Universität Stuttgart
Institut für Automatisierungstechnik und Softwaresysteme

Digitaler Zwilling in der Automatisierung

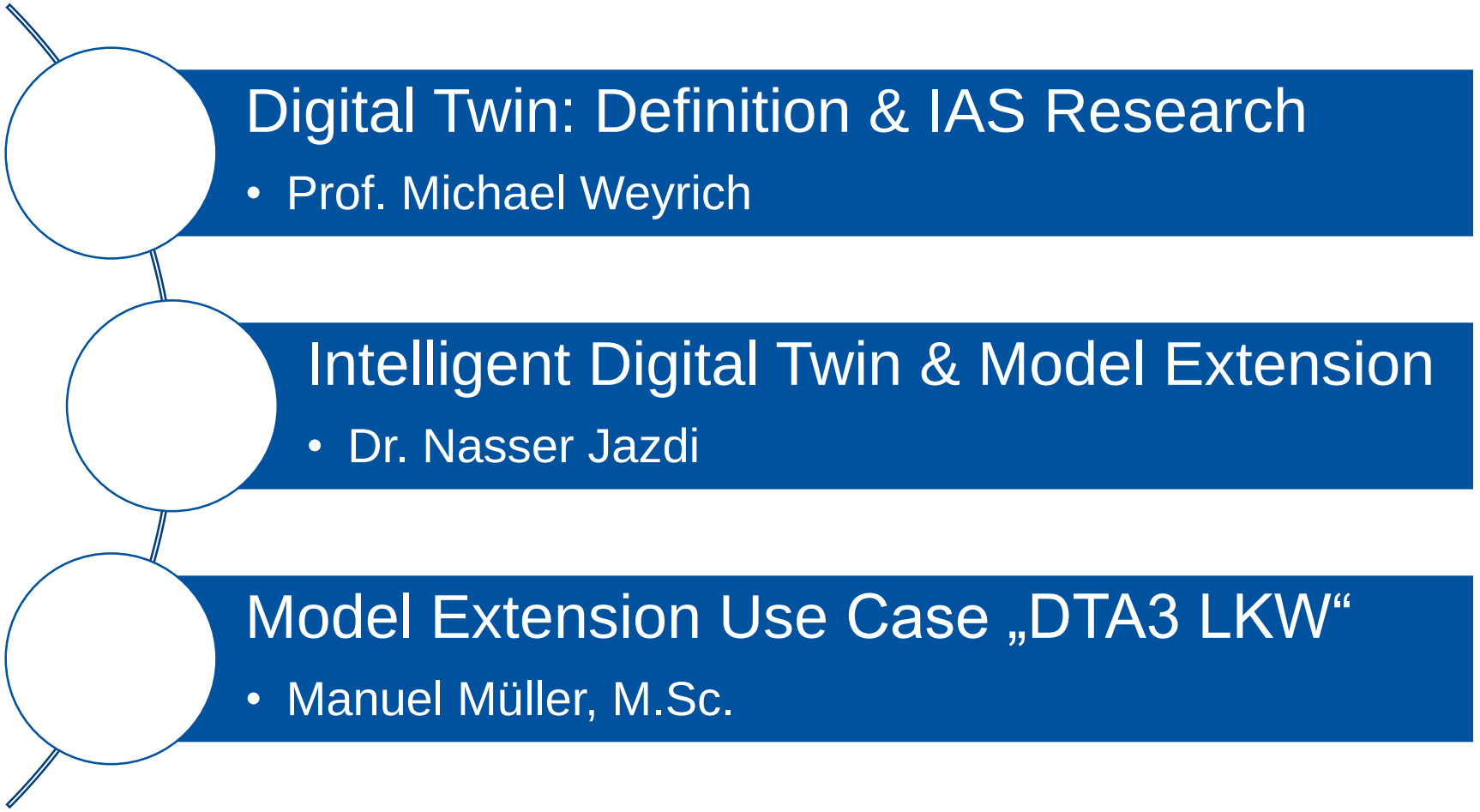
Modelle, Daten Akquisition und Synchronisierung

