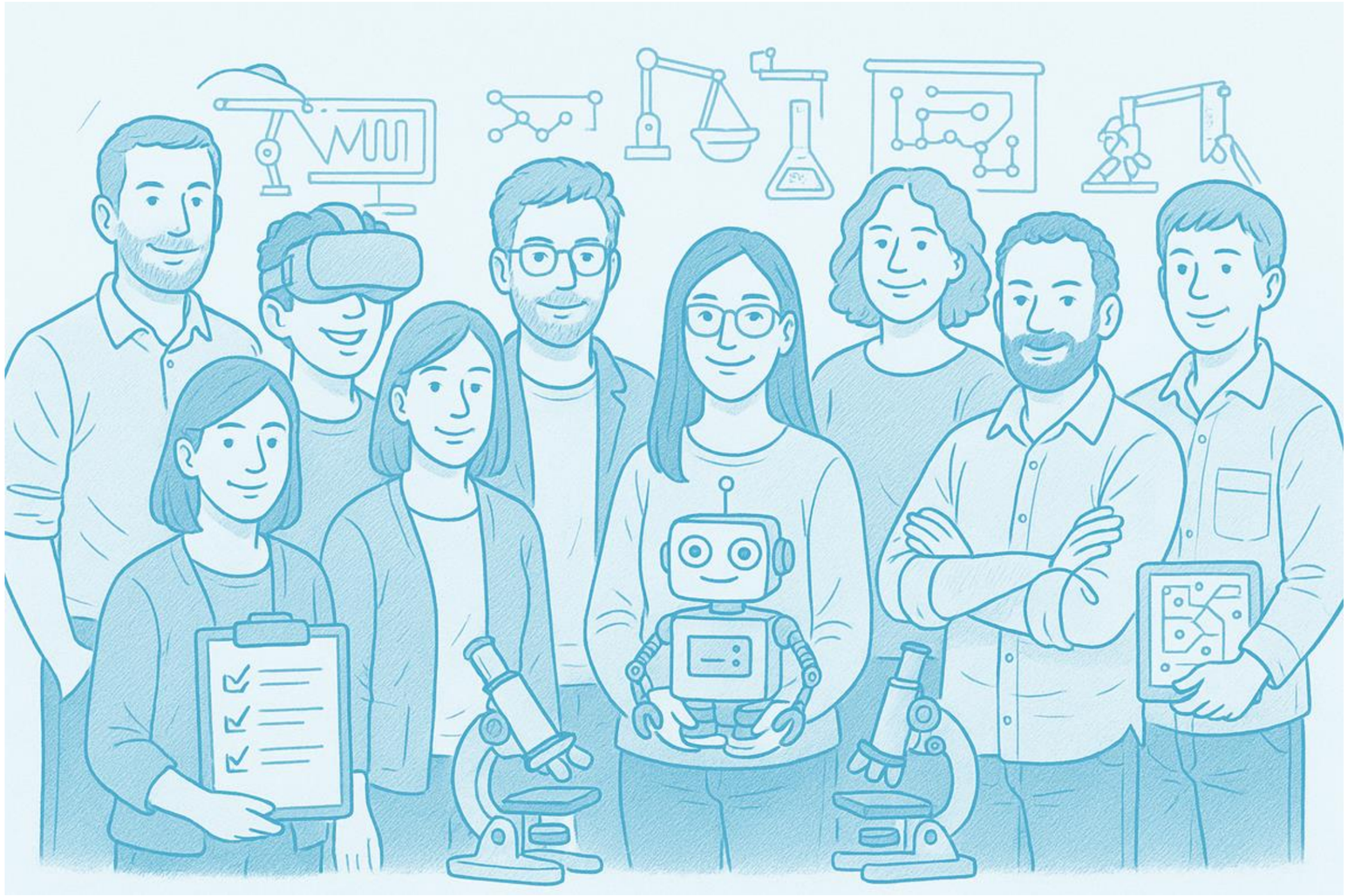
Creating **smarter Energy** solutions with **Monitoring and Predicting**

DIGITAL TWINS

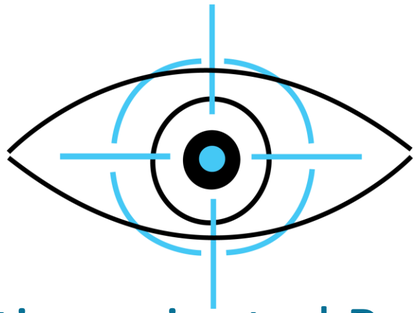
Smart Technology Lab – Who are we?

Interdisciplinarity at its best!

AI Engineers
XR Developers
3D Artists
Experimental Psychologists
Industrial Engineers
Computer Scientists



Smart Technology Research – What can we do for you?



Practice-oriented Research

R&D for companies and organizations

Customized innovative applications

Customized training

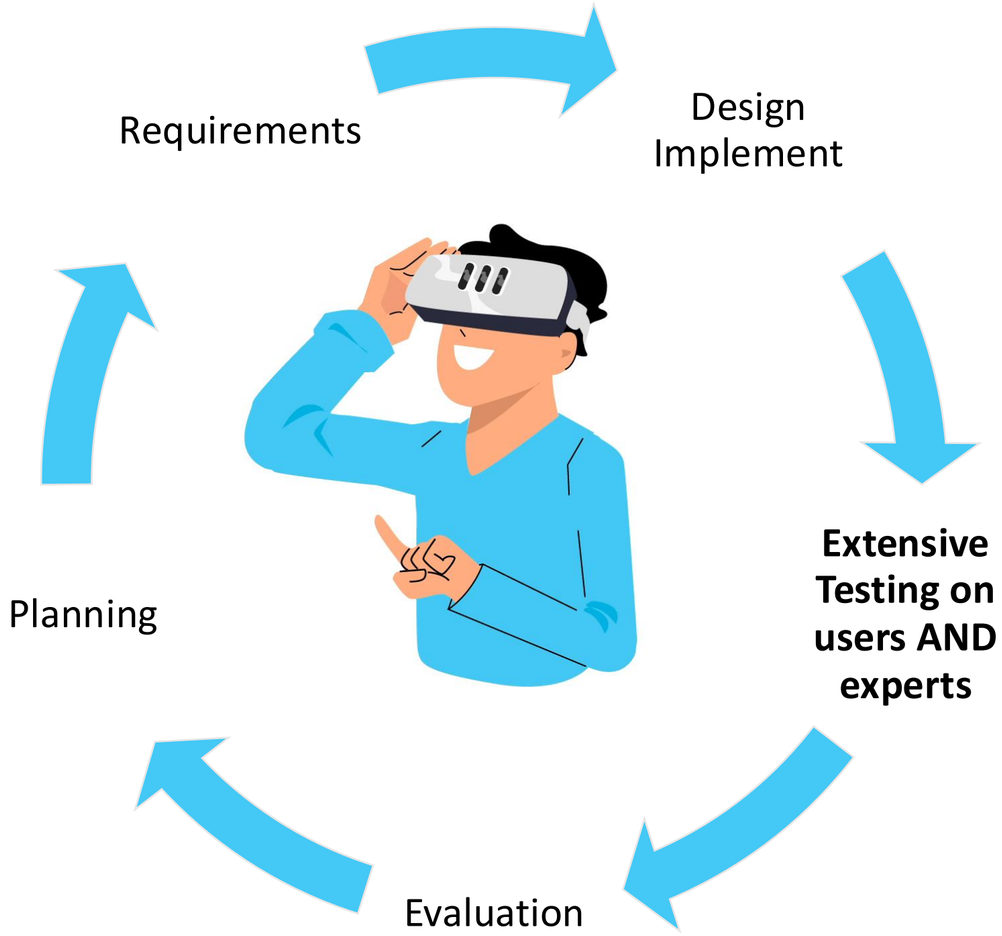
Participate in projects:

TETRA/COOCK+/EFRO/5G/O&O/

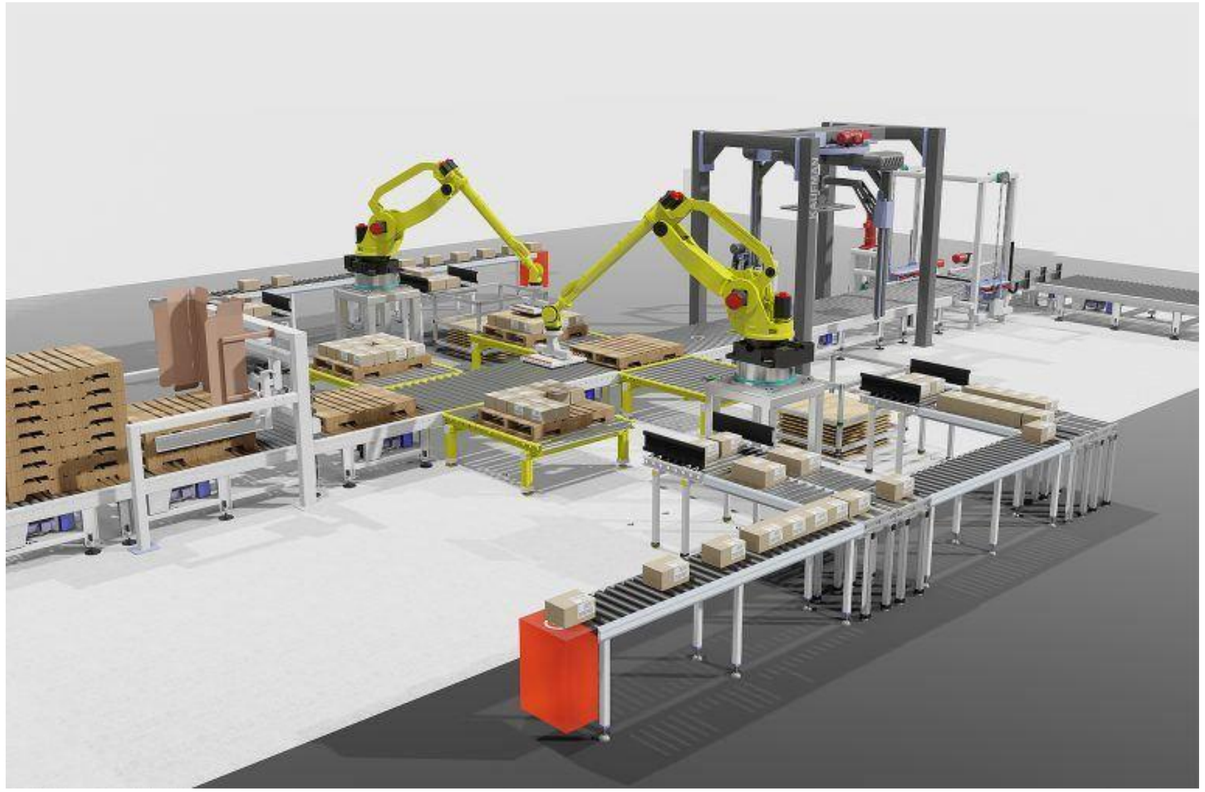
Interreg/ICON/InnoVET/

Smart Education/

EFRO/…

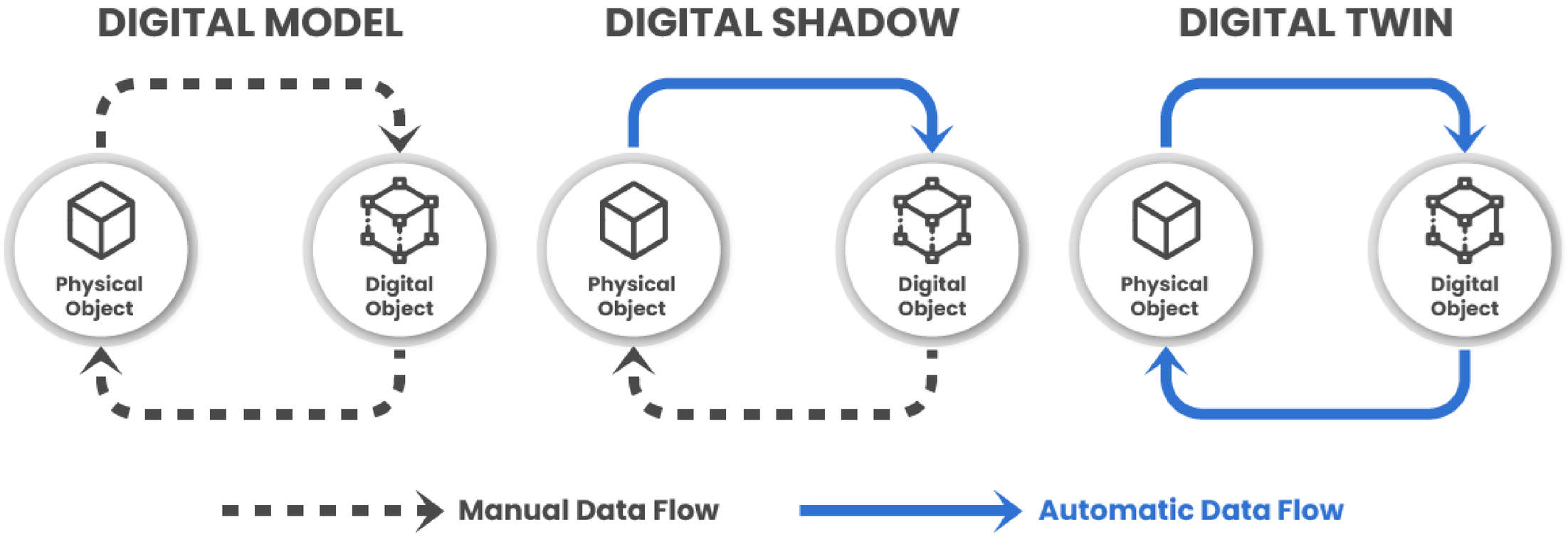


“Digital twins connect the physical and digital worlds — turning data into decisions”



https://hexagon.com/resources/insights/digital-twin/report

The digital twin lifecycle of a production system



Different terminology based on the nature of the connection between the real and the digital production system.

[Werner Kritzinger, Matthias Karner, Georg Traar, Jan Henjes, Wilfried Sihn, Digital Twin in manufacturing: A categorical literature review and classification, IFAC-PapersOnLine, Volume 51, Issue 11, 2018]

Data is essential for digital twins

Starting with Digital Twins

Technical

- Sensors
- Data collection
- Simulation model
- Cloud / IoT
- Cybersecurity

Business

- Efficiency gains
- Cost reduction
- Predictive maintenance
- Faster decision-making

Organizational

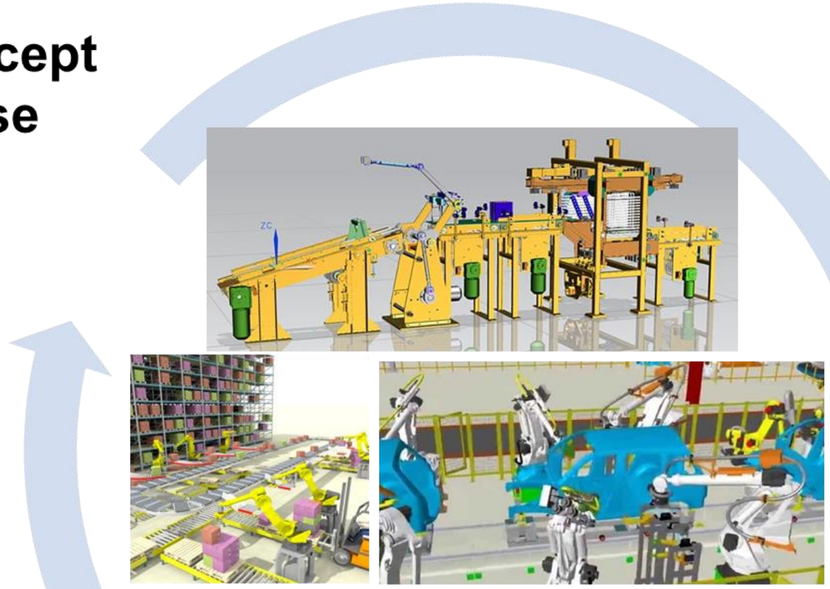
- Production
- IT • Finance
- Management
- Data governance

Human

- Skills
- Trust • Privacy
- Human-in-the-loop
- Acceptance

The digital twin lifecycle of a production system

Concept phase



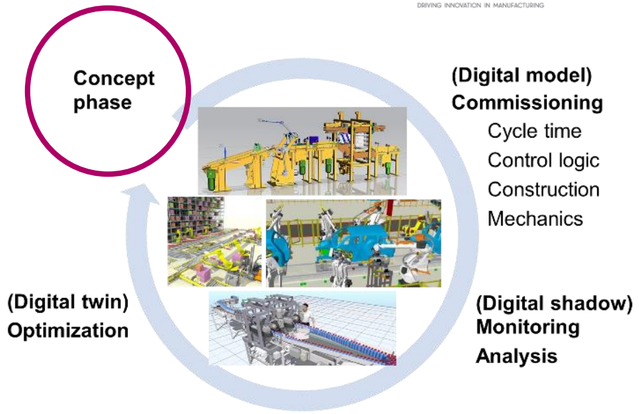
(Digital model)
Commissioning

- Cycle time
- Control logic
- Construction
- Mechanics

(Digital twin)
Optimization

(Digital shadow)
Monitoring
Analysis

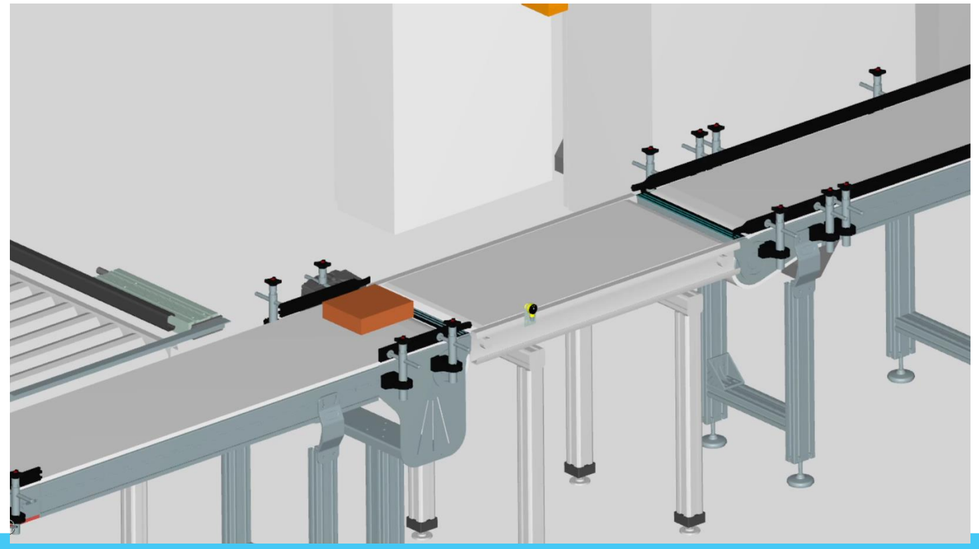
The digital twin lifecycle of a production system

