inFacto

Engineering s.r.o.

Simulation and Optimization of Production in the Digital Age

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WHO ARE WE?

We are a **technology startup** founded at VSB-TUO.

Areas of Expertise: Simulation, **Digital Twins**, Automation, Consulting

WHY ARE WE HERE?

Our goal is to connect academic knowledge with industry needs and translate research results into **practical engineering solutions**.

Ambition to become a **bridge** between science and commerce.

Digital twin & simulation

Simulation

A virtual model of a real system used for testing and analysis without direct connection to reality.

Simulations allow for experimentation and optimization in a controlled virtual environment.

Digital Twin

A **Digital Twin** is a virtual replica of a physical object or system.

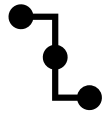
Through the Digital Twin, we can experiment, refine processes, and make data-driven decisions, all without the need for physical changes.

When to use digital twins?

Digital twins can be used at various stages, from design to testing, ensuring a more efficient and reliable production process.

Design

Testing prior to physical implementation



Optimization

Simulate scenarios to fine-tune production.

Validation

Continuous monitoring ensures quality.

Testing

Test properties before production.

Feasibility Study & Concept Verification

Assess ↔
Cycle Time

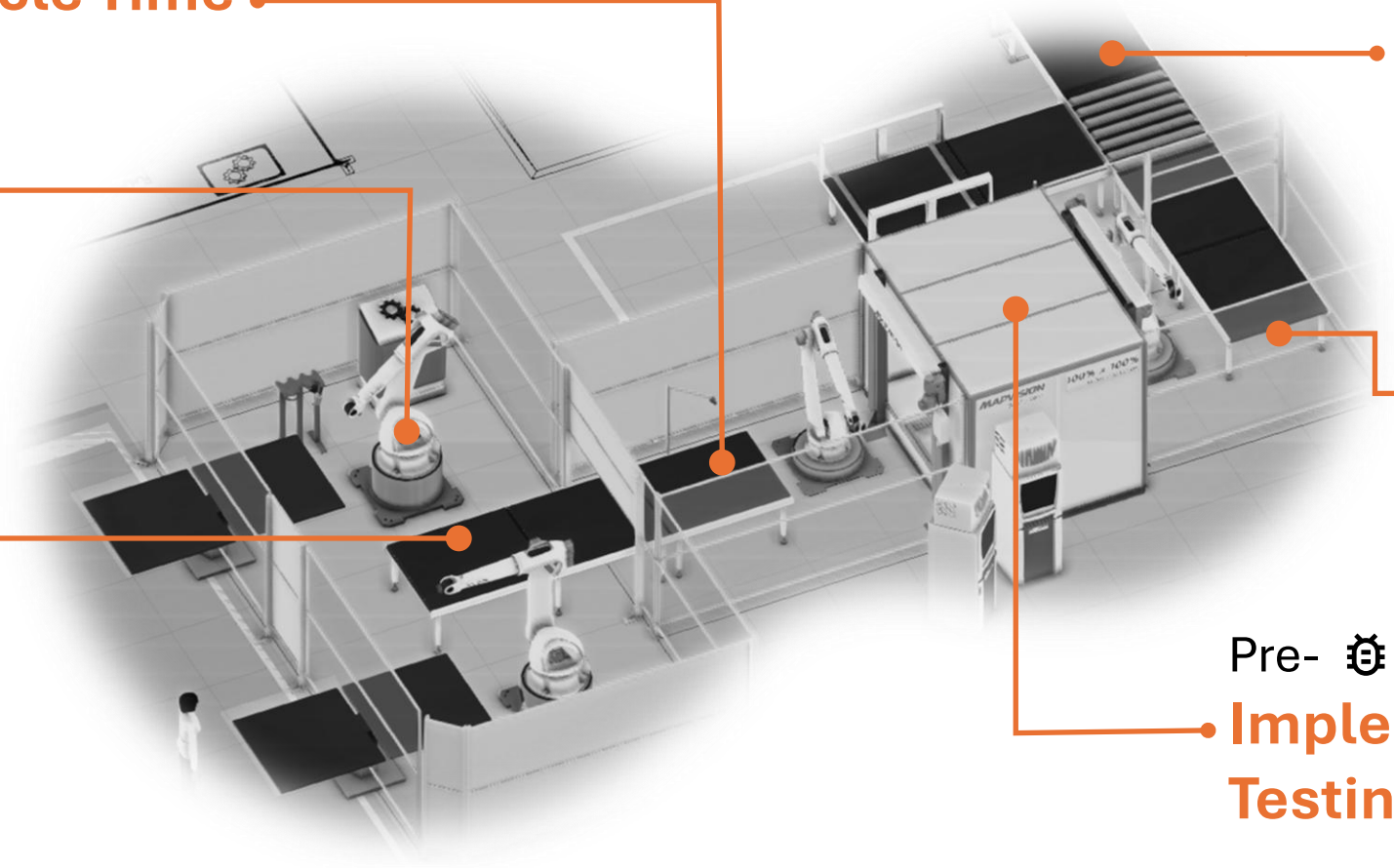
Validate
Robot Range

Discover
Key Parameters

Test
Modifications

Better
Customer Understanding

Pre-
Implementation Testing



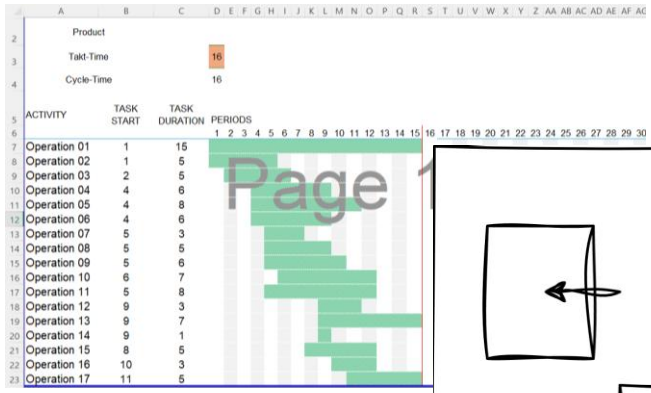
Use case: Concept Verification

Draft → Concept simulation → Realism → Optimize → Digital twin

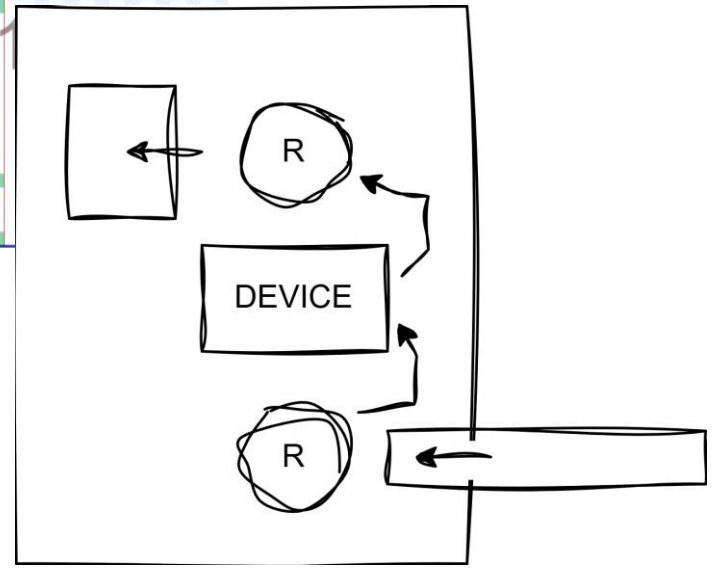
Customer Draft or Description – receive either a conceptual sketch or a **description** from the customer outlining their requirements.

Testing Feasibility – verify the concept's practicality and functionality through simulations and testing.

Risk Mitigation – identify any issues early in the process to reduce risk during final implementation.



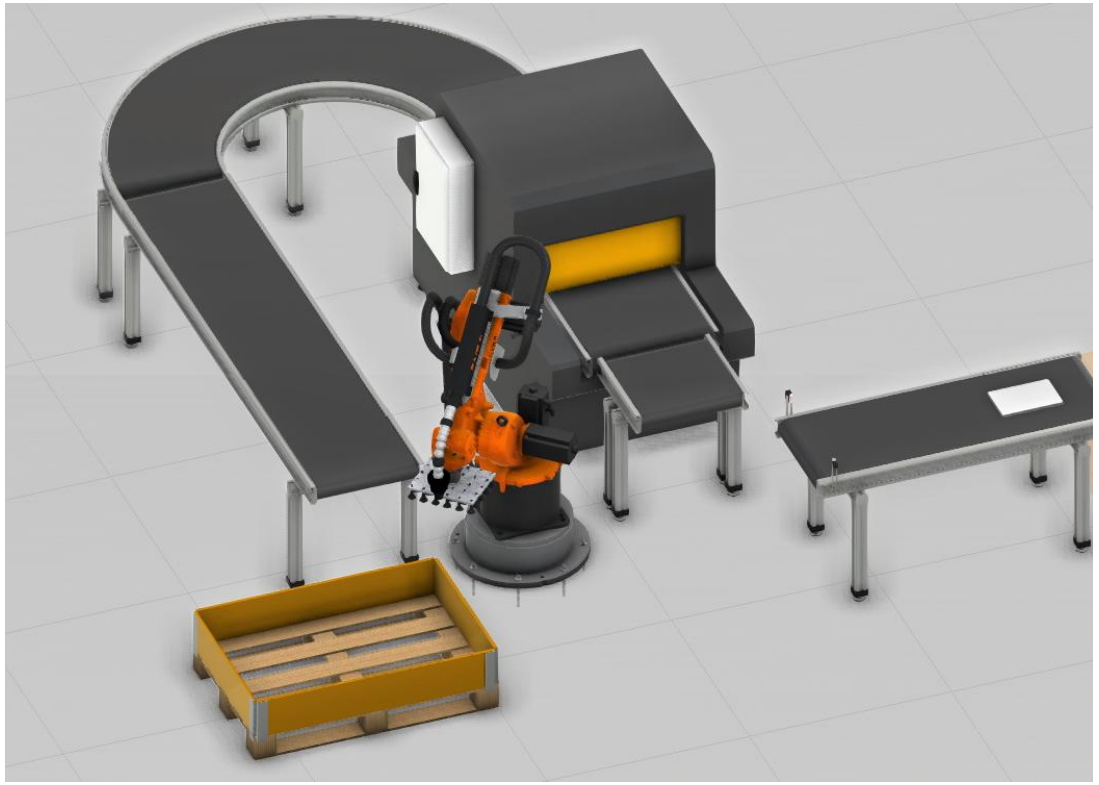
Product				
Takt-Time		16		
Cycle-Time		16		
ACTIVITY	TASK START	TASK DURATION	PERIODS	
Operation 01	1	15		
Operation 02	1	5		
Operation 03	2	5		
Operation 04	4	6		
Operation 05	4	8		
Operation 06	4	6		
Operation 07	5	3		
Operation 08	5	5		
Operation 09	5	6		
Operation 10	6	7		
Operation 11	5	8		
Operation 12	9	3		
Operation 13	9	7		
Operation 14	9	1		
Operation 15	8	5		
Operation 16	10	3		
Operation 17	11	5		