15.10.2021

TuLAUT

Agenda: Digitaler Zwilling in der Automatisierung

Modelle, Daten Akquisition und Synchronisierung

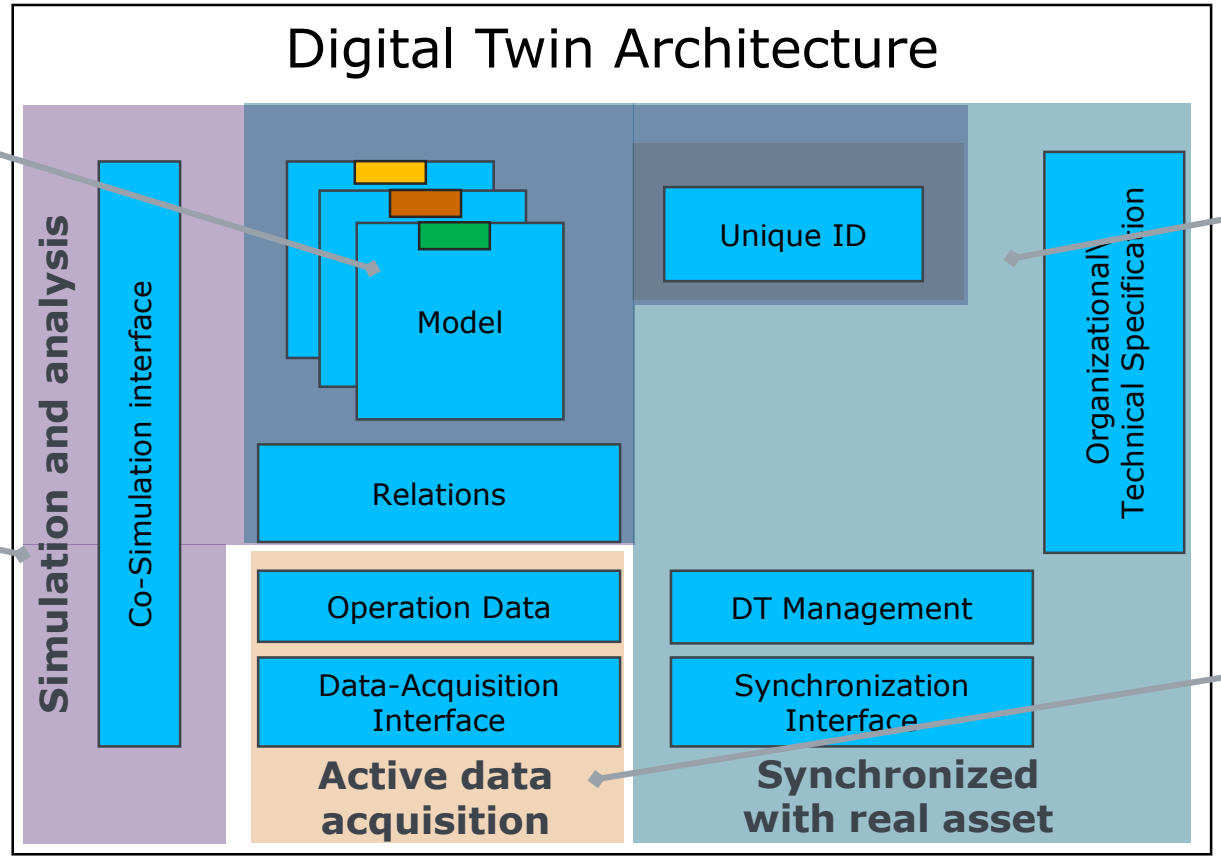


Digital Twin – more than Models and Software Services related to an Physical Asset

There are multiple Components and Functions inside a Digital Twin

Models: multidisciplinary integration of data and models

Simulation: using models for simulations



Synchronization of Data: mapping acquired data to existing models

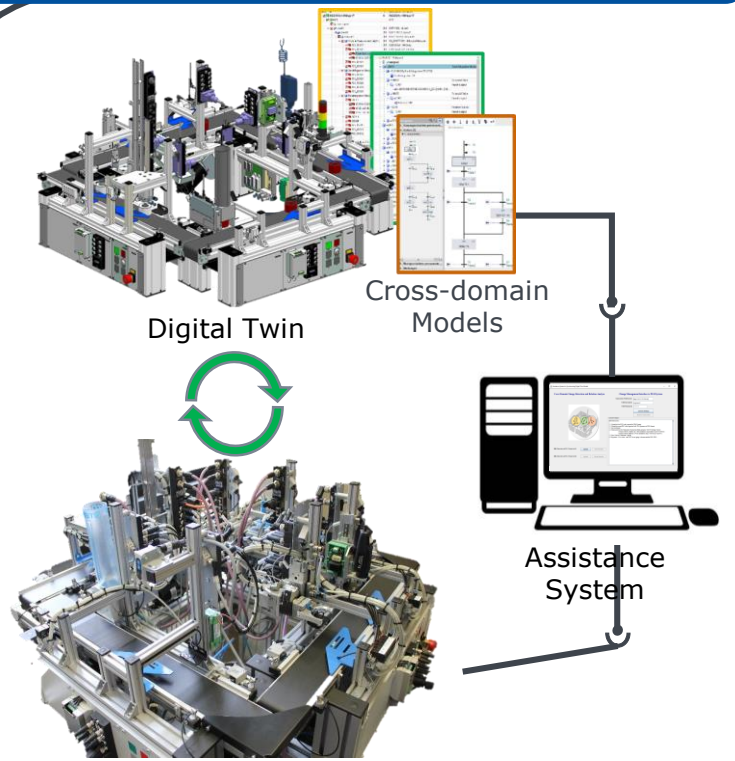
Data Acquisition: e.g. via sensors is necessary to update the Digital Twin with data from the physical asset

