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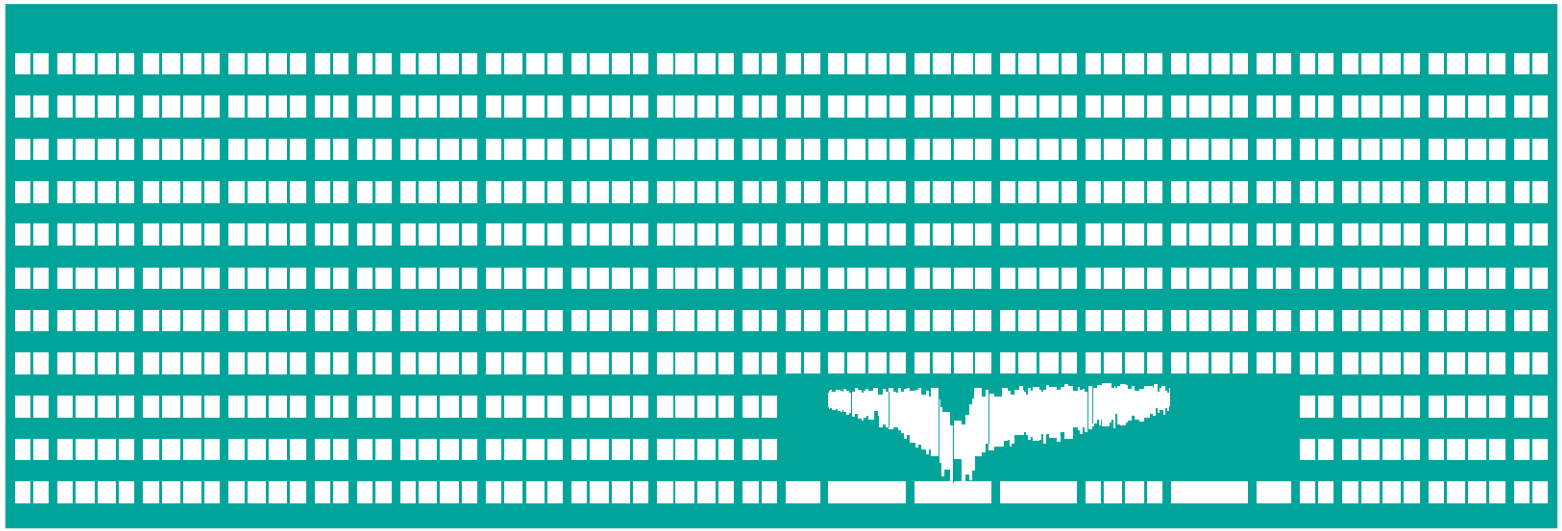

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5th Workshop for Forming and Punching & 1st German-Czech Business Meeting

Smart Factory of the Future

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Smart Factory

A smart factory is a **digitized manufacturing facility** that uses connected devices, machinery and production systems to continuously collect and share data.

This data is then used to inform decisions to improve processes as well as address any issues that may arise.

The smart manufacturing practices used by a smart factory are enabled by a **variety of technologies** including artificial intelligence (AI), big data analytics, edge/cloud computing, digital twins and the industrial Internet of Things (IoT) etc.

Smart factories connect the digital and physical worlds in order to monitor an entire production process.[1]

[1] https://www.twi-global.com/

Smart Factory

Key technologies

- Sensing wide range of process data – process monitoring and condition monitoring.
- Edge computing/Cloud Computing.
- Big Data Analytics.
- Machine learning and artificial intelligence.
- Digital Twins, model based design.
- Virtual and Augmented Reality.
- Internet of Things (IoT).

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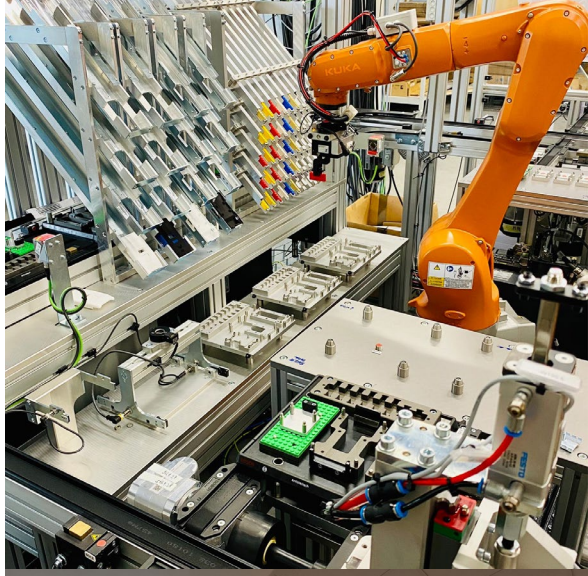
a part of „Platform of new technologies at FEECS CPIT TL3“ supported by the European Regional Development Fund project, CZ.02.2.67/0.0/0.0/16_016/0002467, within the Operational Programme Research, Development and Education

Platform of new technologies at FEECS CPIT TL3

Objectives

The aim of the construction of the FEI CPIT TL3 is to extend the infrastructure of the FEI VŠB-TUO with a building that will provide a comprehensive infrastructure for teaching activities in an innovative concept in newly accredited fields of study and existing fields of study.