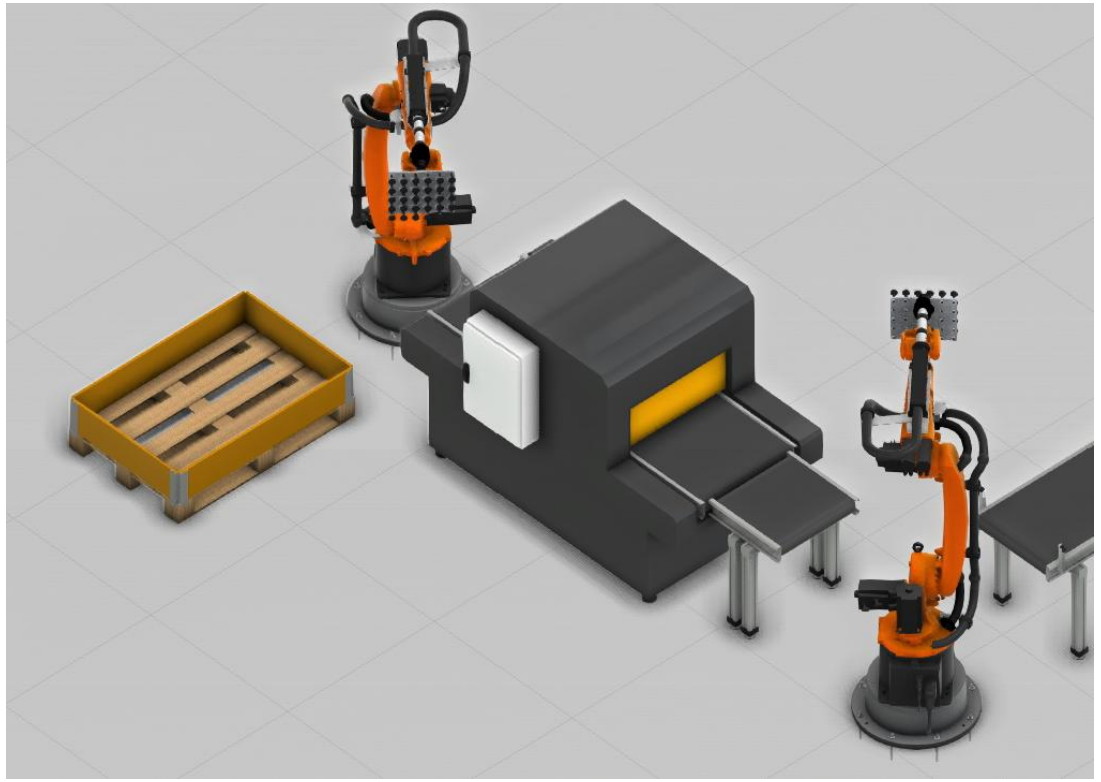


Concept Verification

Draft | **Concept simulation** | Realism | Optimize | Digital twin

Quick concept - includes basic cycle time, robot reach verification, and an attractive preview video
Early-stage customer presentation – adds value by clearly visualizing the proposed solution





Concept Verification

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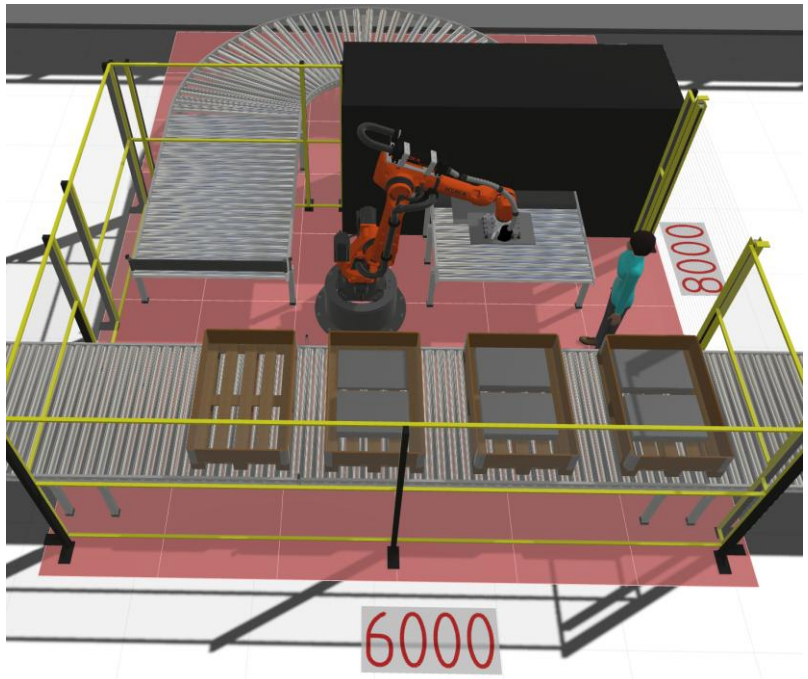
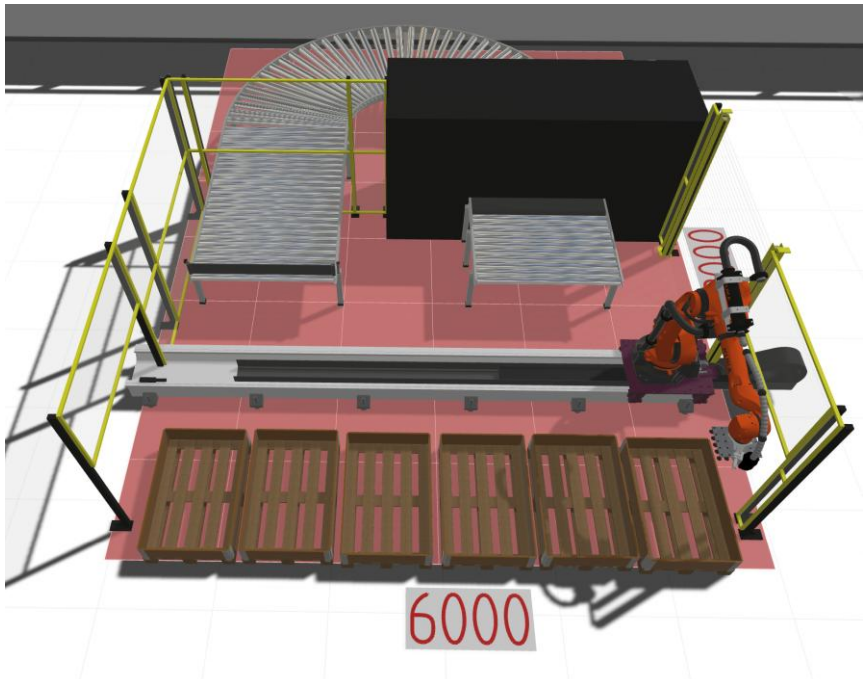
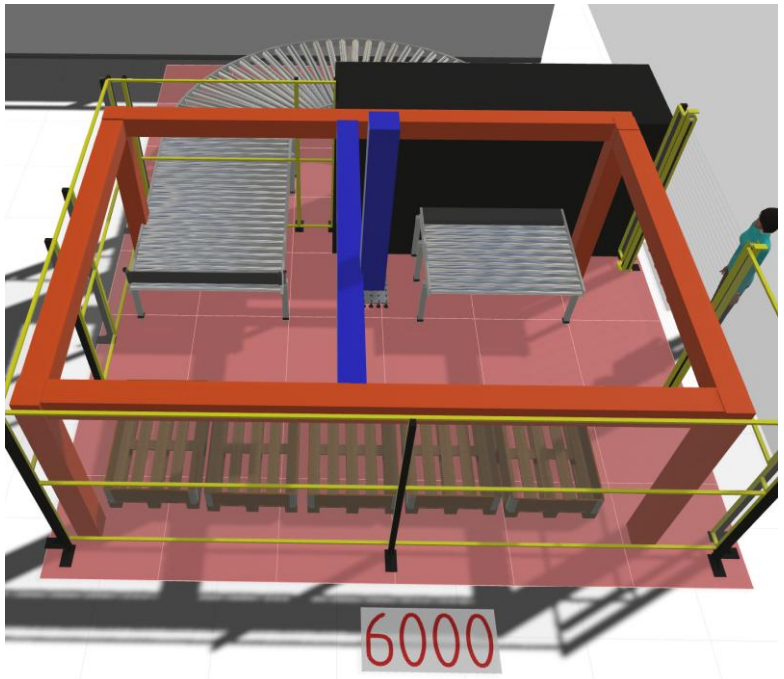