Source: Ashtari Talkhestani, B., Jung, T., Lindemann, B., Sahlab, N. Jazdi, N., Schloegl, W. and Michael Weyrich, An architecture of an Intelligent Digital Twin in a Cyber-Physical Production System. *at - Automatisierungstechnik*, 67(9), pp. 762-782. Retrieved 7 Oct. 2019, from doi:10.1515/auto-2019-0039

Research at IAS: Digital Twin of Mechatronic Manufactuing Cells

Model creation and synchronisation in Mechatronic Operation

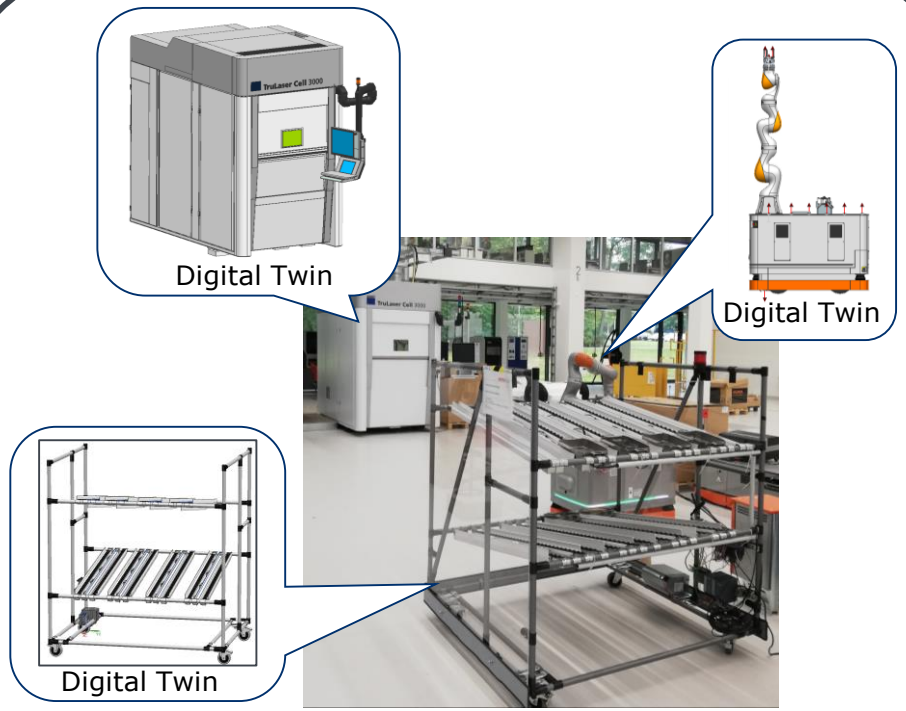
How can we synchronize between Physical Asset and Digital Twin?



An Assistance system for the synchronization of the digital twin

Source: Talkhestani, Behrang Ashtari, et al. "Consistency check to synchronize the Digital Twin of manufacturing automation based on anchor points." *Procedia Cirp* 72 (2018): 159-164.

How can we automate the generation of digitalize Brownfield Systems?



Automatic generation of the digital twin model-structure and relation

Source: D. Braun, W. Schloegl, M. Weyrich, "Automated data-driven creation of the Digital Twin of a brownfield plant," 2021 26th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), 2021 (in press)

Research at IAS: Digital Twin of large Manufacturing Systems

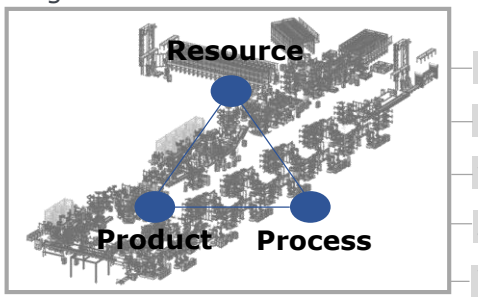
Model synchronization and re-design in large discrete production systems (Cooperation: Daimler and Schmalz)

How can a Digital Twin support the re-planning in Automotive?