- **Smart Factory** - laboratory facility for teaching intelligent industrial technologies according to the Industry 4.0 concept.
- **Health.Lab** - laboratory facility for teaching advanced technologies in the field of biomedicine.
- **Mobility.Lab** - laboratory facility for teaching automotive electronic systems/elektromobility.
- **AIM.Lab** - laboratory facility for atrificial intelligence in industrial applications.



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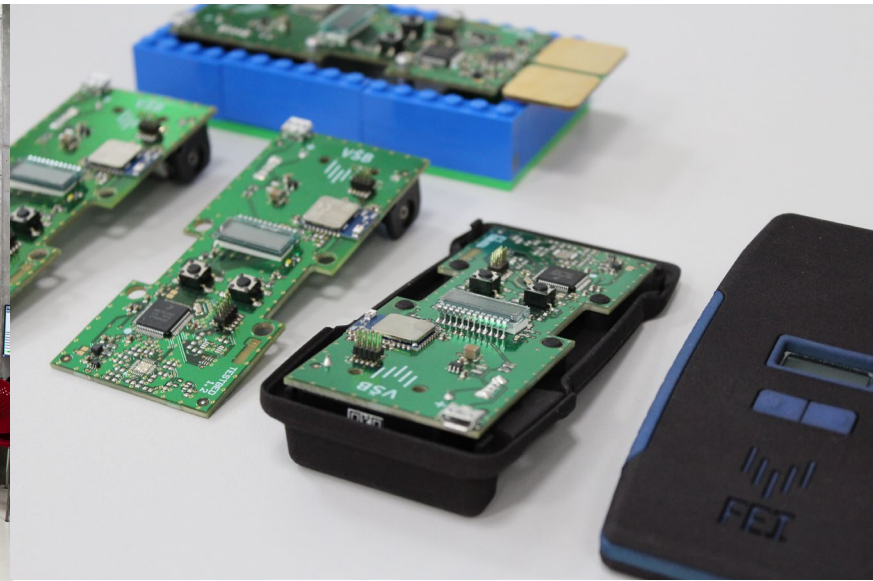
Introduction

- Experimental testbed built on Industry 4.0 principles.
- Education, presentation and research in the field of digital manufacturing.
- A platform for collaboration between the university and industrial companies.
- Smart Factory enables engineering and research collaboration from the level of individual technologies to complex production systems.



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Industry 4.0 basic principles

- **Virtualization** - virtual copies of the smart factory linking sensor data with virtual and simulation models of the factory.
- **Service orientation** - offering services to cyber-physical systems (CPS), operators, smart factory via internet of things/services.
- **Interoperability** - the ability of cyber-physical systems (CPS) to communicate with each other via the Internet of Things/Internet of Services.
- **Decentralization** - the ability of the cyber-physical system to act autonomously within the smart factory.
- **Real-time operation** - the ability to analyze real-time data and intervene in the manufacturing process in real time.
- **Modularity** - ability to adapt the smart factory to changing requirements by replacing or extending individual modules.

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Expertise

- Industrial automation, HMI/SCADA systems.
- Industrial and mobile robotics.
- Systems and process virtualization, digital twin.
- Condition monitoring, predictive maintenance.
- Signal acquisition and processing, machine vision, artificial intelligence applications.
- Industrial VR/AR reality applications.
- Industrial 5G network.