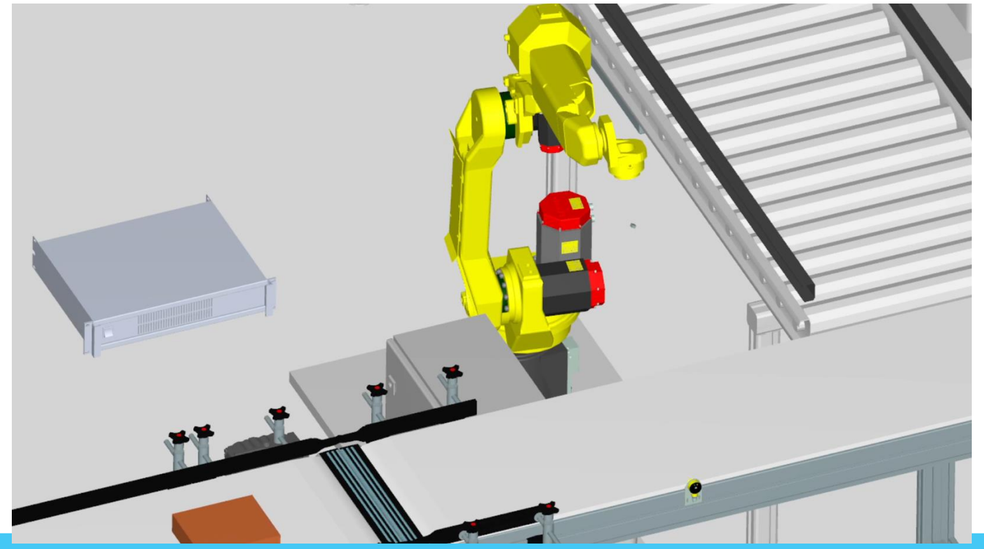


Demonstration 0 - Concept phase

Comparison of different concepts

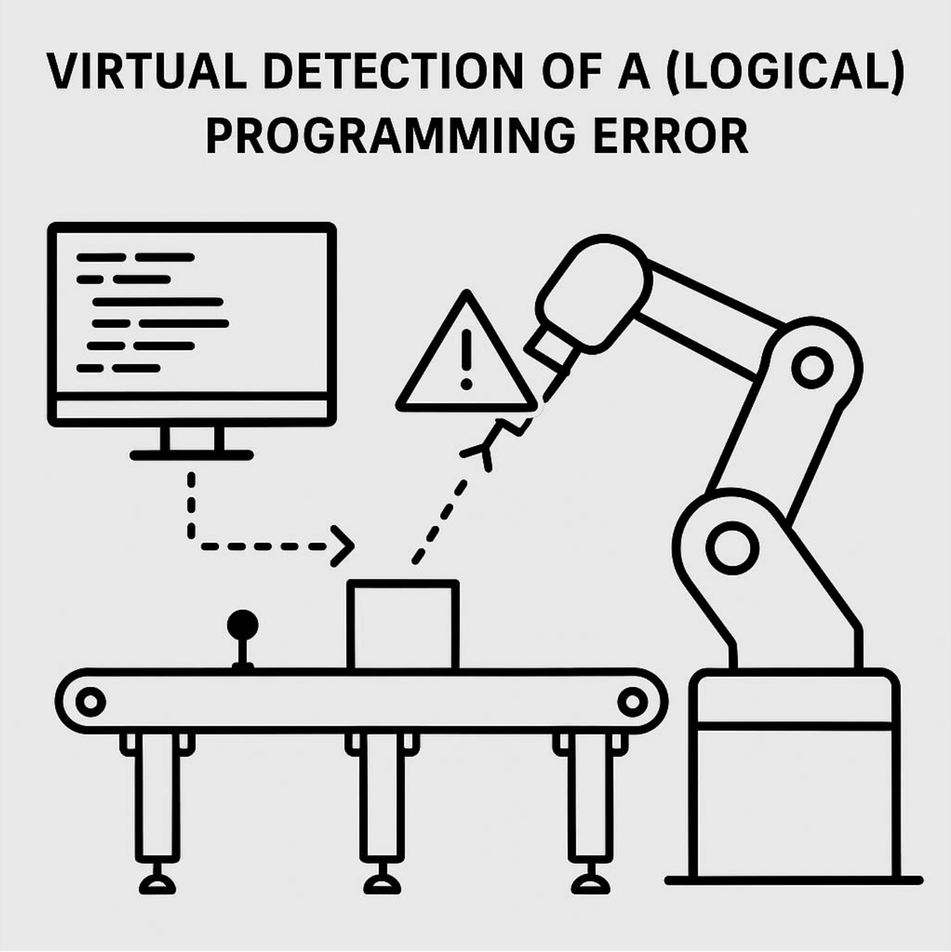
Cost | Cycle time | Accuracy | Etc.