Automotive Body

Digital representation and identification of changes

Product integration and optimization of production



Content

- Bill of Resources
- Station sequence
- Vehicle models and variants
- Joining points
- Vehicle parts

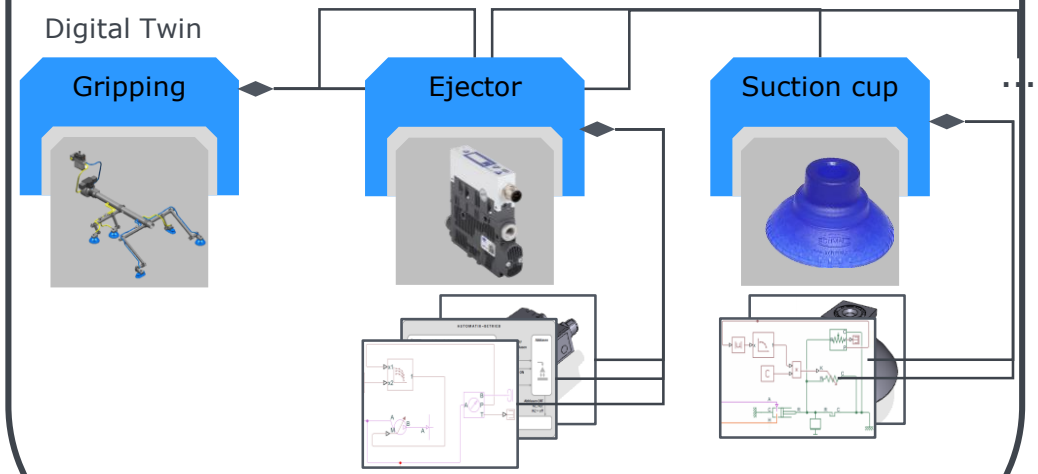
Digital twin for integration planning

Creating model and data quality for (re-)planning

Source: Biesinger, Florian, et al. "A digital twin for production planning based on cyber-physical systems: A Case Study for a Cyber-Physical System-Based Creation of a Digital Twin." *Procedia CIRP* 79 (2019): 355-360.

How can the Digital Twin be used in Planning with varying depths?

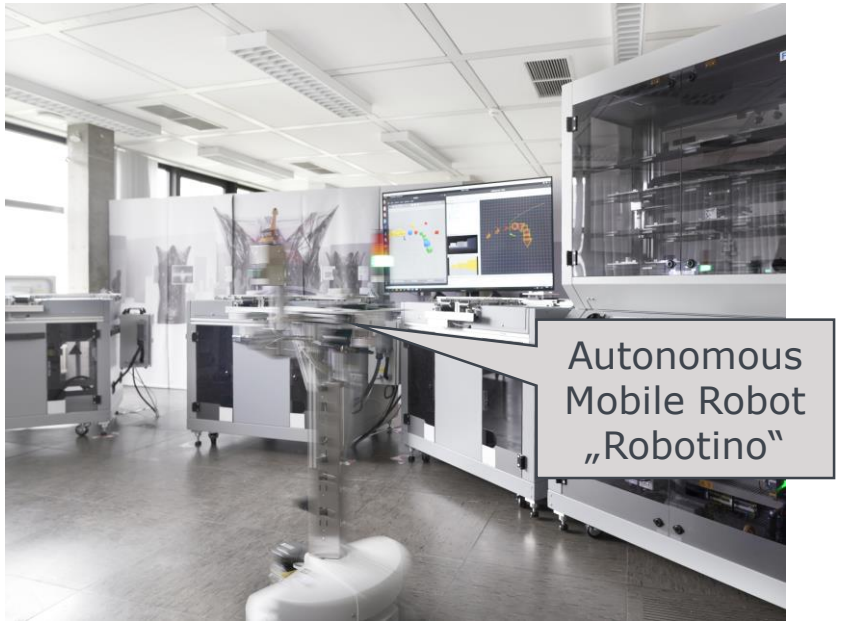
Asset: Vacuum Gripping System



(Re-)design of vacuum-gripping systems

Research at IAS: Digital Twin of Modular Systems

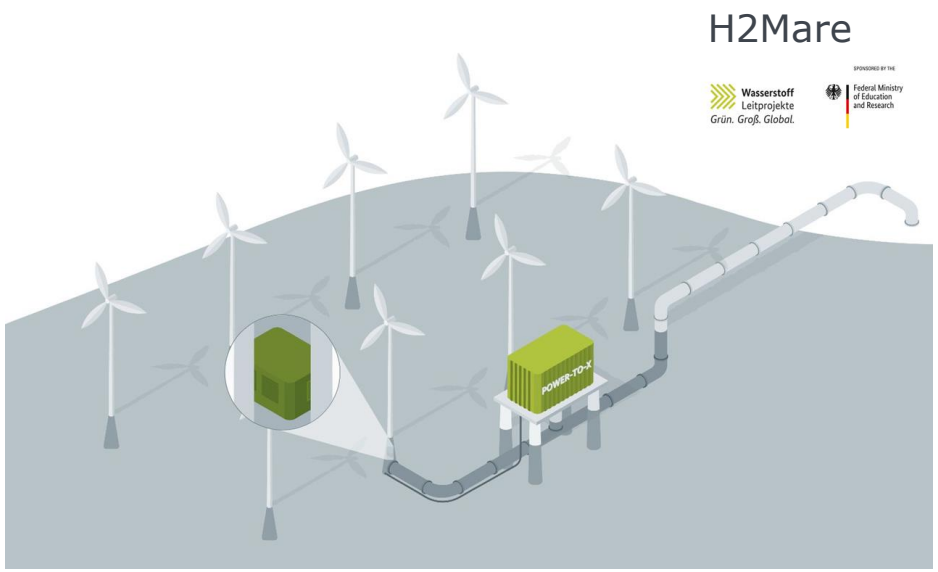
How can we create trust in autonomous robots safety?