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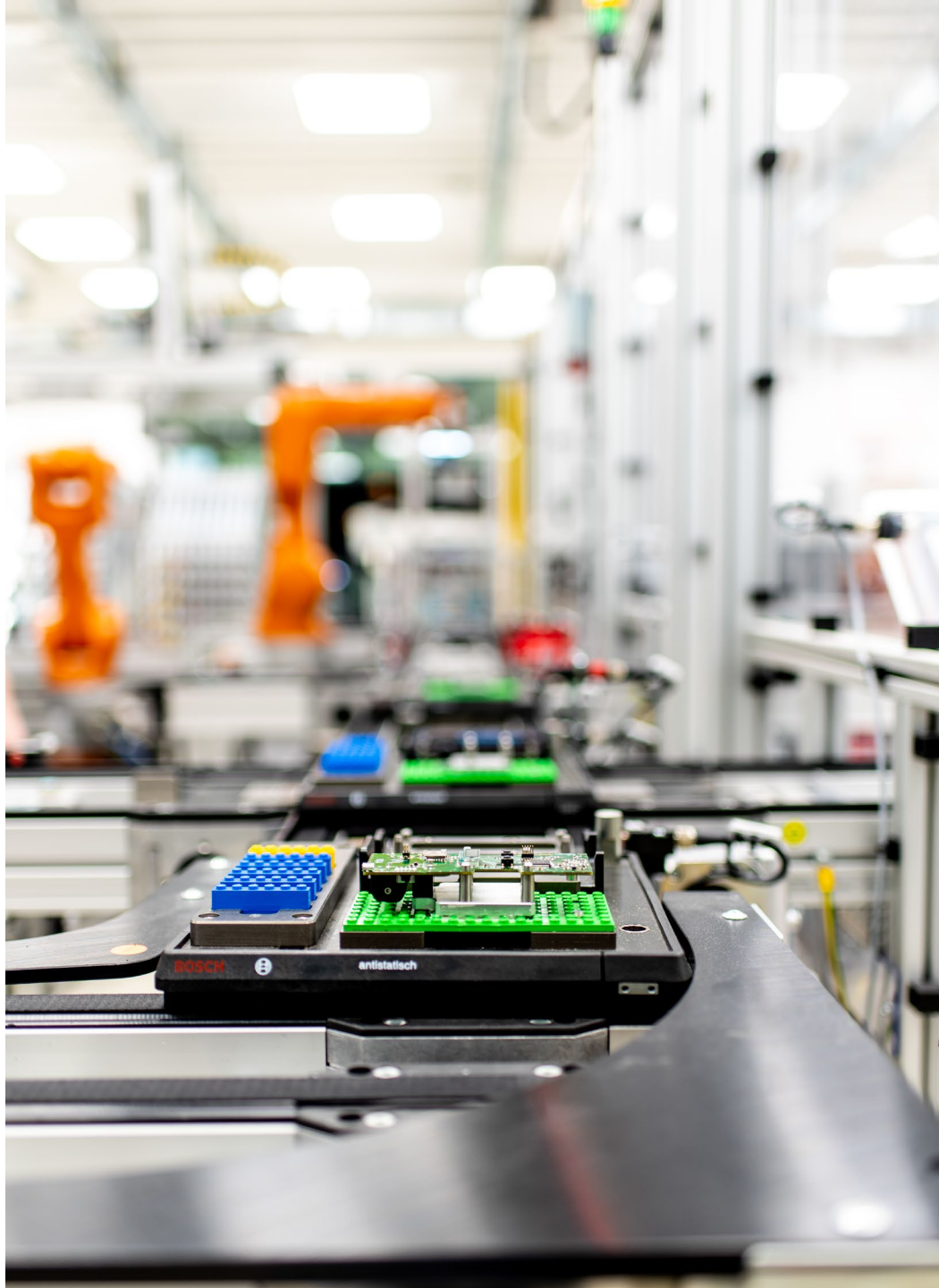
Industrial automation, HMI/SCADA systems

Smart Factory is equipped with control systems mainly from Siemens, BaR, Bosch Rexroth, Mitsubishi Electric. It enables testing of centralized/distributed architectures, industrial communication systems including 5G, HMI/SCADA visualization systems. It also enables testing of process and diagnostic data acquisition, transmission and processing tasks.



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Industrial and mobile robotics

Within the Smart Factory, 10 industrial robots (Kuka, Mitsubishi Electric, Fanuc) are installed in various types of tasks. The individual installations allow to solve both typical deployment of industrial robots and special use of robots for precise measurements or bin picking.

Mobile industrial robots (MIR) are also available, enabling autonomous movement throughout the laboratory space. The lab is set up for demonstration and testing of mobile industrial robots in various types of applications.