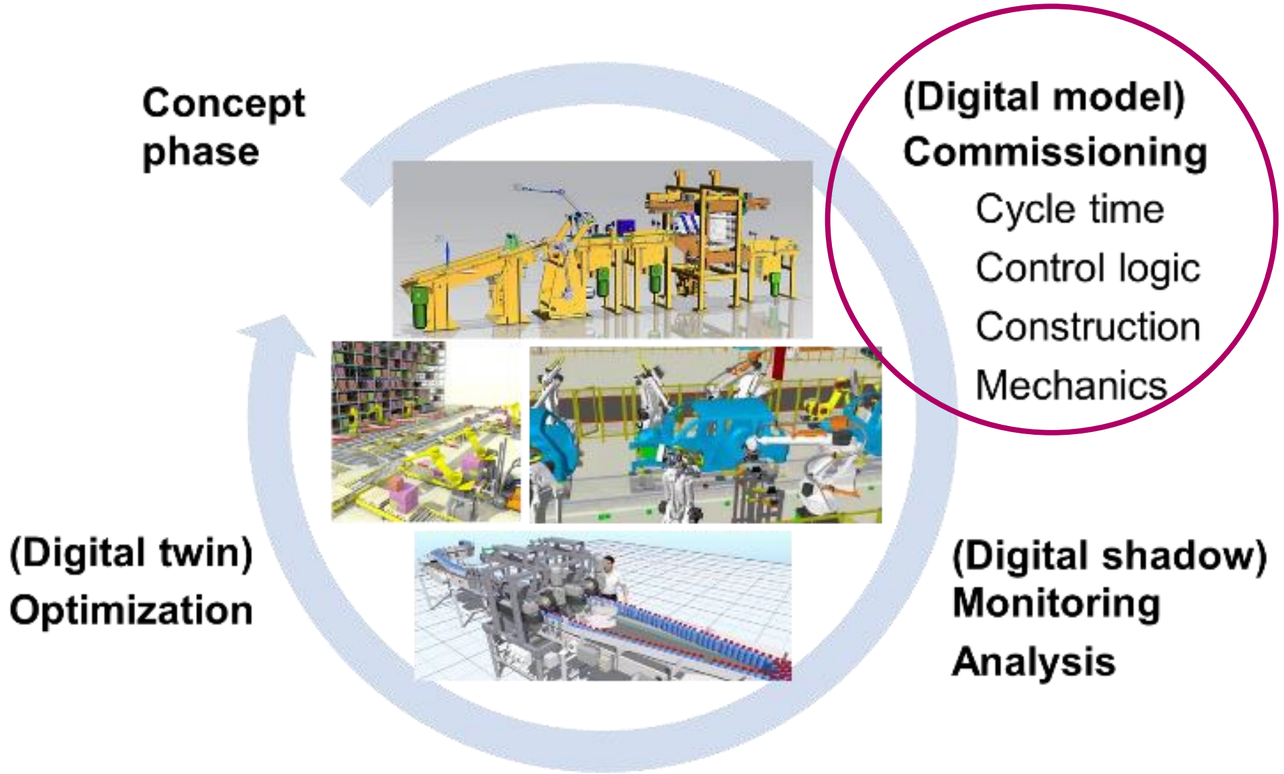




The digital twin lifecycle of a production system

Demonstration 1 - Digital model commissioning of industrial control systems

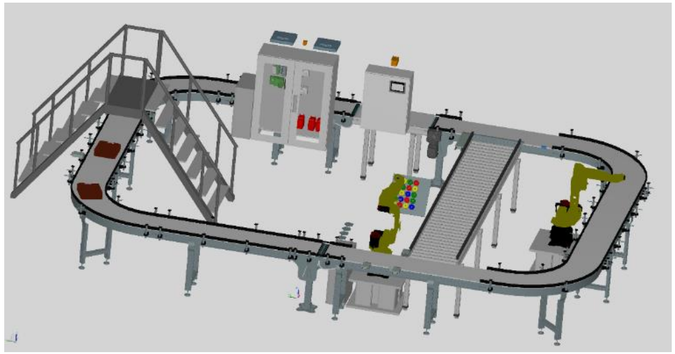


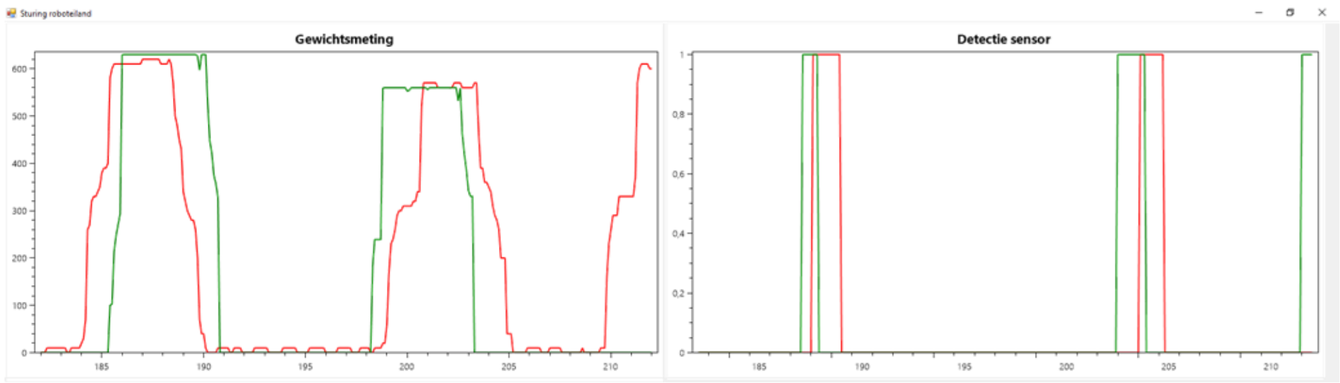


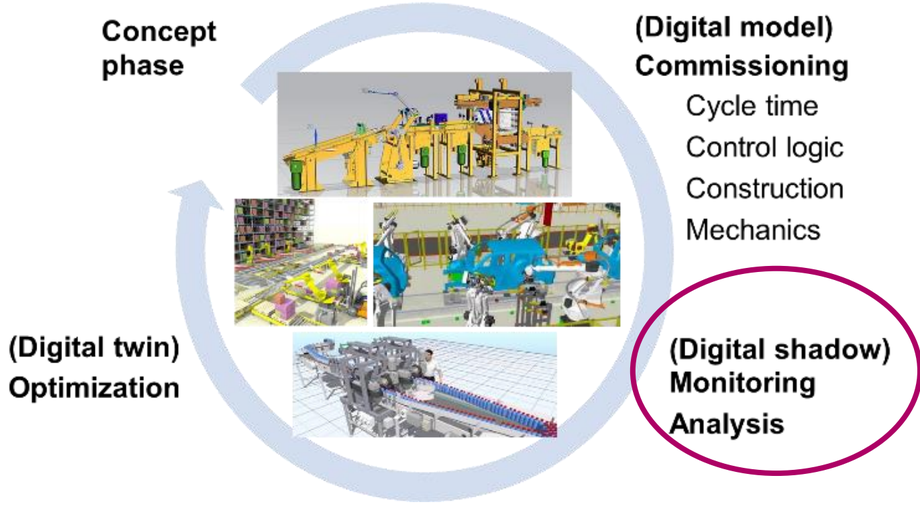
The digital twin lifecycle of a production system