Digital Twin of mobile robots in- and outdoors including navigation and interaction aspects

Source: Löcklin, A., Ruppert, T., Jakab, L., Libert, R., Jazdi, N., & Weyrich, M. (2020, September). Trajectory Prediction of Humans in Factories and Warehouses with Real-Time Locating Systems. In *2020 25th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA)* (Vol. 1, pp. 1317-1320). IEEE.

How obtain modularity for Offshore Power-to-X Prozesse?”

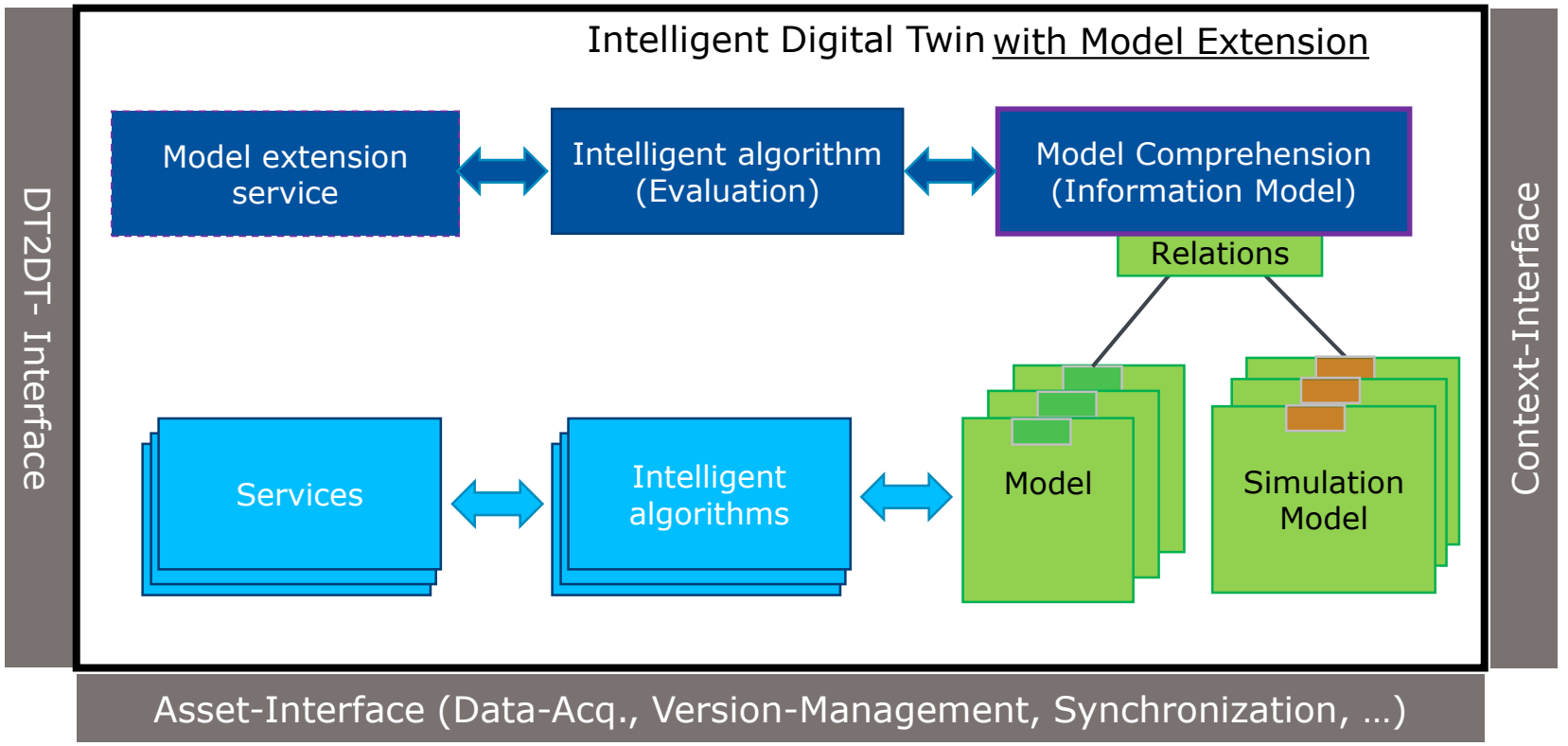


Development of a realistic and flexible Digital Twin over the life cycle

Source: https://www.uni-stuttgart.de/universitaet/aktuelles/meldungen/Nachhaltige-Wasserstoffgewinnung-auf-hoher-See/