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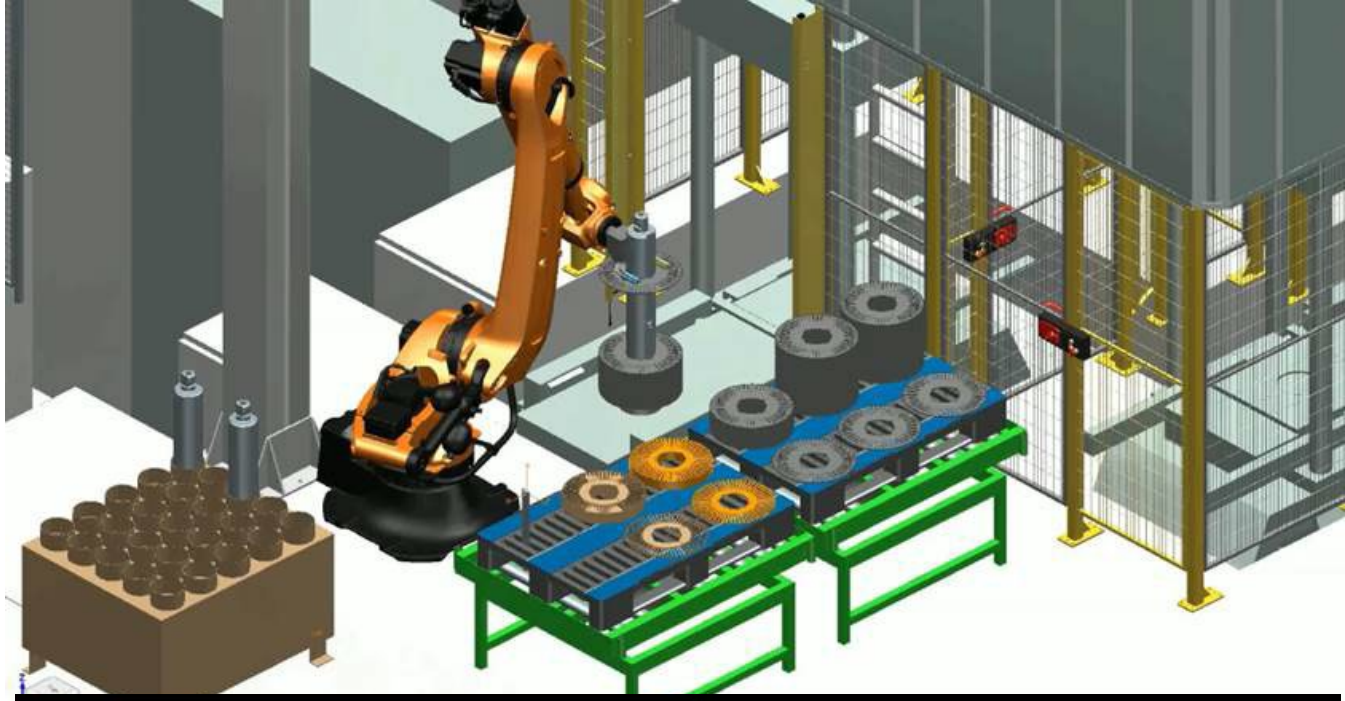
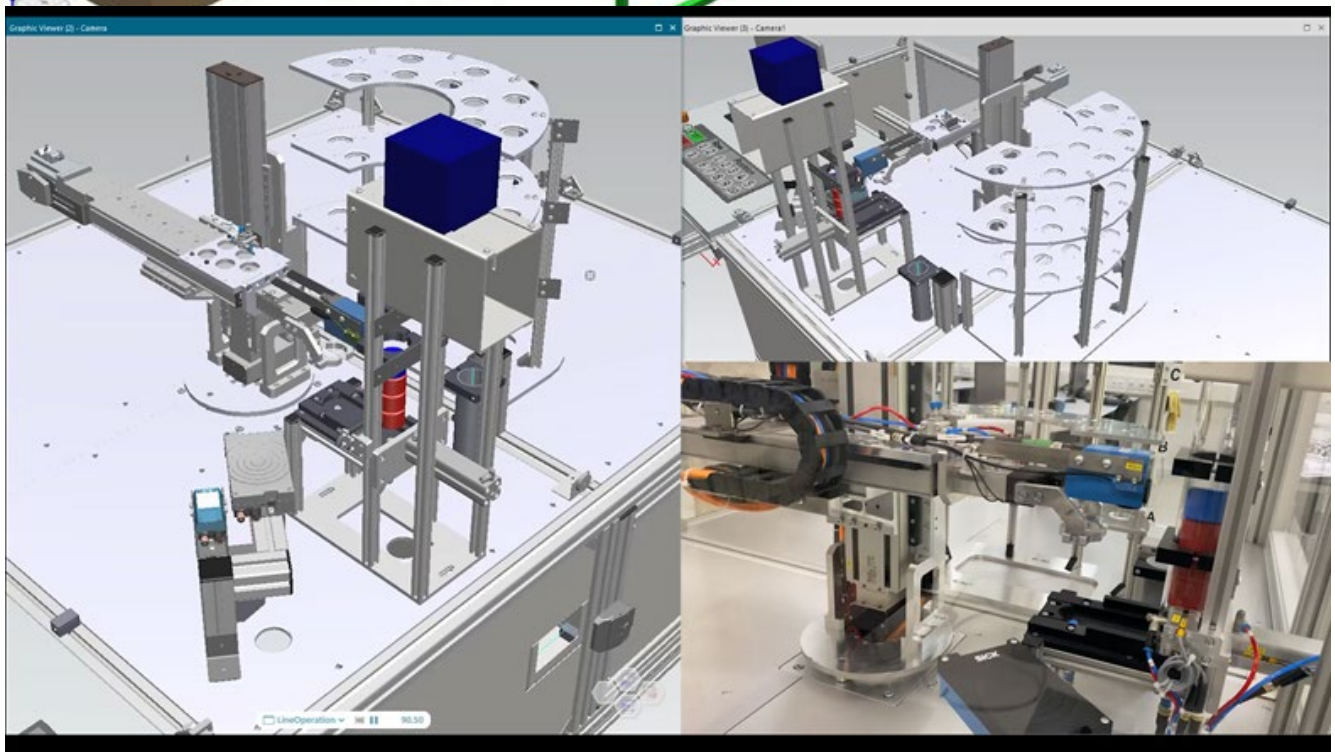
Systems and process virtualization, digital twin