Demonstration 2 - Realization of a digital shadow

Synchronisation between real and digital environment

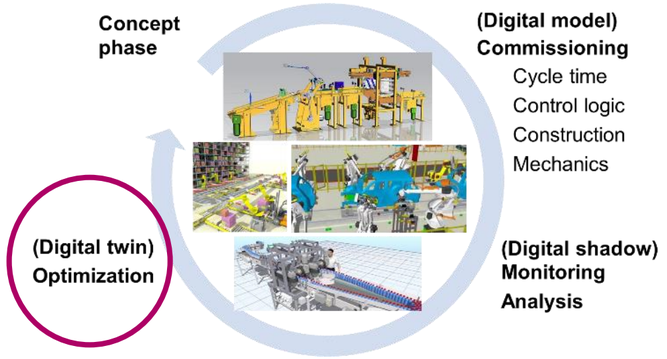




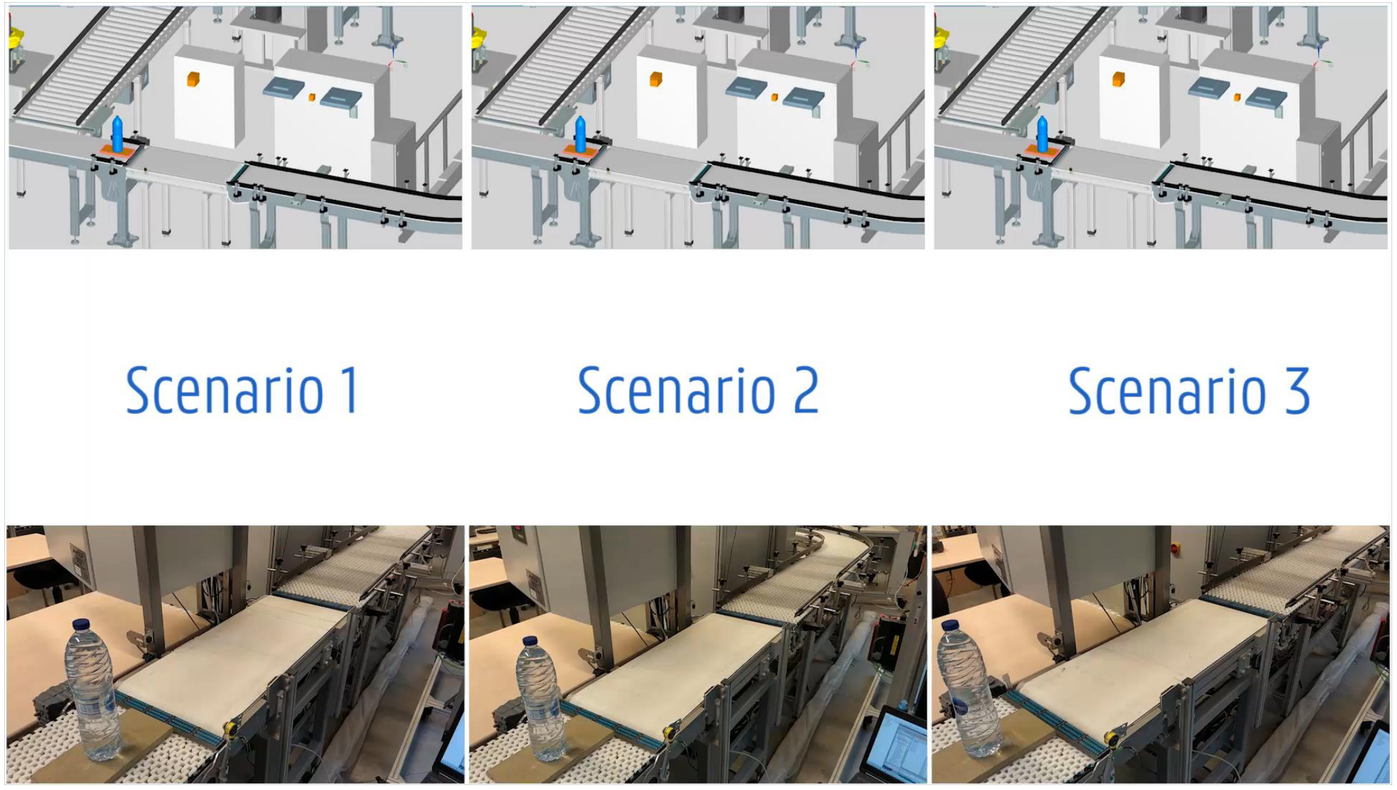


The digital twin lifecycle of a production system

Demonstration 3 - Step towards a digital twin

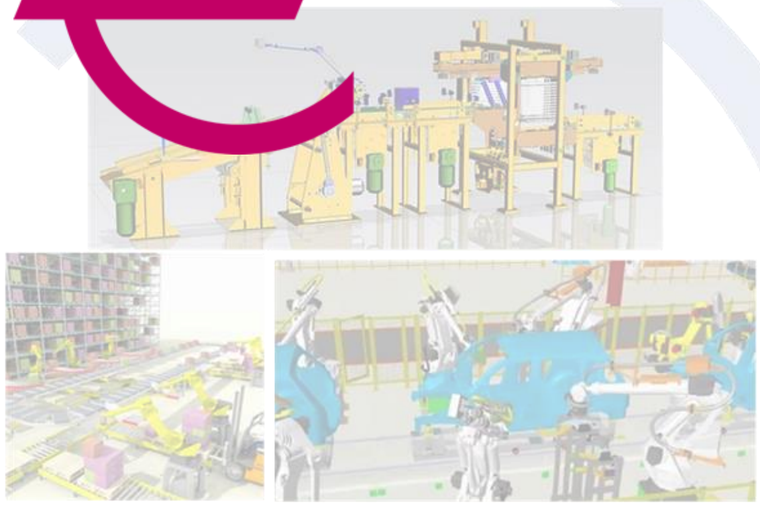


Virtual tuning of the control parameters



Cost-benefit analysis

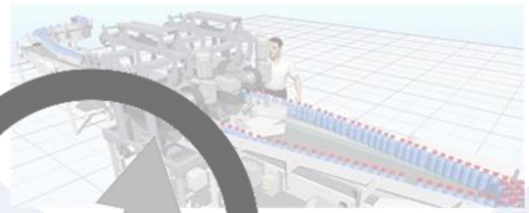
Concept phase



(Digital model)
Commissioning

- Cycle time
- Control logic
- Construction
- Mechanics

(Digital twin)
Optimization



(Digital shadow)
Monitoring
Analysis

AI enhances the intelligence of the digital twin,

The digital twin serves as a powerful, context-rich data source for **AI**

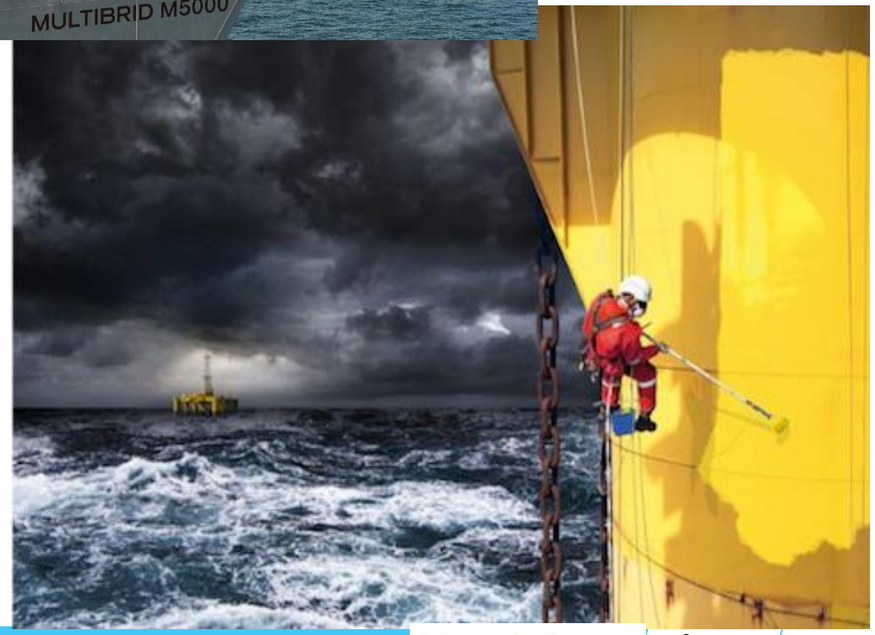
Anomaly detection:
Machine vibrates more than usual

Predictive Analytics:
Motor will fail after 40 operating hours

Smart dashboards:
Filtering irrelevant data via AI – dynamic adjustment

Reinforcement learning:
Robots learn to assemble autonomously (first virtually, then in reality)

Digital Twins in Offshore? Why?



Digital twins in offshore

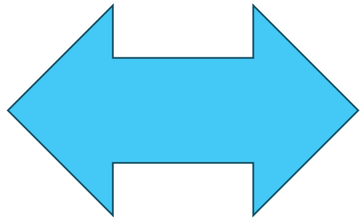
Aspect	Manufacturing	Offshore
ENVIRONMENT	Controllable (factory hall)	Extreme and unpredictable (sea, weather, corrosion)
SCALE	Machines & production lines	Large-scale infrastructure (wind farm, platform)
DATA	Mainly internal, repetitive	External (weather data, wave movements) + internal SCADA
OBJECTIVES	Efficiency & cost reduction	Safety, reliability & continuity
INTERVENTION	On-site maintenance is relatively easy	On-site maintenance is expensive, dangerous, time-consuming

Digital twins is offshore

Manufacturing industry

Focus on

- Efficiency
- Product quality
- Reducing human error
- Safety

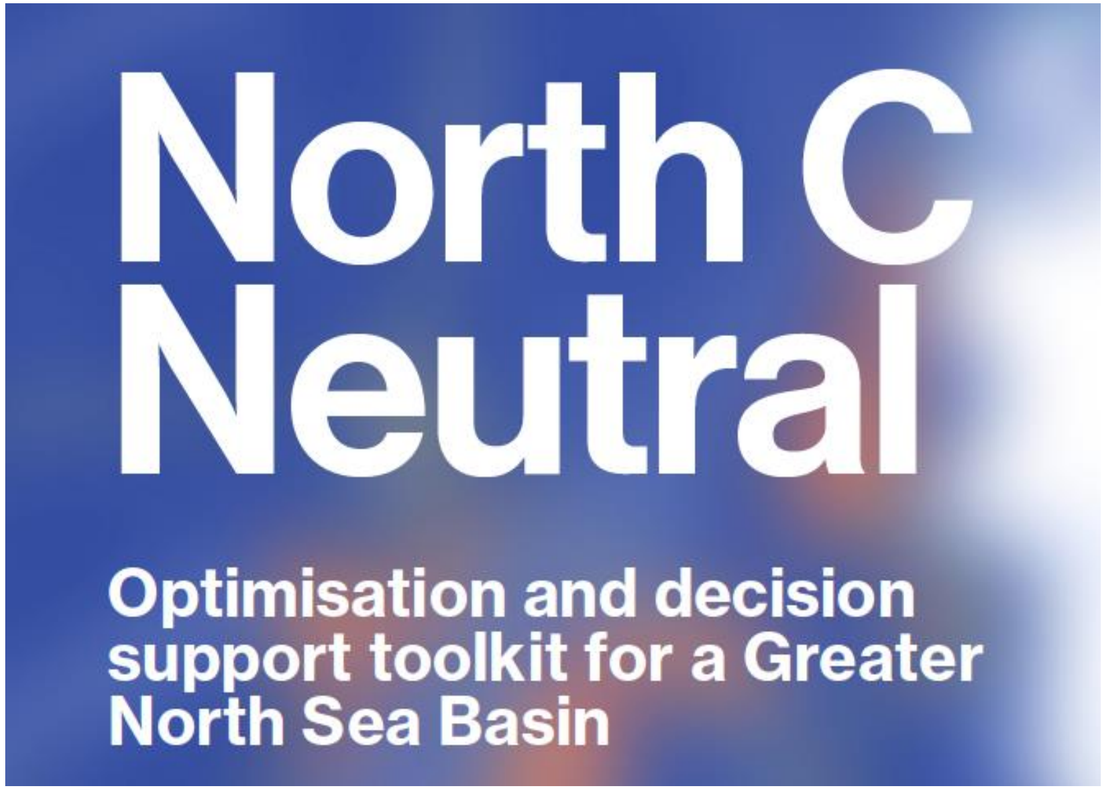


Offshore industry

Focus on

- Reliability (early anomaly detection, …)
- Maintenance optimization (predicitive servicing,…)
- Safety (storm prediction, …)
- Cost control (reduce downtime, extend component life….)

Marine Spatial Planning North Sea Basin



North C Neutral: Optimazation model for anyone managing (a portion of) the North Sea Basin

Offshore wind, grid infrastructure, ports, shipping, ecology, fisheries and other marine functions all compete for limited space.