Architecture and Components of the Intelligent Digital Twin with Model Extension

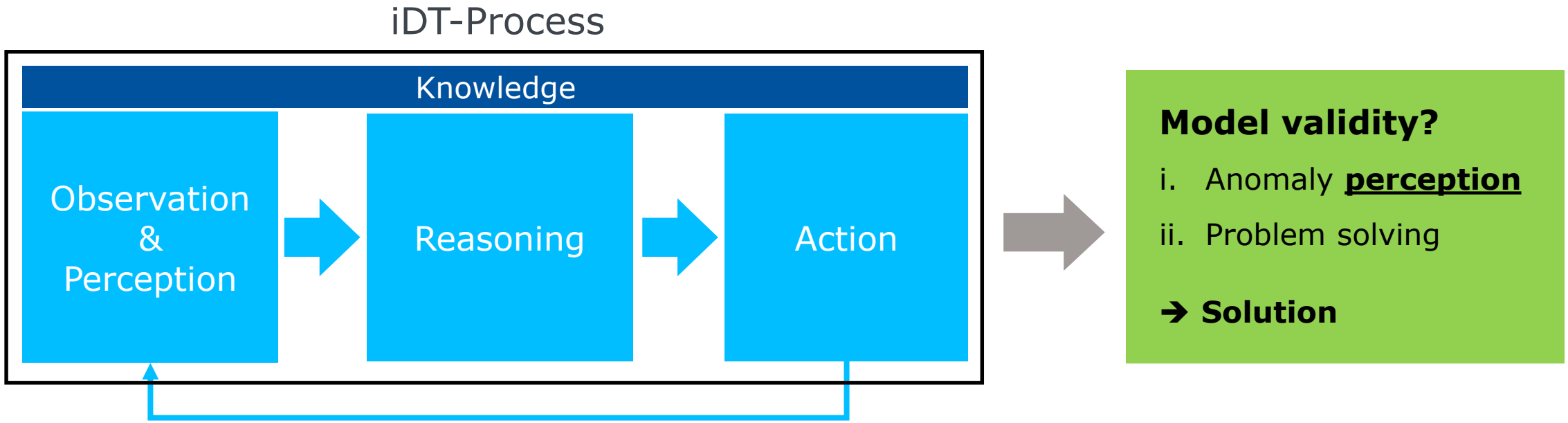
What happens if the environment of the DT or the requirements change?



➔ How does model extension work?