Smart Factory is equipped with several systems for the implementation of digital twins, in particular Tecnomatix Process Simulate, Tecnomatix Plant Simulation and Visual Components.

The creation of a comprehensive digital model allows the design and functionality of the equipment under development to be verified, tested, operators trained, or virtual commissioning carried out. A number of practical examples on how to create and use the digital twin effectively are provided in the Smart Factory.





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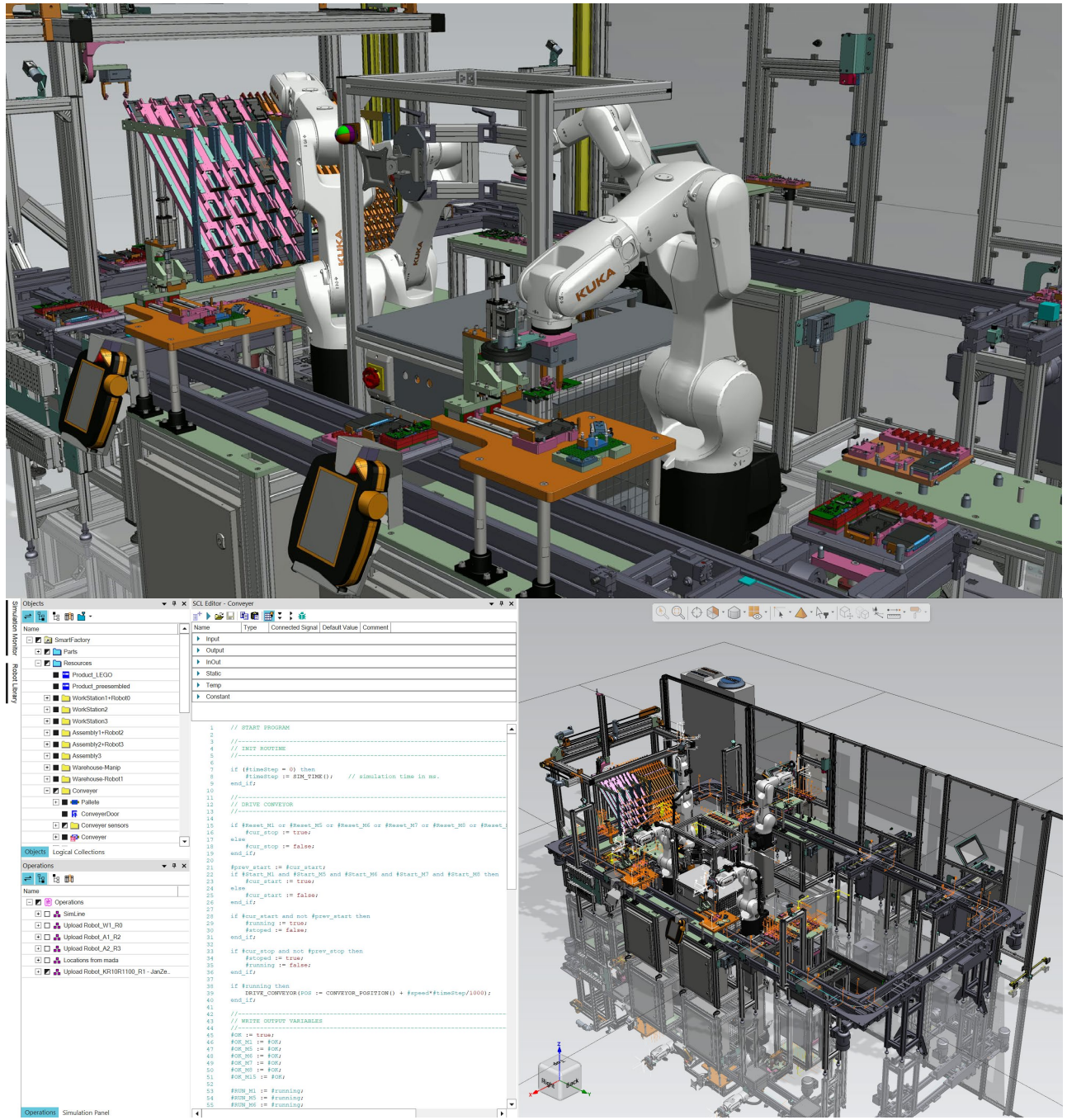
Digital twin