By ORG Urbanism & Architecture BV

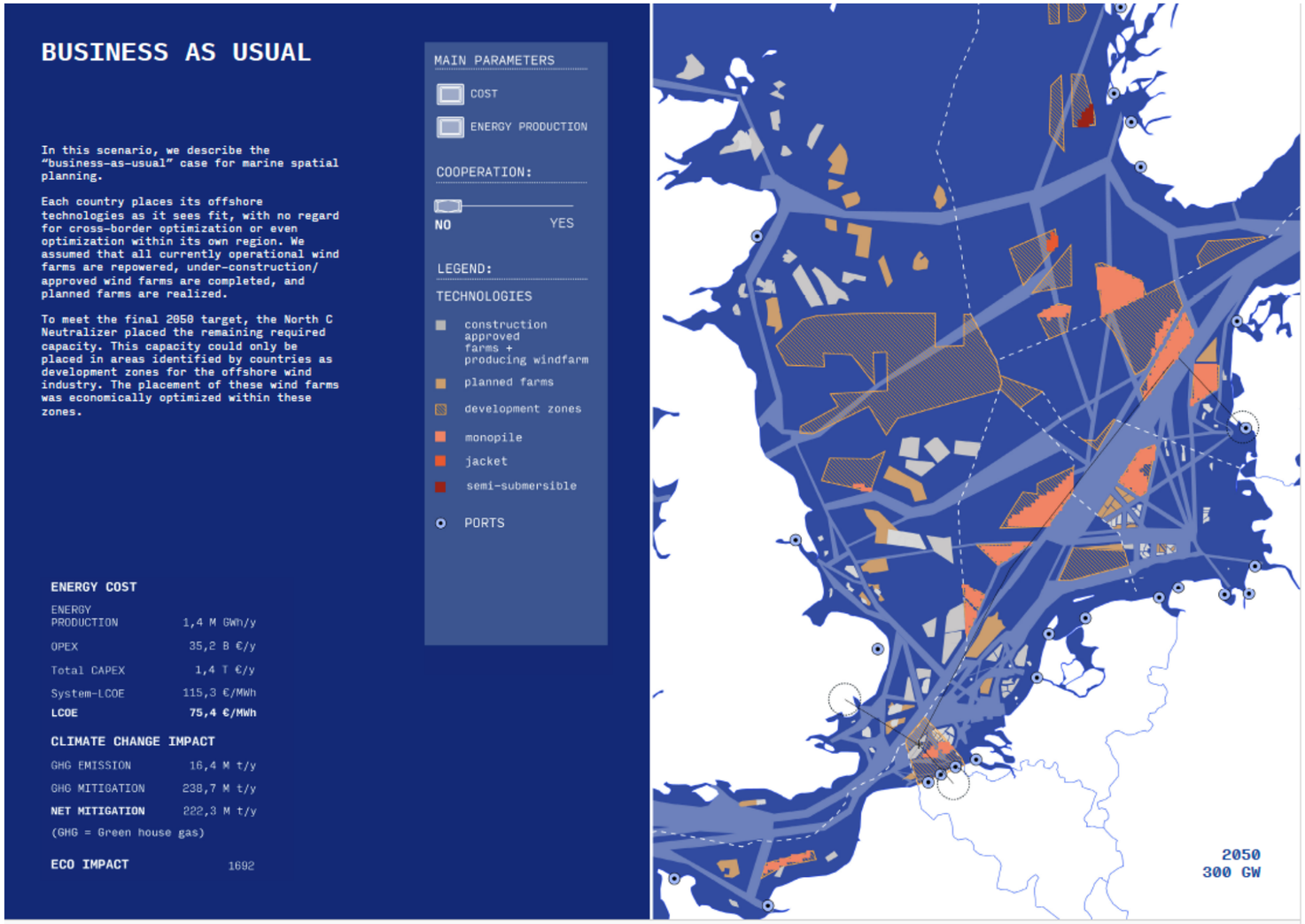
BLAUWE CLUSTER

THE REEF

POM West-Vlaanderen

ORG

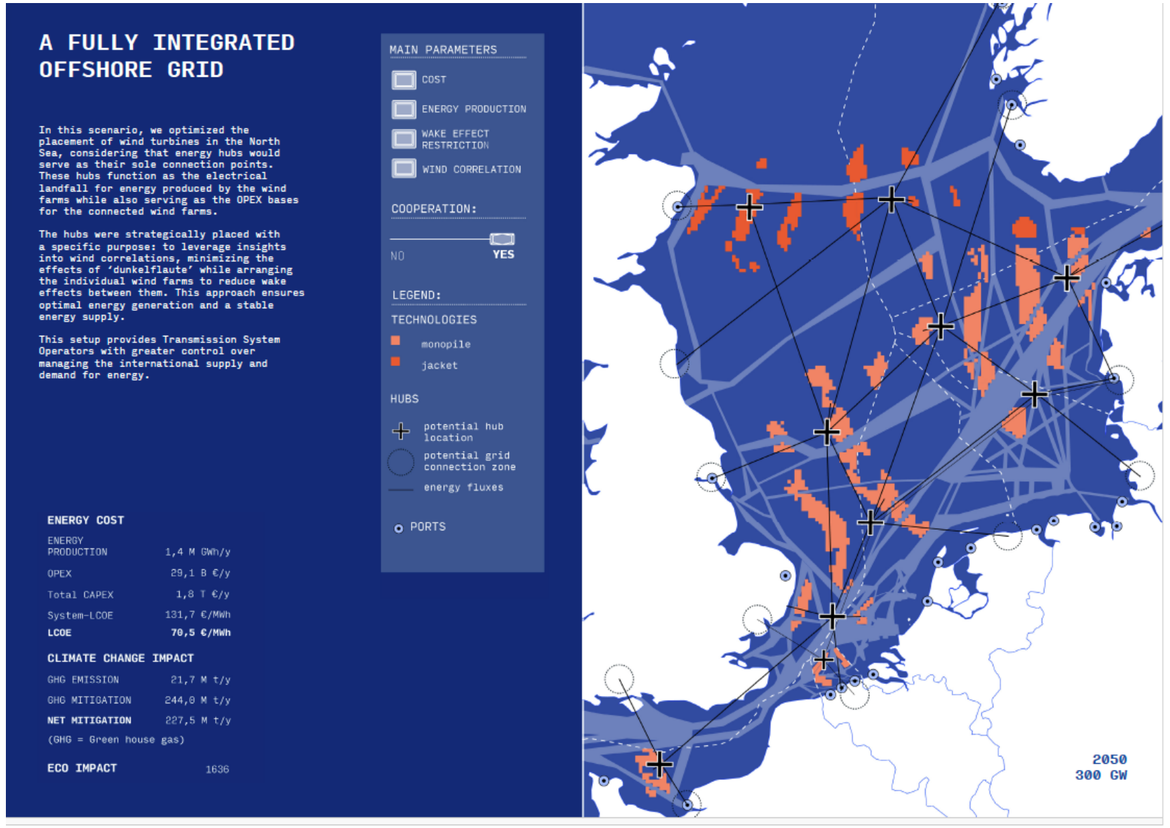
Baseline scenario for 2050 – 300 GW target



- Reference case for future comparison
- Limited cross-border coordination
- Cost-optimized within predefined national zones
- Reveals bottlenecks in space and grid infrastructure
- For Belgium, the main impact is on space, ports and grid connections

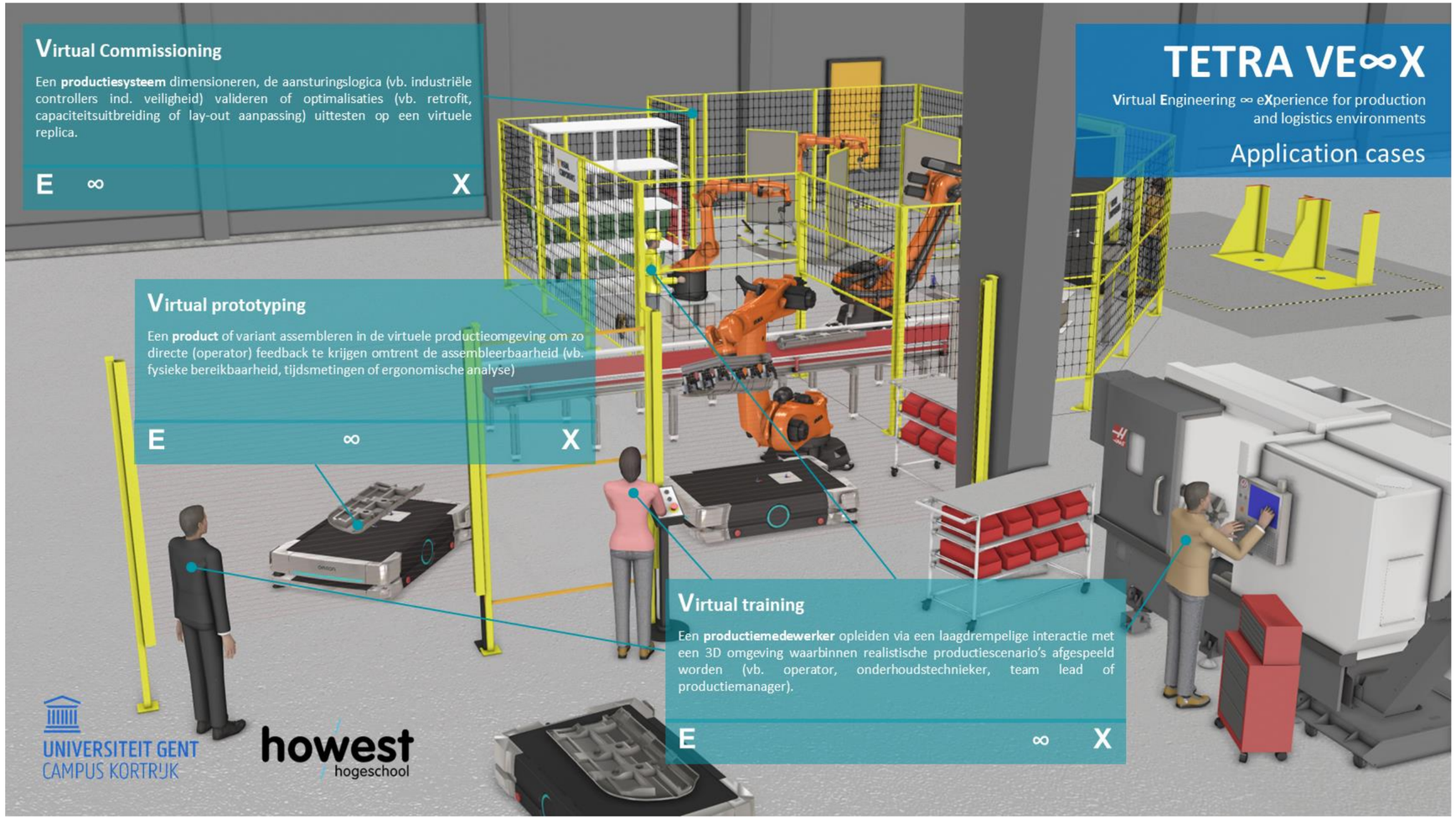
Fully integrated offshore grid

- Same energy output, different system design
- Integrated grid lowers OPEX
- Higher upfront CAPEX for hubs and grid infrastructure
- Lower LCOE, but higher System-LCOE
- Better net GHG mitigation and slightly lower eco impact