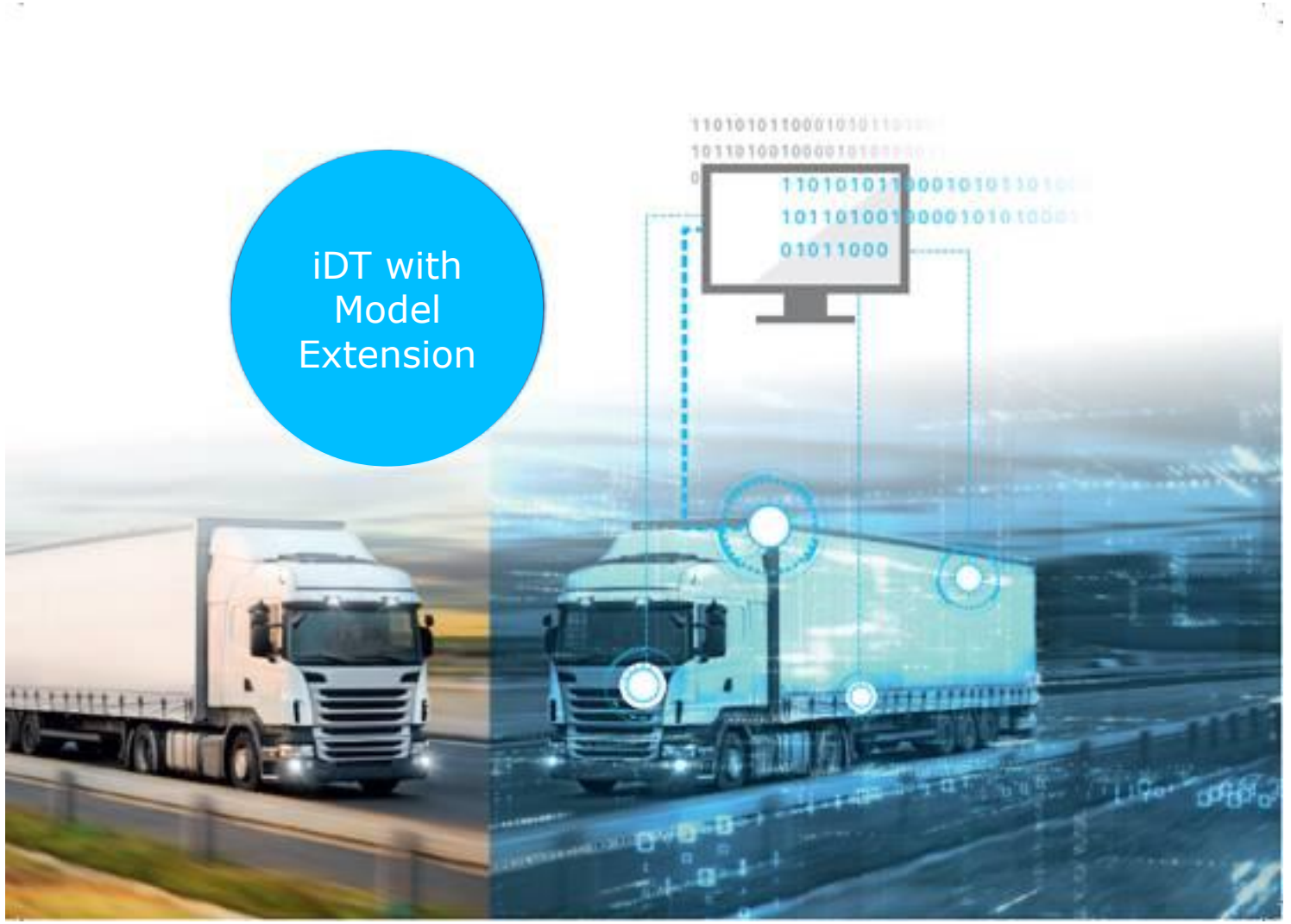
How can models realize that they have lost their validity?

- Detection of changes inside and outside of the DT
- Analysis of changes
- Generating own solution



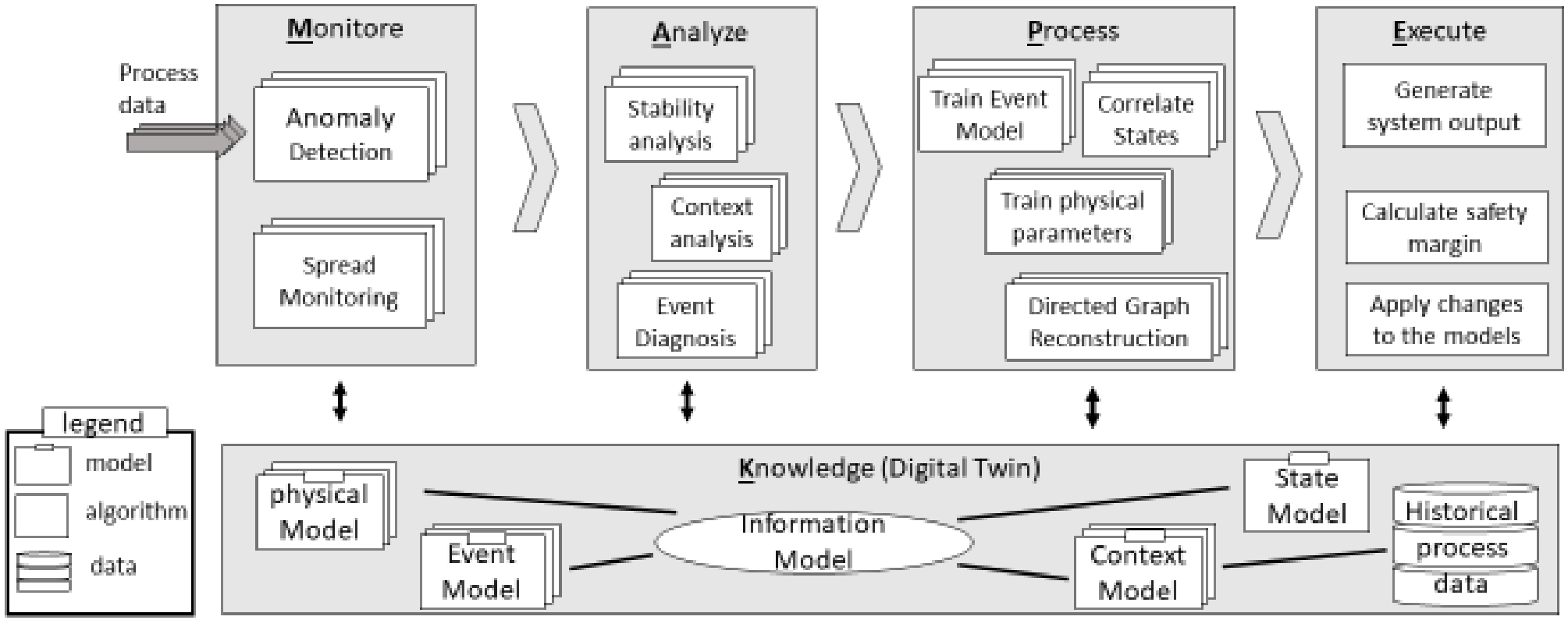
How can models realize that they have lost their validity? Application

