Member of

SCIO AUTOMATION

SIMULATION & DIGITAL TWIN IN TEST WAFER MANAGEMENT

Dr.-Ing. Karl-Benedikt Reith

AIMS 5.0

FABMATiCS

AGENDA

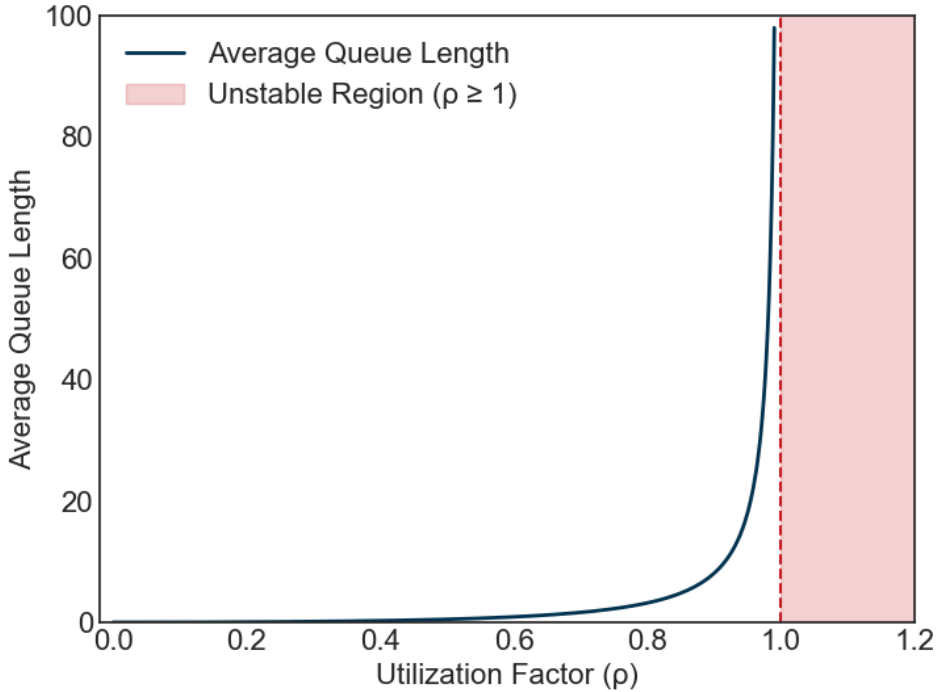
1. Motivation
2. Three Levels of Analysis
3. Material Flow Simulation
4. Digital Twin
5. Use Case: Test Wafer Center

WHY SYSTEM ANALYSIS IS CRUCIAL

Complex real-world processes often behave unexpectedly!

Analysis allows for:

- understanding system dynamics
- preventing instability
- optimizing resource allocation
- quantifying trade-offs
- support strategic decision-making



Minimal Example: Average queue length in front of a single service station (M/M/1).

LEVELS OF ANALYSIS

How to assess general solutions or specific details of a solution?

Level 1:
Analytical Approaches

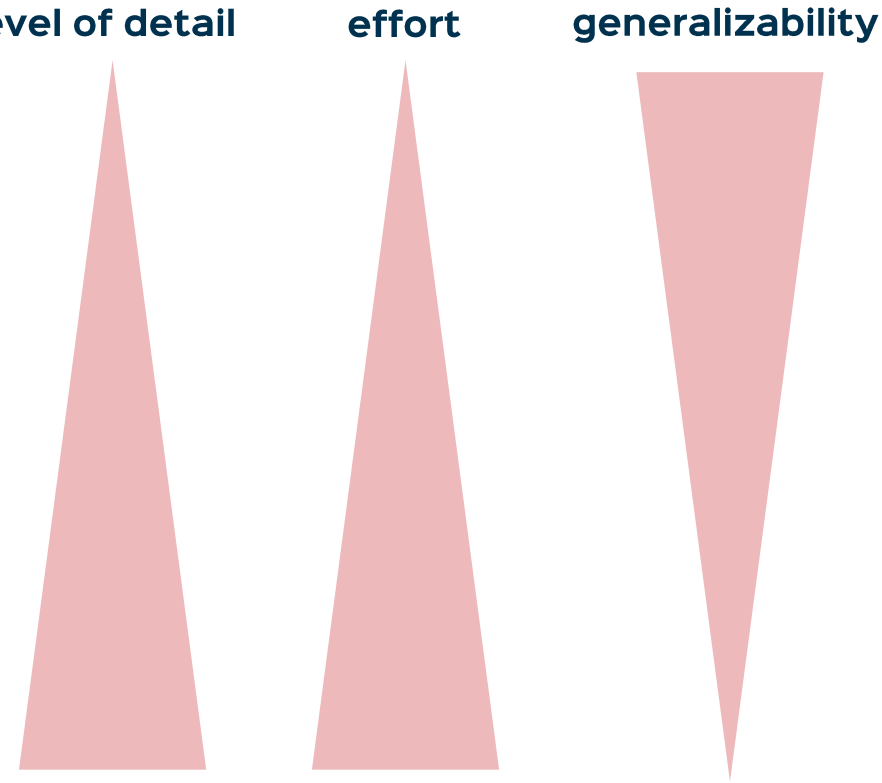
"quick & rough estimations"