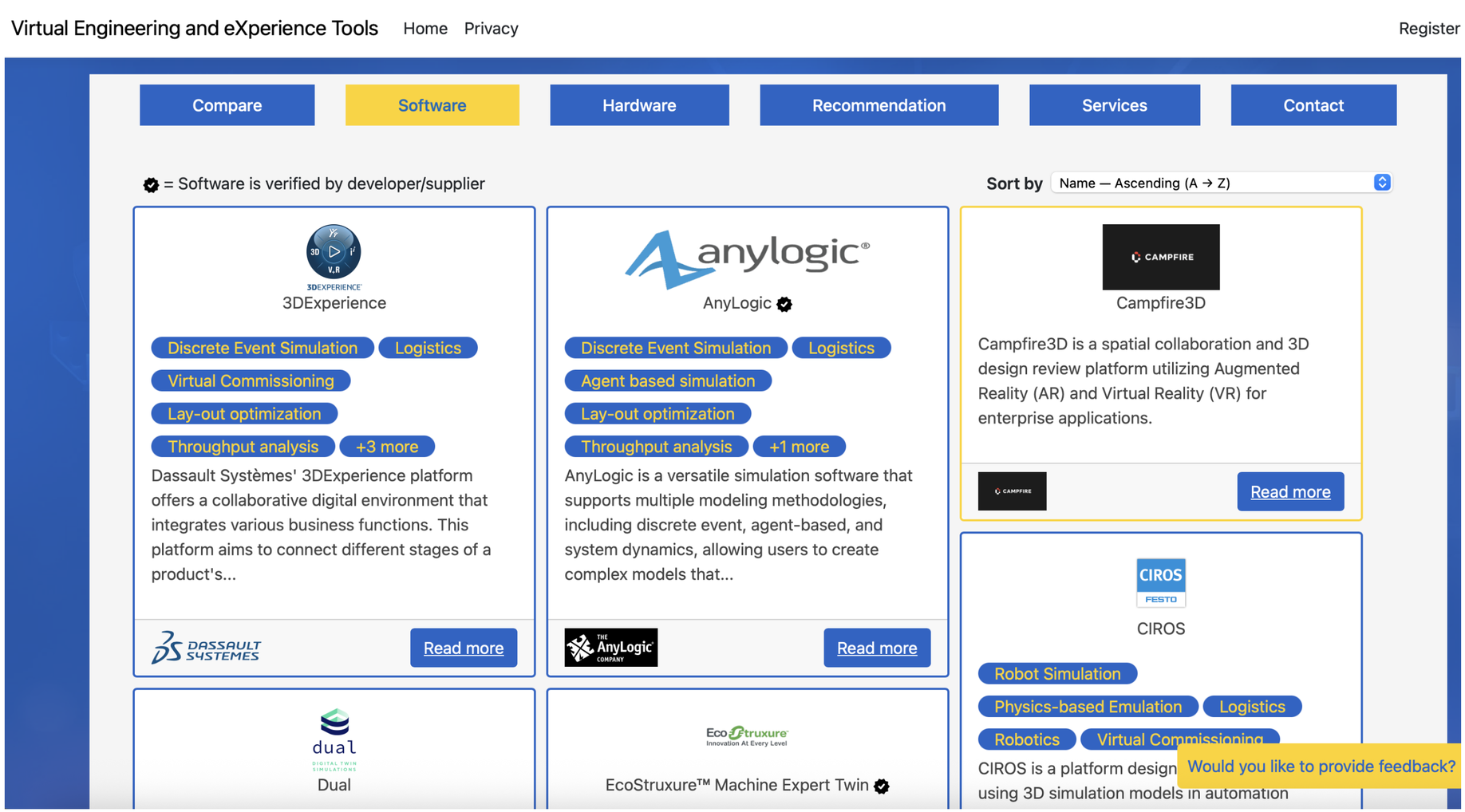
Virtual Engineering ∞ eXperience for production and logistics environments

TETRA VE∞X project



XRintelligence
Extended Reality

Virtual Commissioning

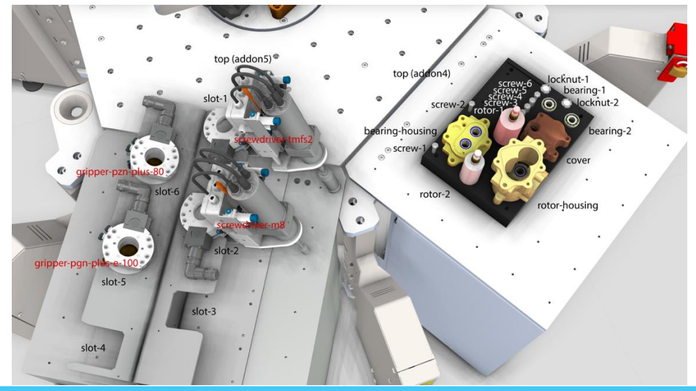


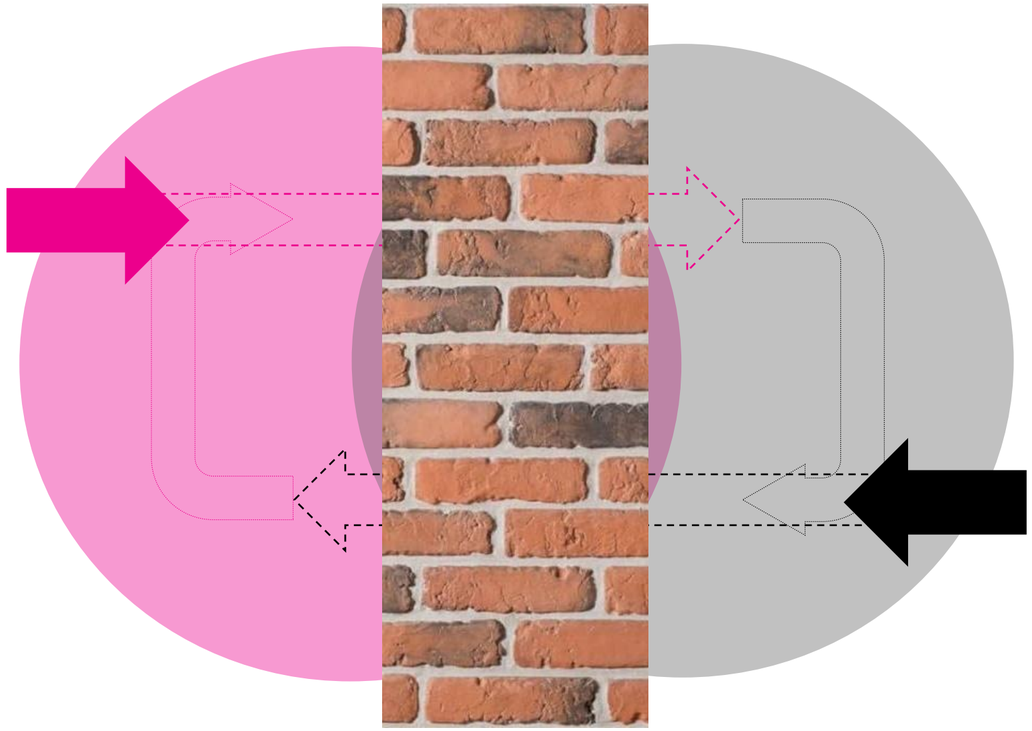
Virtual Engineering ∞ eXperience for production and logistics environments

Challenge

Virtual Engineering Platforms

Manufacturing scenarios strongly depend on human actions. Not only at normal operation, but certainly when things go wrong, the so-called **unhappy flow**.





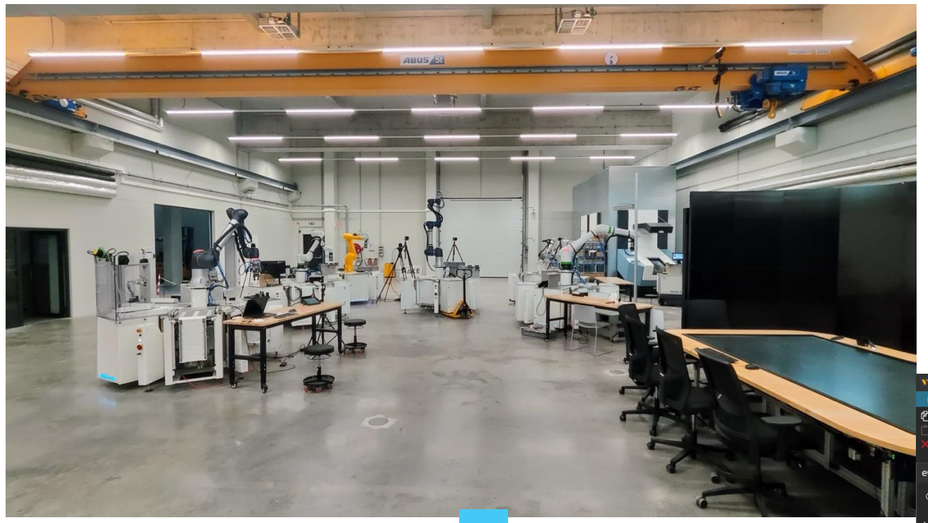
- Not easy to select an appropriate tool
- Labor intensive content creation and interaction
- Double work

Virtual Experience Platforms

User experience applications require a decent level of detail to validate and train **realistic manufacturing scenarios**.