- Truck for transport of juices in Scandinavia
- Deployment in Southern Europe
- Loss of quality with the same DT
- Detection of missing accelerometer
- Own solution: soft sensor



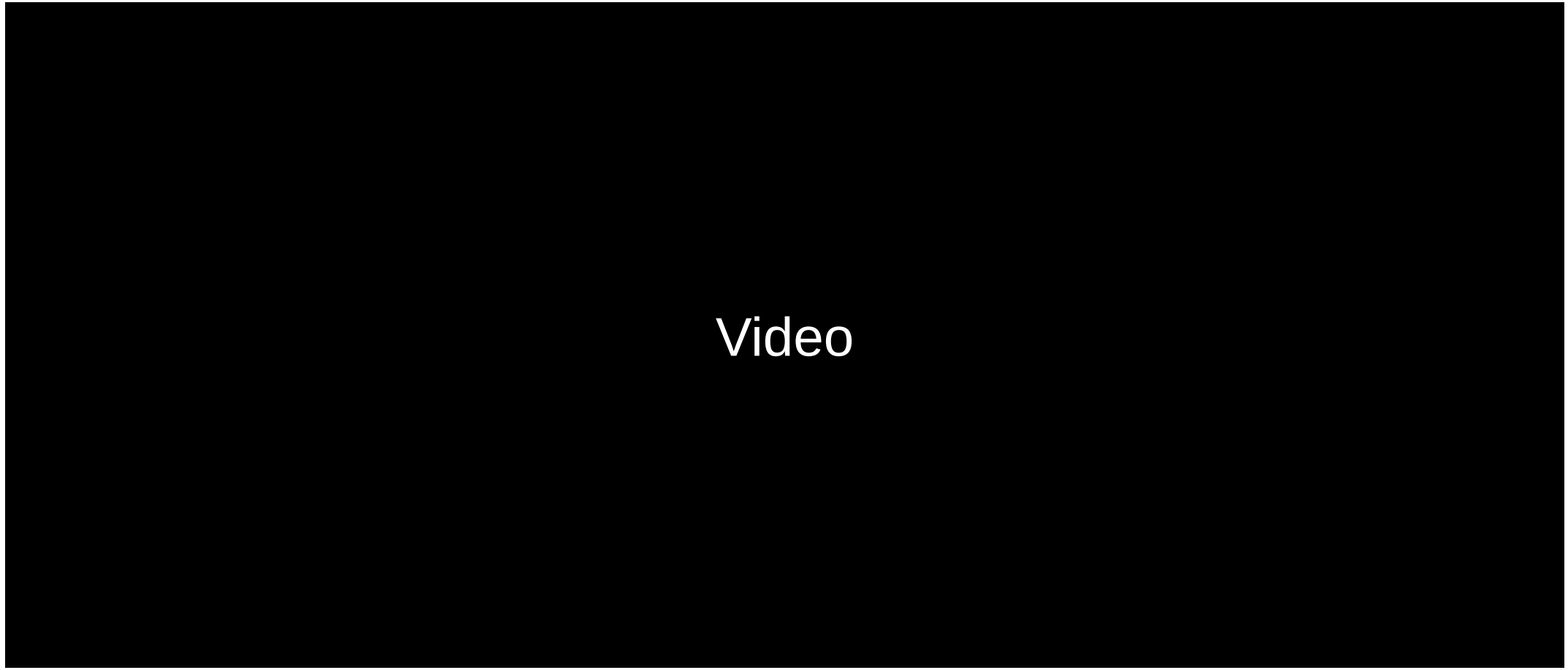
How can a model extend its boundaries?

Architecture for intelligent model extension



Source: **Manuel Müller*, Andreas Löcklin*, Nasser Jazdi*, Lennard Hettich*, Michael Weyrich*:** *Adaptive Models for Safe Maintenance Planning of Cyber-physical Systems.* In: CIRP ICME, 2021 (Accepted)

Presentation of the logistics scenario



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Vielen Dank!

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