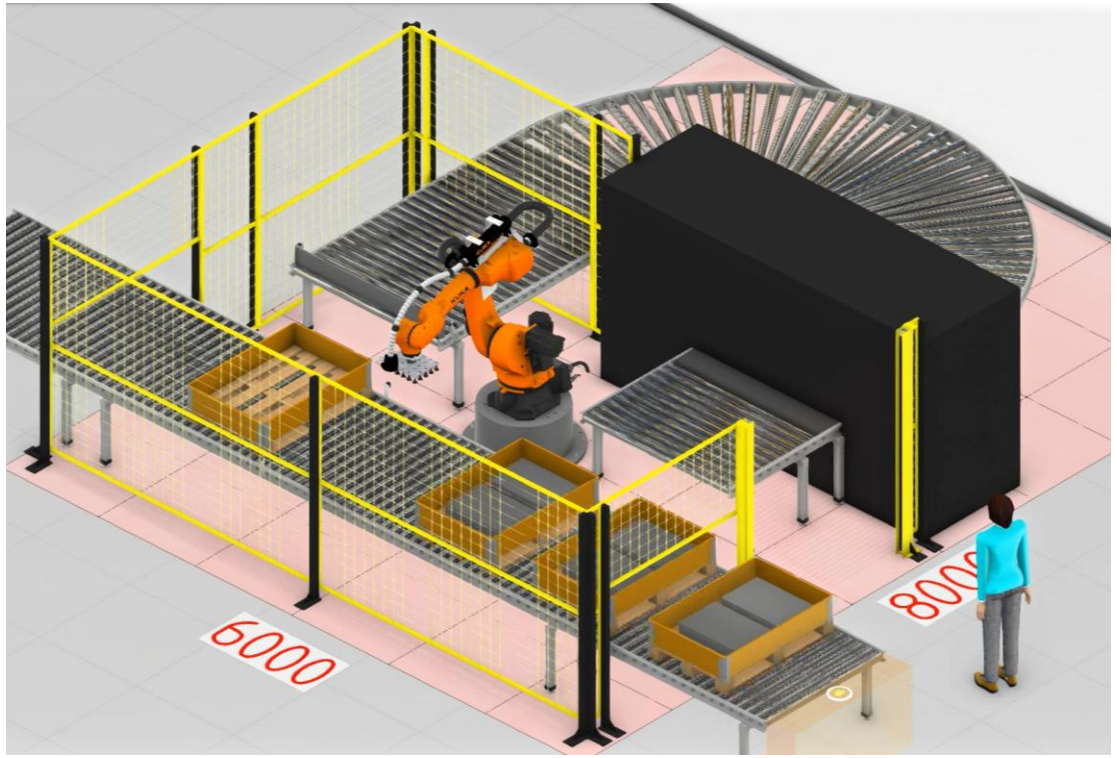
Concept Verification

Draft → Concept simulation → **Realism** → Optimize → Digital twin

Real objects and integration into factory layout – realistic **placement** of the concept within the production environment.

Refinement of **dimensions** and details – accurate specifications for better visualization.

Real-time simulation – dynamic models for more precise predictions and decision-making.



Concept Verification

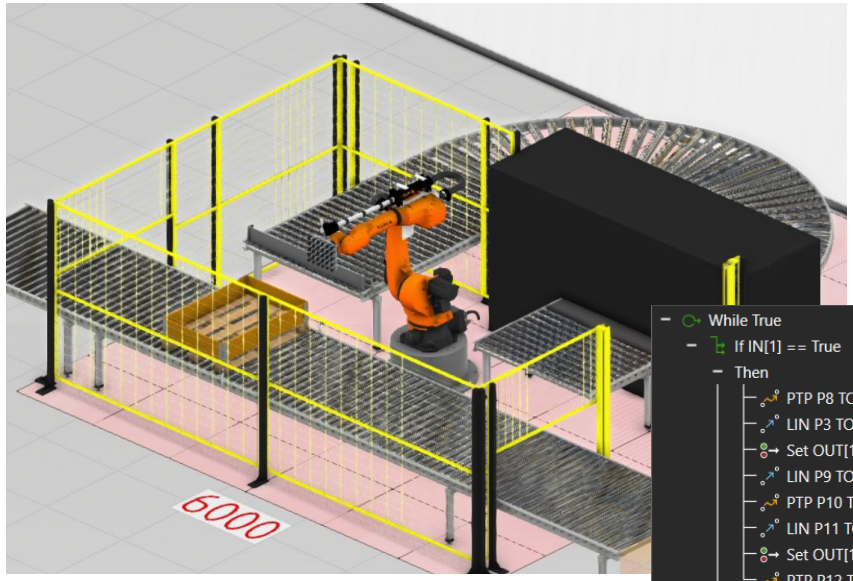
Draft → Concept simulation → Realism → **Optimize** → Digital twin

Optimize robot program for efficiency – improve **cycle time** and reduce energy consumption.