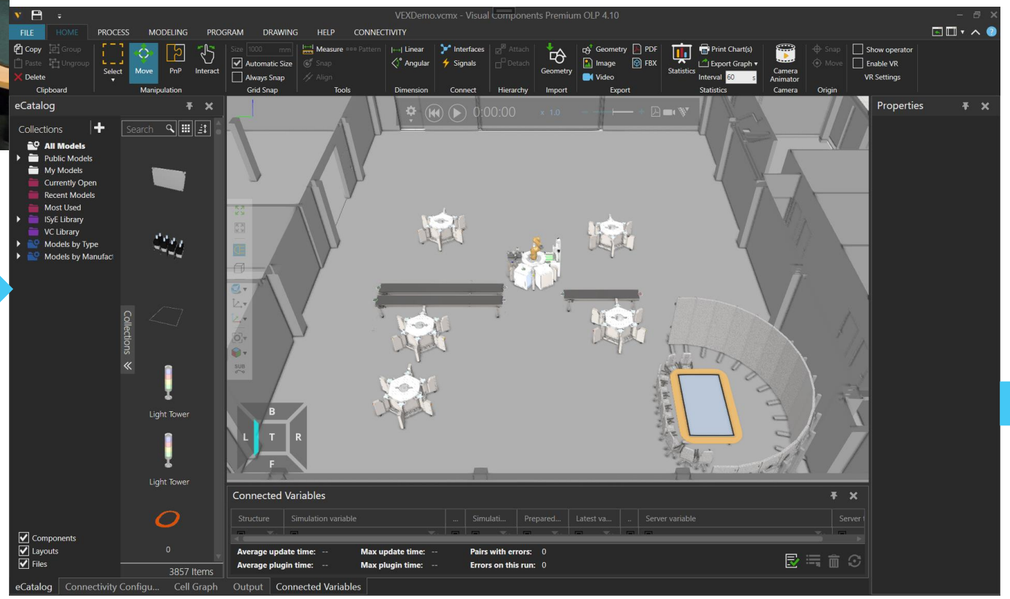
To XR or not to XR

VE∞X proof-of-concept scenario: Use case



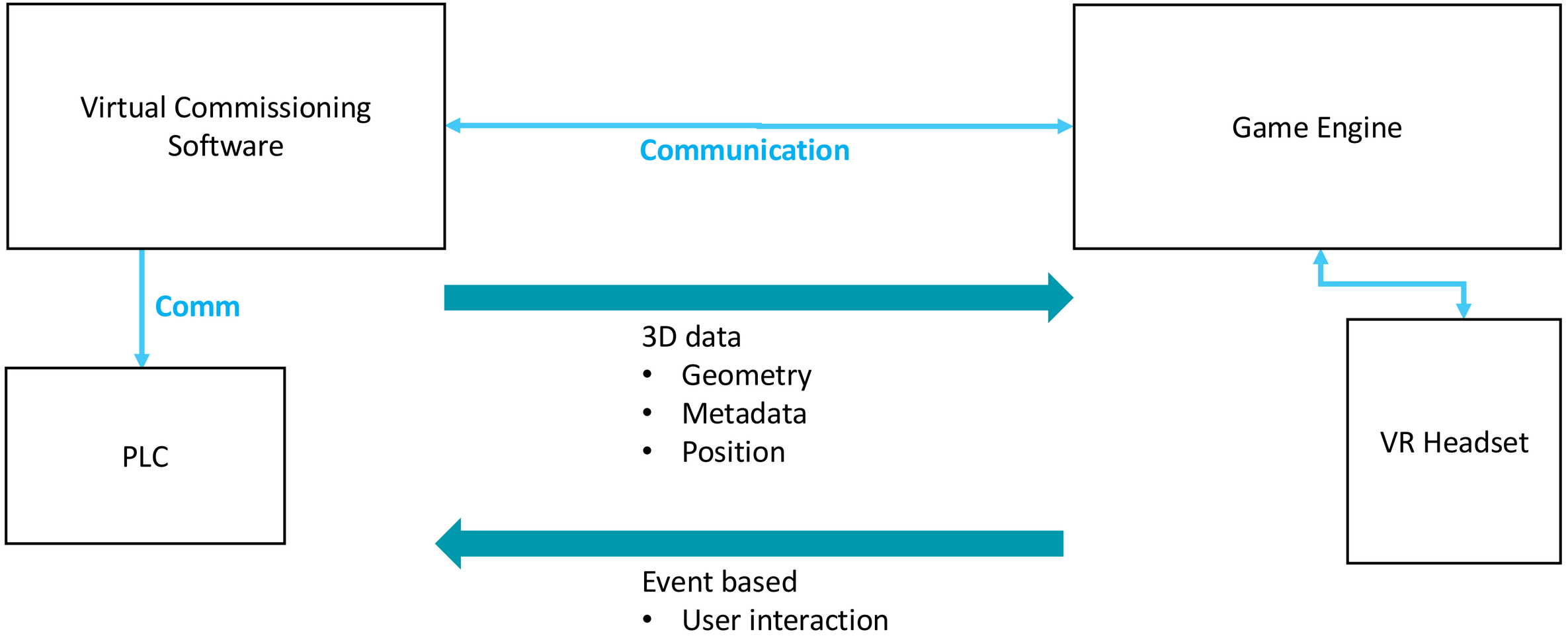
Flanders Make – InfraFlex Lab

Visual Components – VEXDemo



VR

VE∞X proof-of-concept scenario: General

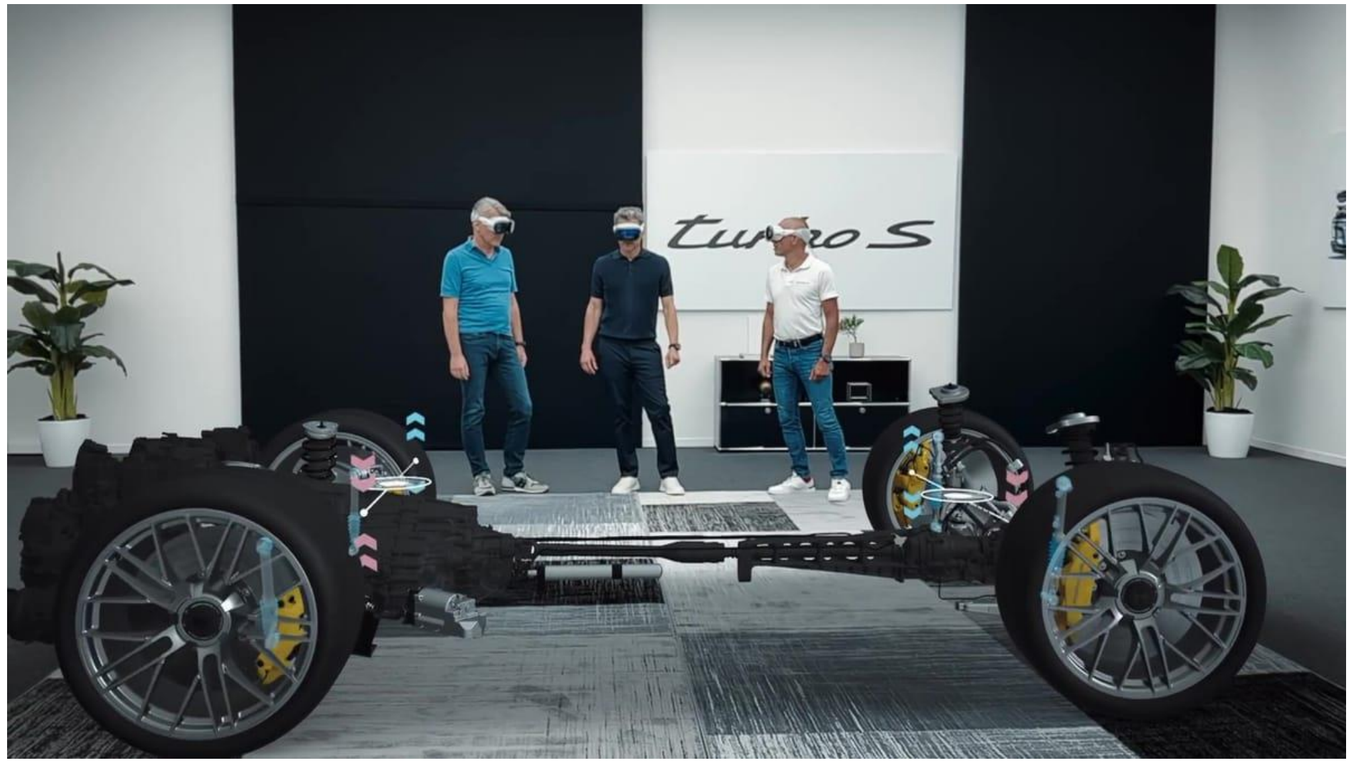


LYBOVER – XR for design where interactions with employees is relevant

Lybover is an industrial engineering company
that designs, builds, and installs customized process solutions for industry.

howest
university of applied sciences

XR can be valuable for sales, customer experience, product presentation, and stakeholder communication



howest university of applied sciences

howest
hogeschool

Let’s get in touch!

Charlotte.larmuseau@howest.be

Dr. Charlotte Larmuseau
https://www.linkedin.com/in/charlotte-larmuseau-3401b851/