To complement the physical smart factory line, we also have its digital twin in a virtual form. It includes all components just like the real machine (sensors, detectors, robotic programs, conveyors...) and is controlled by the same program as the actual machine.

This enables not only testing the machine's states but also testing program modifications without the need to interfere with the real production line.



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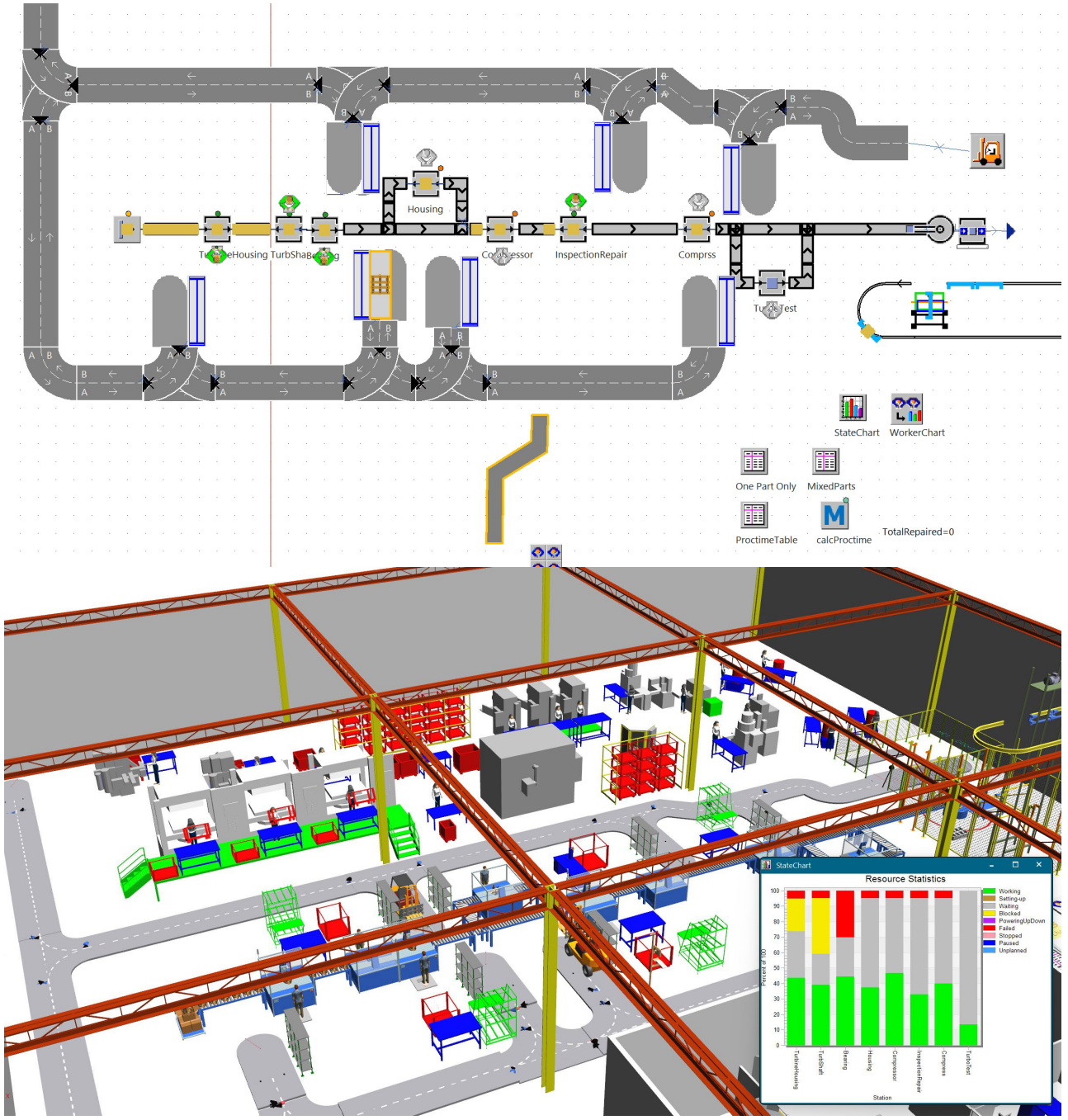
Digital twin

In another domain of digital twins, we focus on translating an industrial partner's manufacturing plant into a virtual representation to enable simulation of production states under specific parameters.