Path planning and motion optimization – enhance robot movements to avoid unnecessary actions.

Simulation for performance testing – **validate** and refine the program through virtual scenarios.

Adjustments during implementation – coordinate with **construction**, and other




```
While True
  If IN[1] == True
    Then
      PTP P8 TOOL_DATA[1] *NULL* 100%
      LIN P3 TOOL_DATA[1] *NULL* 2500mm/s
      Set OUT[1] == True
      LIN P9 TOOL_DATA[1] *NULL* 2500mm/s
      PTP P10 TOOL_DATA[1] *NULL* 100%
      LIN P11 TOOL_DATA[1] *NULL* 2500mm/s
      Set OUT[1] == False
      PTP P12 TOOL_DATA[1] *NULL* 100%
    Else
      PTP P4 TOOL_DATA[1] *NULL* 100%
      Wait IN[0] == True
      LIN P5 TOOL_DATA[1] *NULL* 2500mm/s
      Set OUT[1] == True
      LIN P7 TOOL_DATA[1] *NULL* 2500mm/s
      PTP P2 TOOL_DATA[1] *NULL* 100%
      LIN P1 TOOL_DATA[1] *NULL* 2500mm/s
      Set OUT[1] == False
      LIN P6 TOOL_DATA[1] *NULL* 2500mm/s
```

Concept Verification

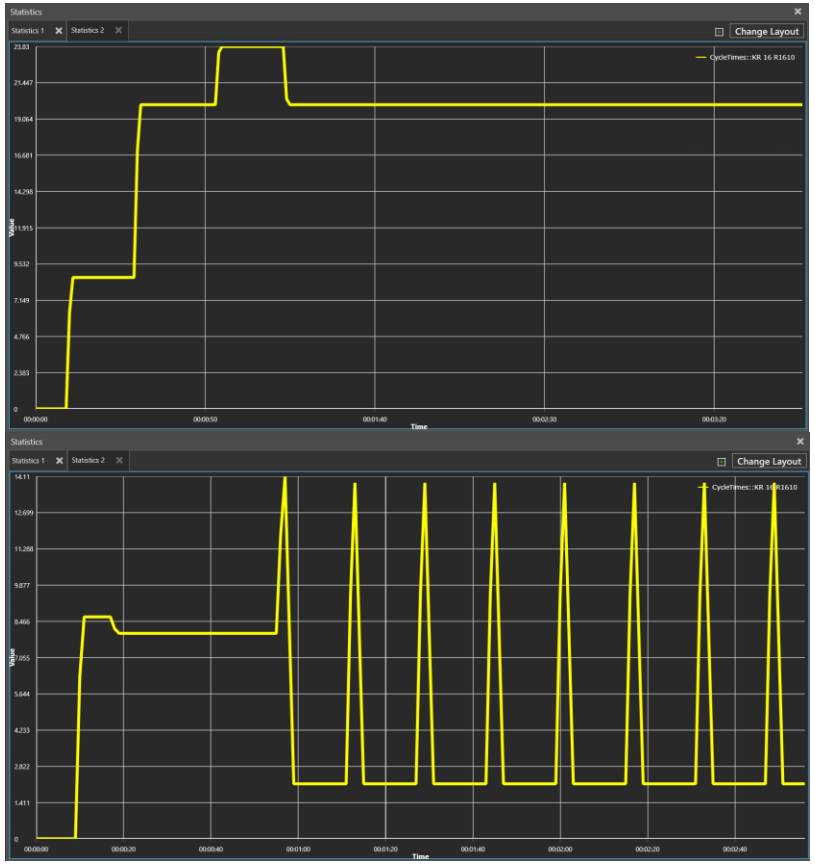
Draft → Concept simulation → Realism → **Optimize** → Digital twin

Adjustments **after modifications**

Recalculation of **cycle time** and **reach** – ensure both are optimized following the changes.

Testing for **consistency** – confirm that the robot's range and cycle time align with the desired performance.

Final validation – perform real-world or simulated tests to verify all changes and their effects.



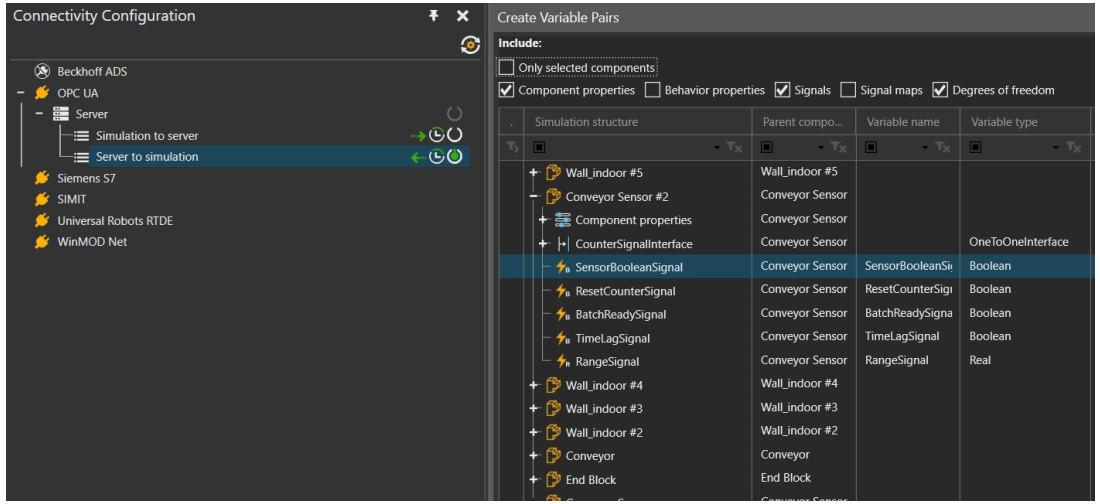
Concept Verification

Draft → Concept simulation → Realism → Optimize → **Digital twin**

Full Digital Twin Implementation – **integration with PLC** systems for real-time monitoring and control.

PLC Program **Testing** – simulate and validate robot control programs within the digital twin environment.

Optimization and Debugging – **test and optimize robot behavior** in the digital twin before deployment in the physical system.