Level 2:
Material Flow Simulation

"for complex environments"

Level 3:
Digital Twins

"include real-world software/hardware"



OBJECTIVES IN TEST WAFER MANAGEMENT

Objectives: The TW Management…

- provides a sufficient test wafer supply
- guarantees high tool uptimes
- is robust to different product patterns
- is well arranged & organized
- has a smooth startup
- can adapt to future changes
- is economically justifiable

Material Flow Simulation

→ Are TW built as needed?

→ Do TW reach tools in time?

→ Do TW always reach tools in time?

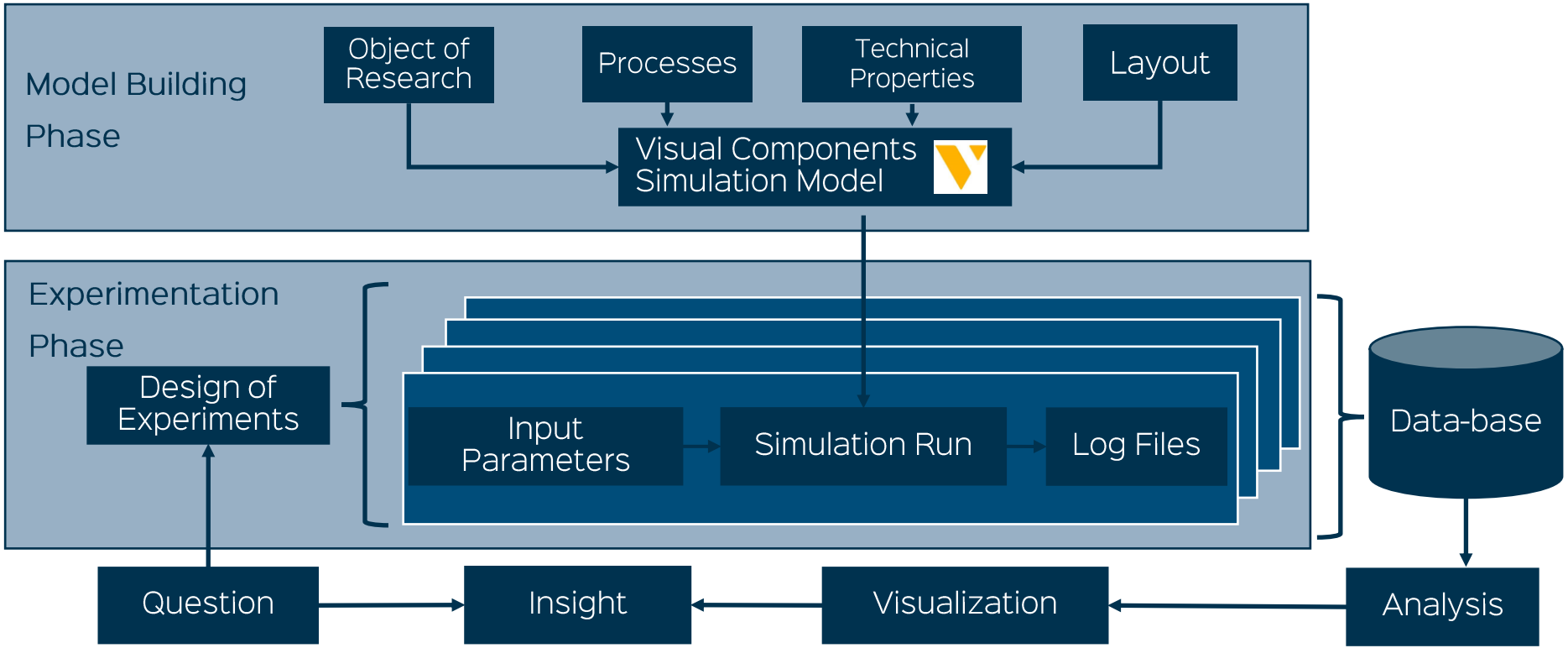
→ How much sorting & storage capacity do we need?