This digital twin is also utilized for advanced production planning, layout optimalization and experimental parameter testing.



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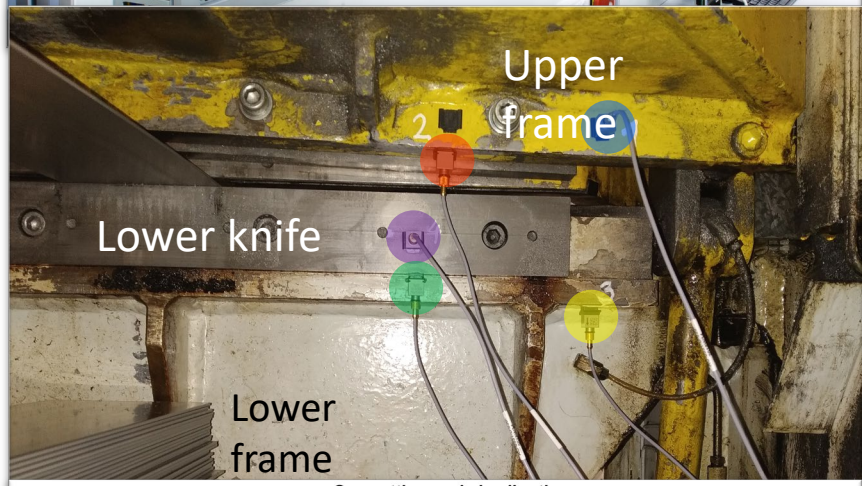
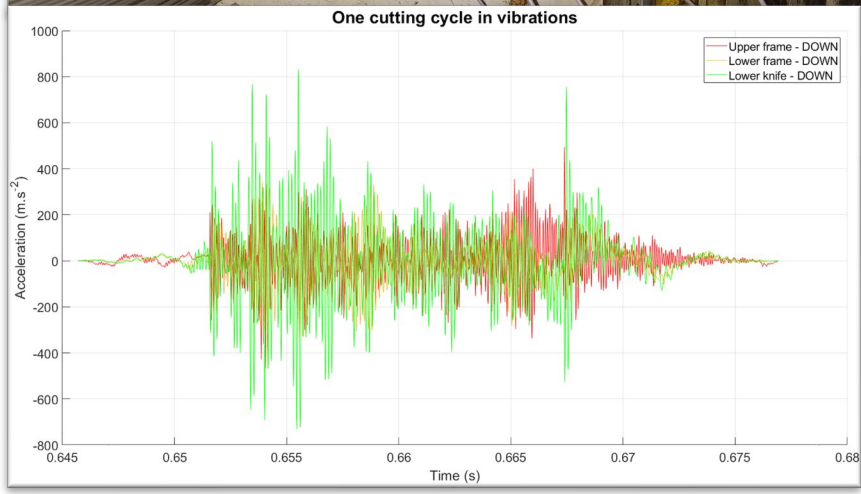
Signal acquisition and processing, machine vision

Smart Factory has technologies for collecting diagnostic data, especially vibro-diagnostic, image, acoustic, process, etc. Using advanced data processing methods, including artificial intelligence, models are created to predict failures of monitored industrial systems in order to plan maintenance and increase its efficiency.

The systems are tested and deployed in industrial enterprises especially in the automotive sector where minimizing production downtime is a key priority.