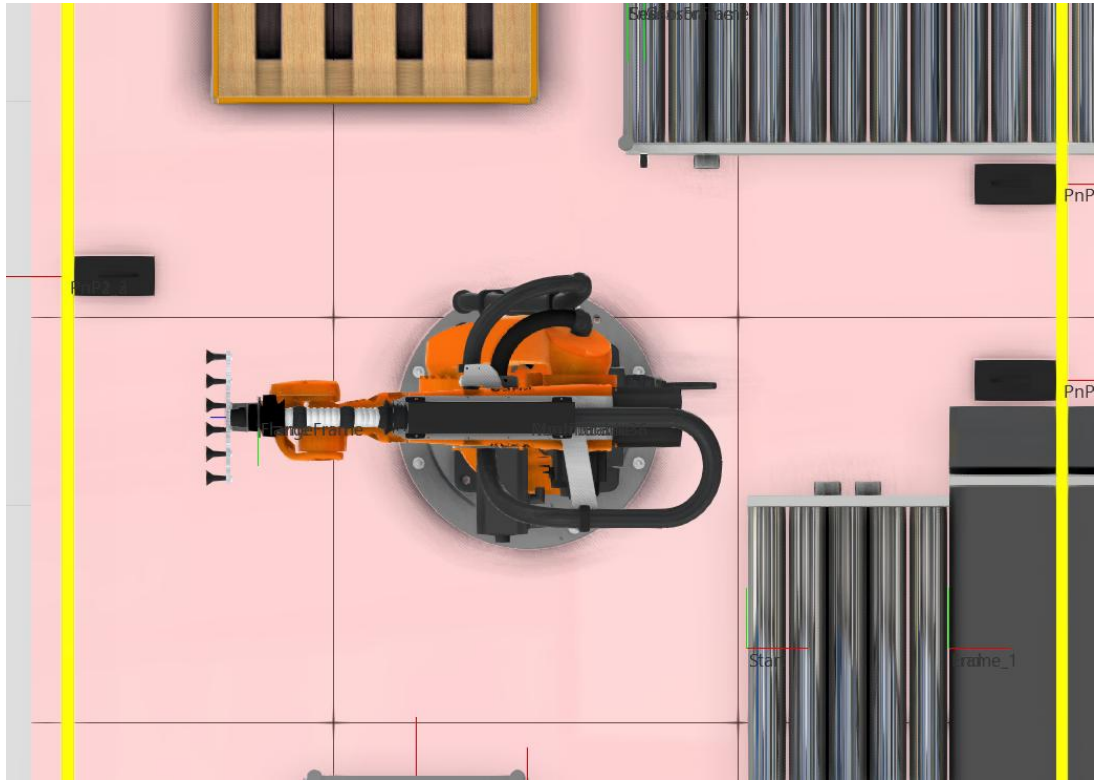
Concept Verification

Draft → Concept simulation → Realism → Optimize → Digital twin → **Future use**

Machine adjustments and simulations – use digital twin for **testing modifications** before physical changes.

Optimization with real-time data – continuously optimize performance using data from the digital twin.

Pre-implementation preparation – plan and test modifications off-site while the machine is already deployed at the customer's location.



Digital twin for production optimalization

Layout Optimization – improve factory floor design for better workflow and space utilization.

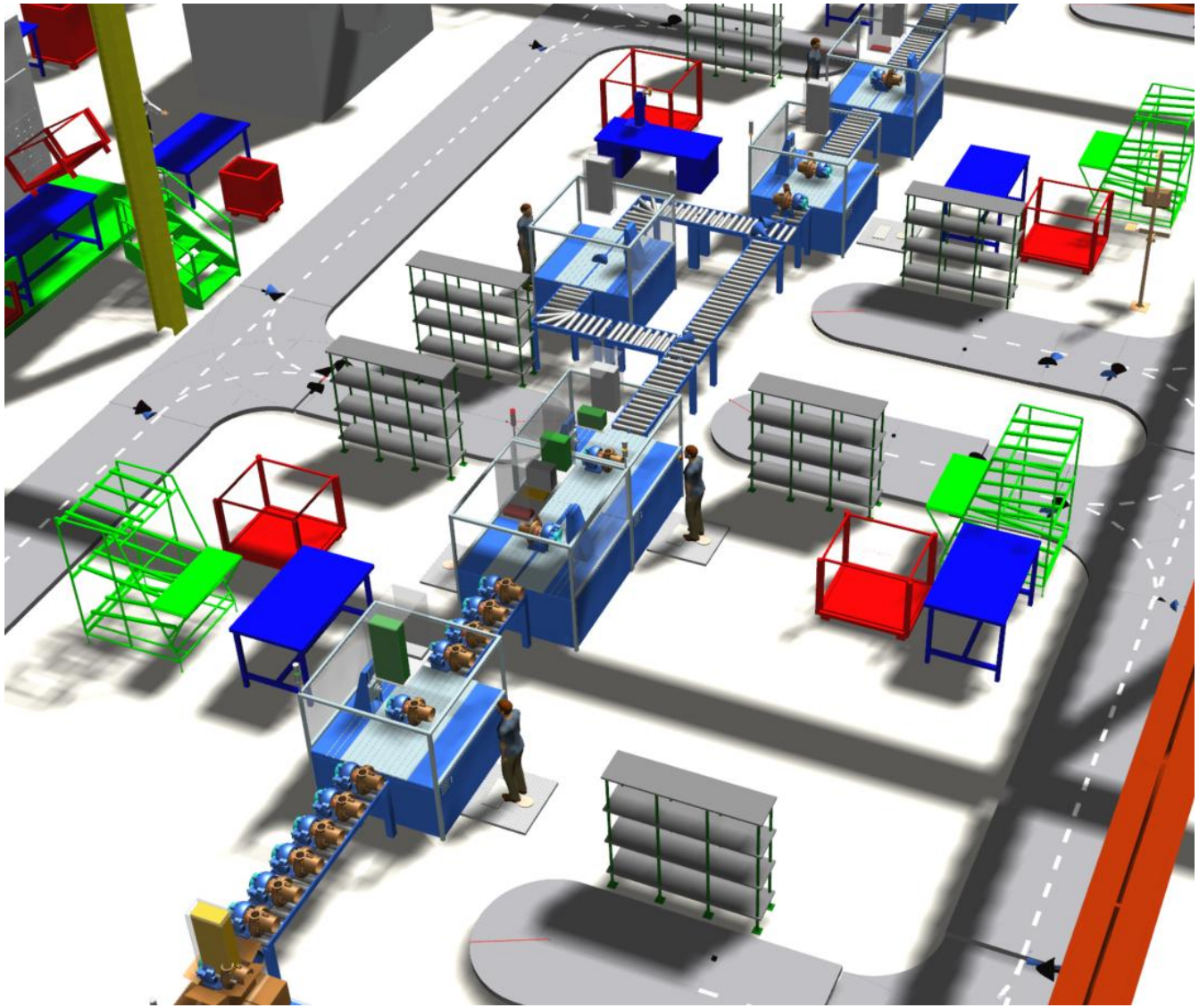
Production Verification and Optimization – ensure production processes are running efficiently with real-time adjustments.