→ Can it be quickly integrated into the MES?

→ How flexible is my hardware?

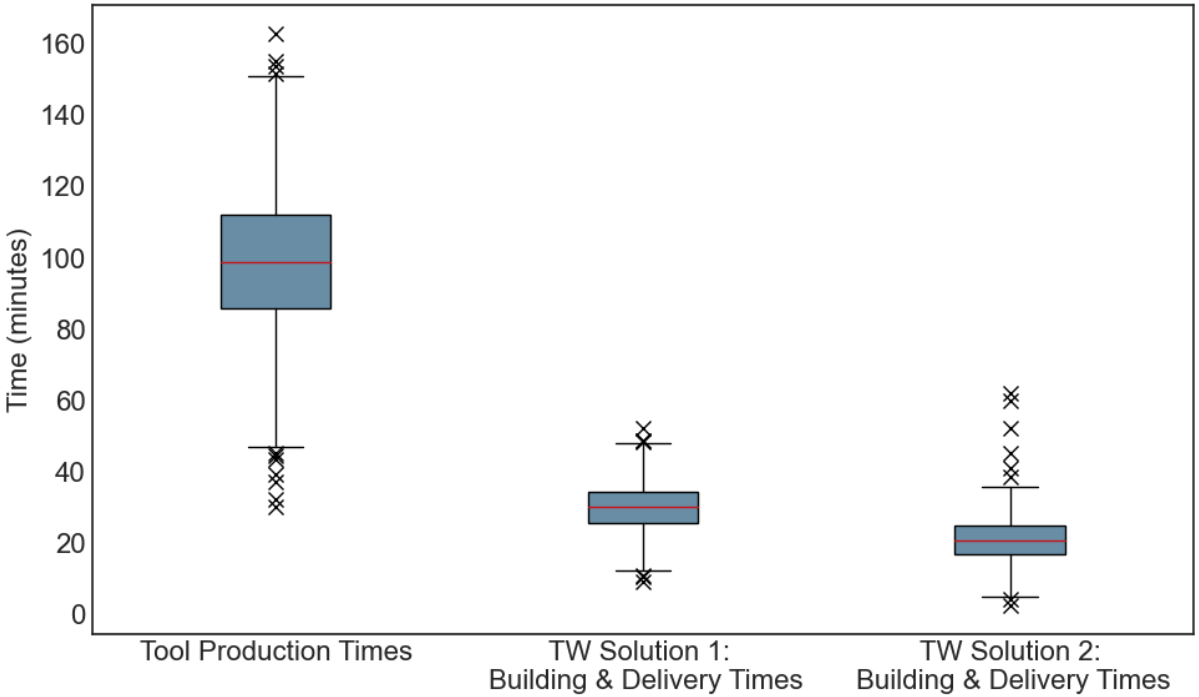
Digital Twin

MATERIAL FLOW SIMULATION WORKFLOW

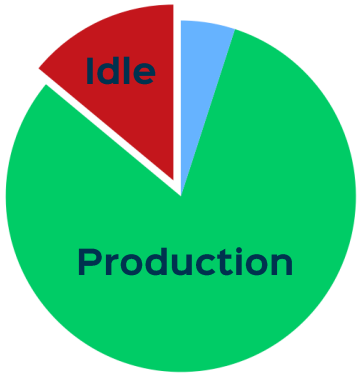


TYPICAL RESULTS OF A SIMULATION STUDY 1

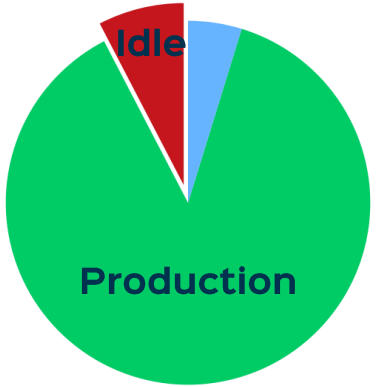
Representative example plots



Solution 1



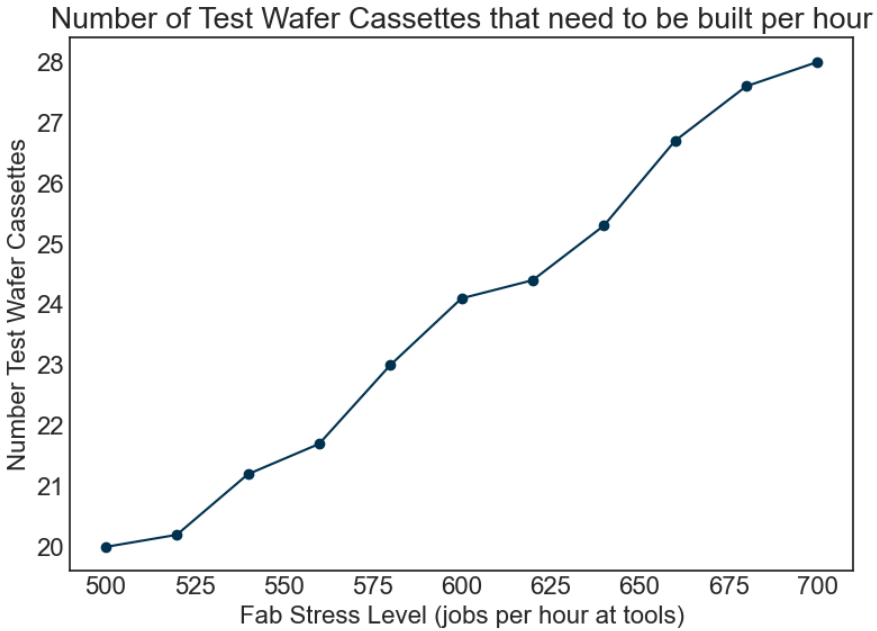
Solution 2

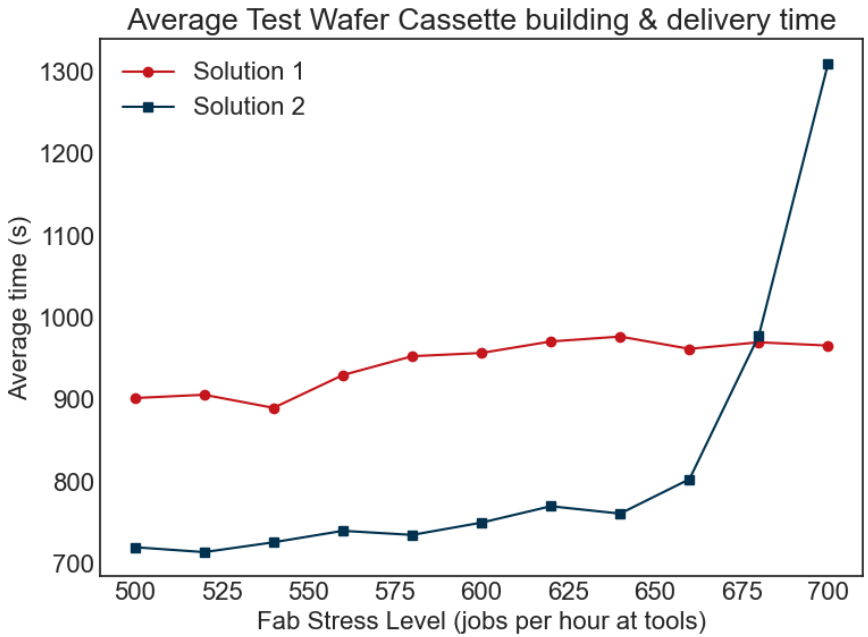


Tool E10 States

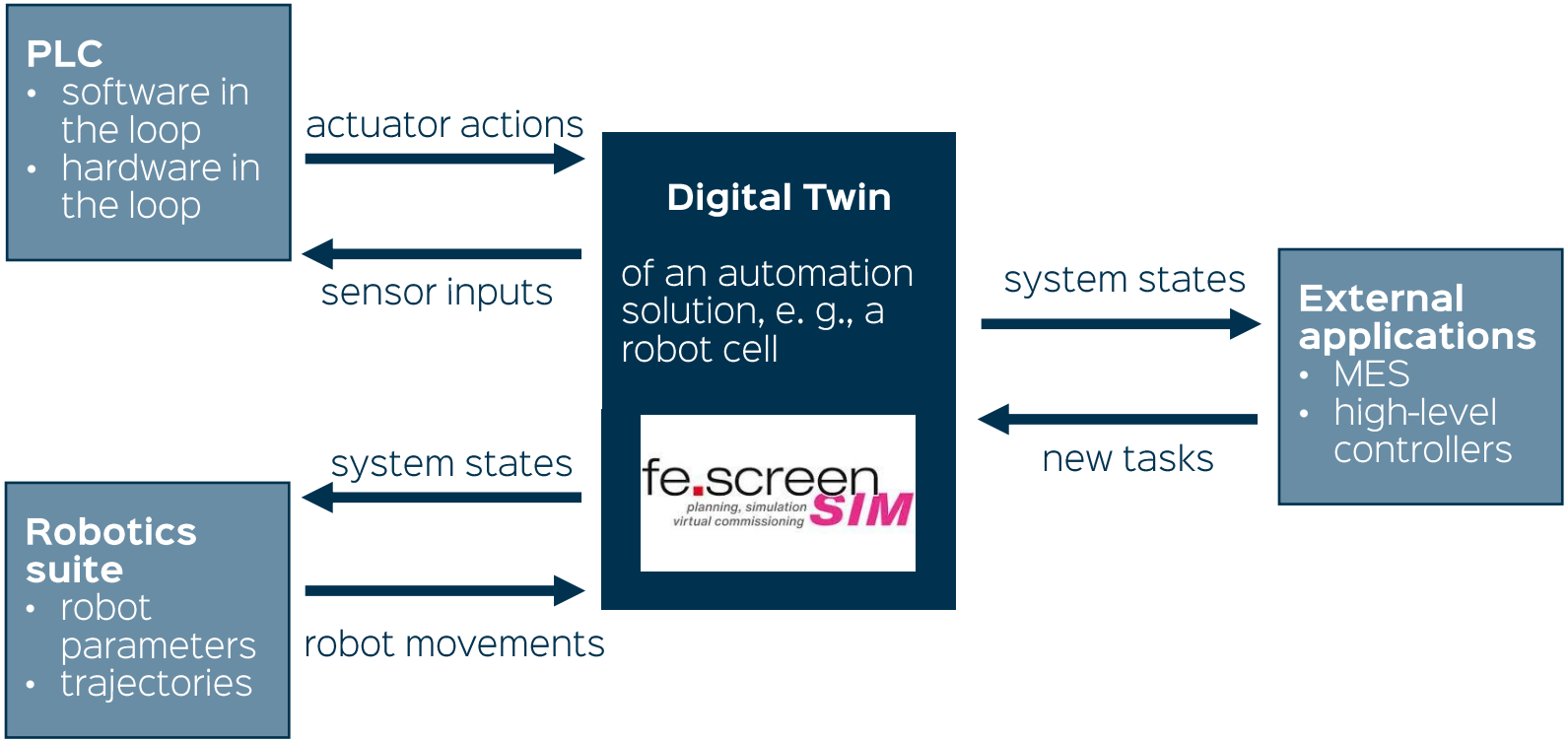
TYPICAL RESULTS OF A SIMULATION STUDY 2

Representative example plots



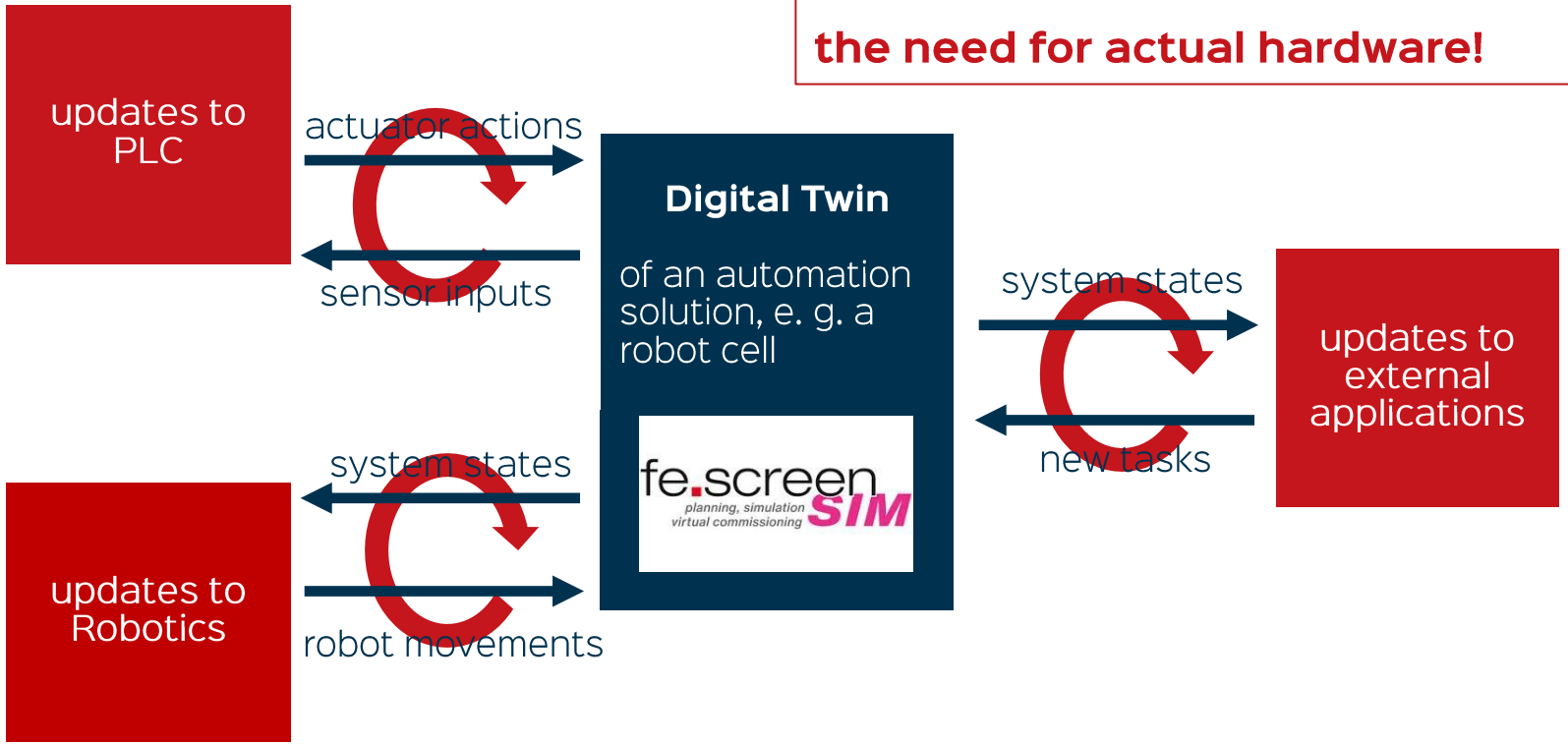