Planning – optimize production schedules based on data-driven insights.

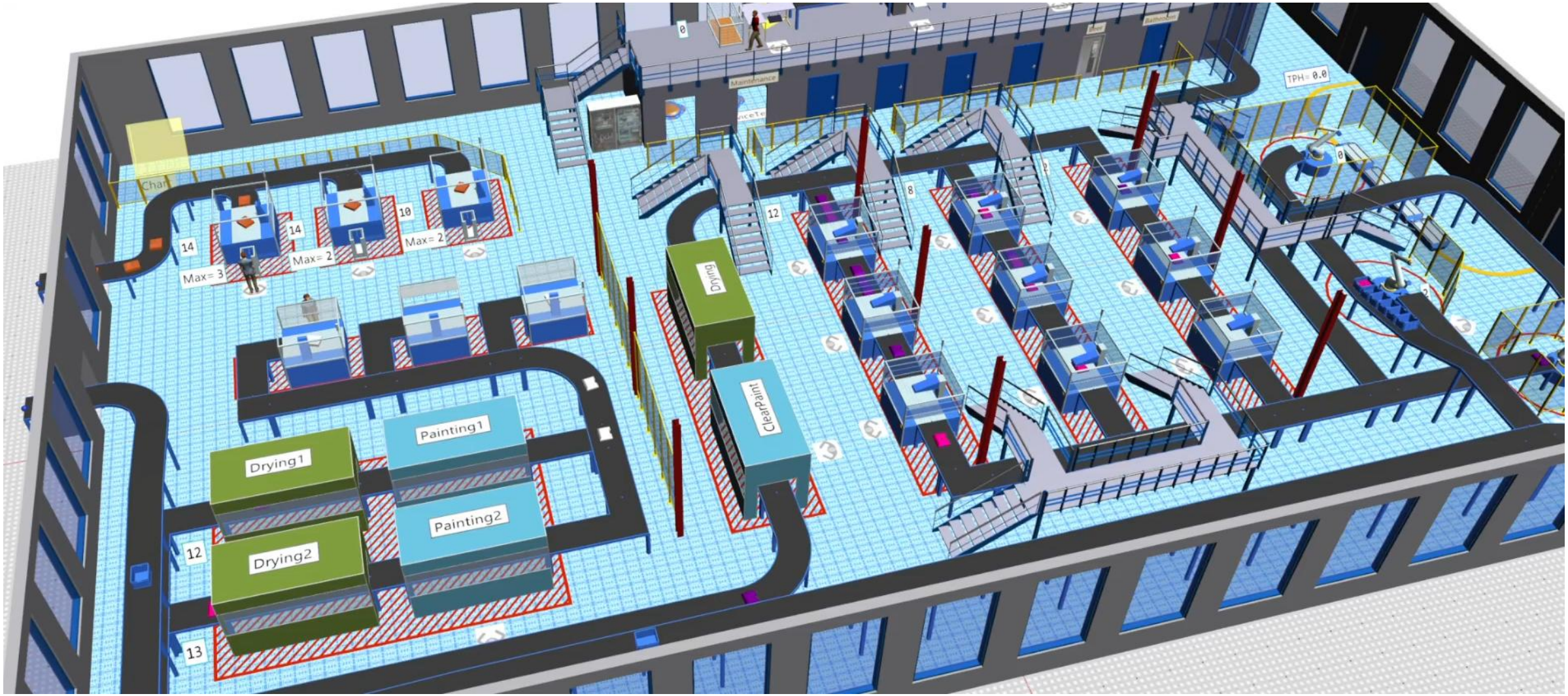
Experiments to Validate Changes – simulate different production scenarios to verify the impact of proposed changes.

Layout optimization

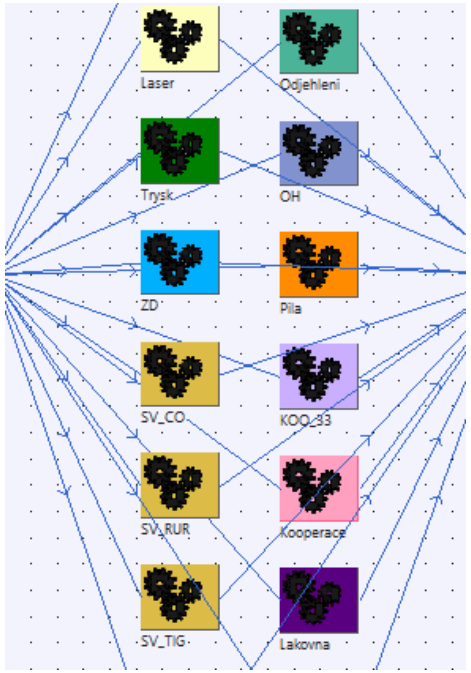
- Corridor and warehouse utilization
- Route cost optimization for **AGV** or **AMR**
- **Work** and station **Setup** time optimization
- Optimal production planning



Use case: 3D simulation of your ptoduction



Use case: Planning of production



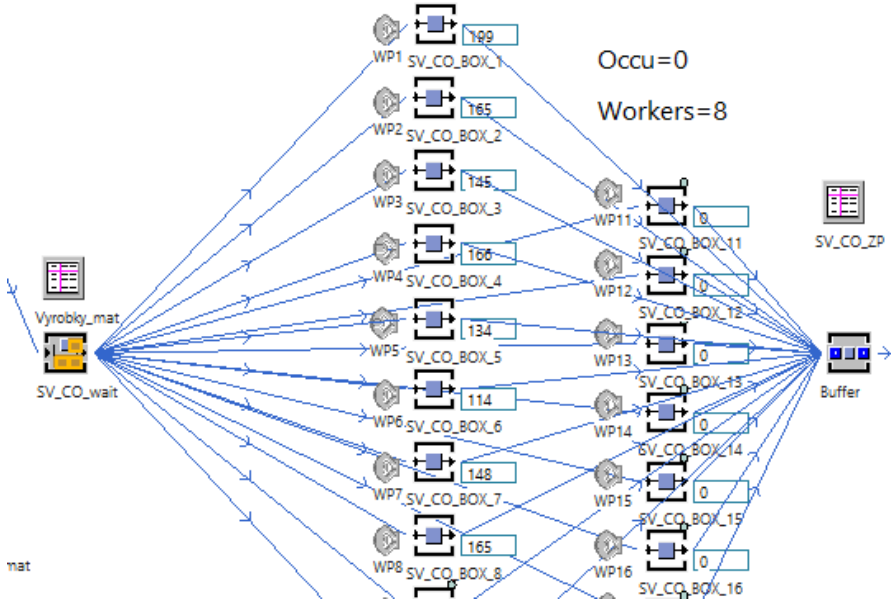
Real application
by our team

Production planning

Available capacity forecast

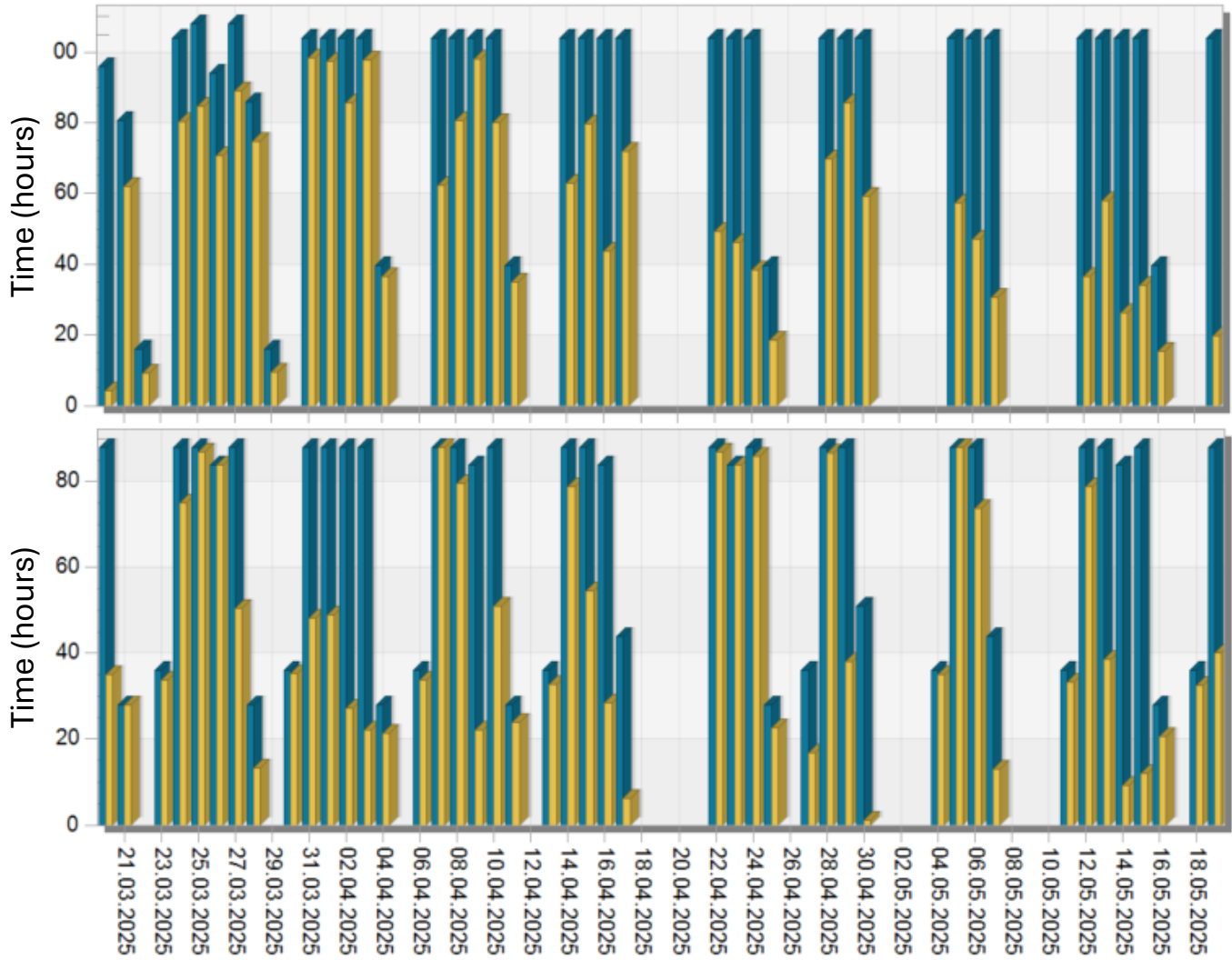
Uptodate worker capacity

Export data to **ERP** or **EIS**



Use case: Planning of production

- Real application by our team
- **Production planning**
- Available capacity forecast
- **Uptodate** worker capacity
- Export data to **ERP** or **EIS**



Usage of DT in Automation

Optimization and Design Anywhere:

- Addressing optimizations and providing solutions in various fields

Design of Automation Solutions:

- 3D visualizations and simulations
- Integration with other enterprise systems

Virtual Commissioning:

- Linking Digital Twin to the real-world system

Functional Safety:

- Simulation of workplaces with collaborative robots
- Evaluation of safety, suitability, and cost-effectiveness

Integration with Virtual Reality:

- Opportunities for VR integration for enhanced training and visualization

Thank you for your attention

Jan Zemánek

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