DIGITAL TWIN WORKFLOW



DIGITAL TWIN WORKFLOW

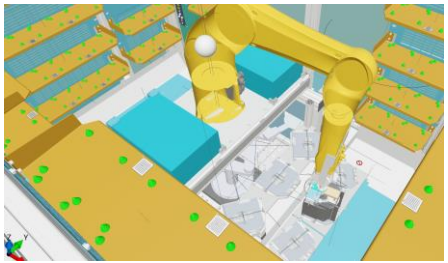
Quick and valid feedback without the need for actual hardware!



BENEFITS OF A DIGITAL TWIN

Equipment-centered view

- development/enhancement of software without the need for hardware components
- first software tests on the digital twin (especially helpful for moving elements)
- allows to have a digital twin for each generation of a hardware



Customer-centered view

- allows a pre-delivery integration of the digital twin into a customer's system architecture for testing

USE CASE: TEST WAFER CENTER

An example for an automated solution for stocker integrated test wafer sorting.

Main Components

- 6-axis robot for carrier handling
- wafer handling robot
- shelves on each side for carrier storage
- up to 14 sorter ports

Main Applications

- storage & sorting of test-wafers
- composition & re-sorting of new test lots
- adding and removing dummy wafers
- available also for HA200 boxes (box opener!)

SUMMARY & MAIN TAKEAWAYS

- A sophisticated analysis is essential to evaluate complex systems (especially in automation projects).
- Three complementary levels of analysis (analytical, simulation, and digital twin), which work together seamlessly to provide comprehensive insights.
- Analytical approaches provide quick, preliminary results for rough estimations.
- Material flow simulation delivers precise, quantitative results for complex processes, enabling informed decision-making.
- Digital twins accelerate time-to-market, ensure seamless integration, and support flexible long-term usage of new equipments.

FABMATiCS

THANK YOU

Fabmatics GmbH
Zur Steinhöhe 1
01109 Dresden / Germany
+49 351 65237-0
info@fabmatics.com
www.fabmatics.com

Member of SCIO AUTOMATION