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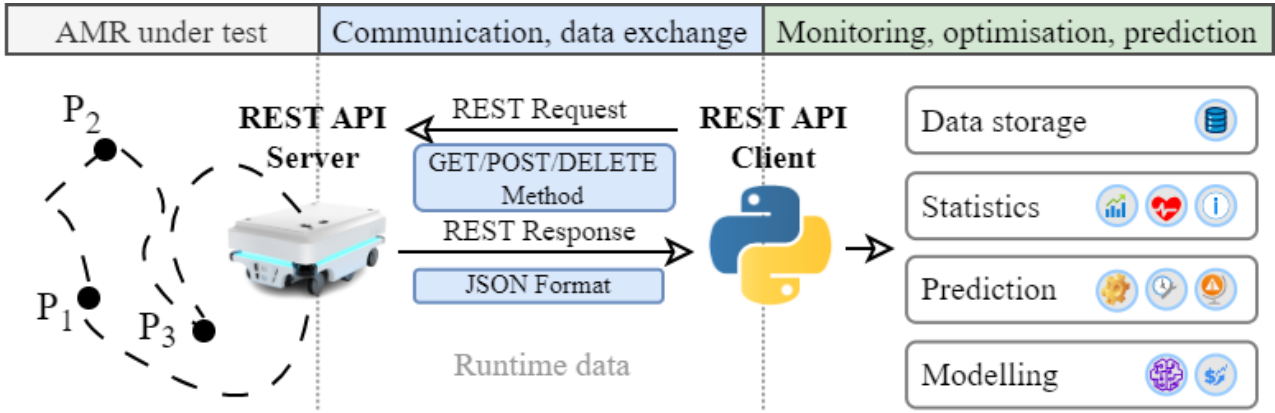
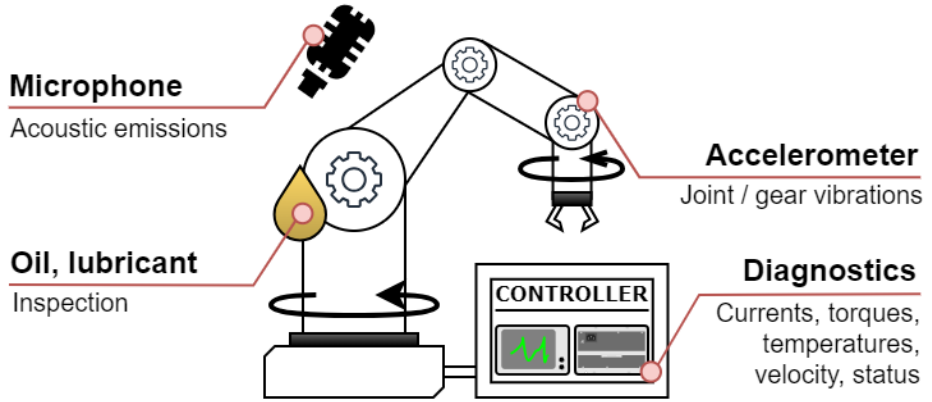
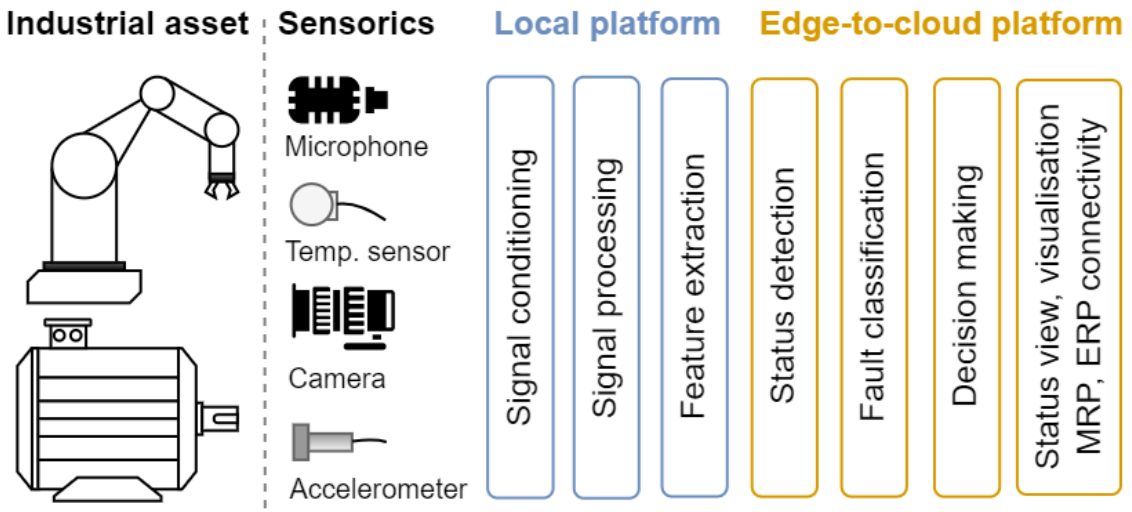
Edge computing, predictive maintenance

Smart Factory also serves for data collection and Edge Computing Scenarios. Nowadays, we collect data from various industrial assets to entablish online monitoring and prediction maintenance.

Currently, data from the production line, mobile robots and industrial robots is collected and processed in Edge Computing layer. Thanks to this, we can model behaviour of mobile robots (AMRs) or classify the status of industrial robots (KUKA).







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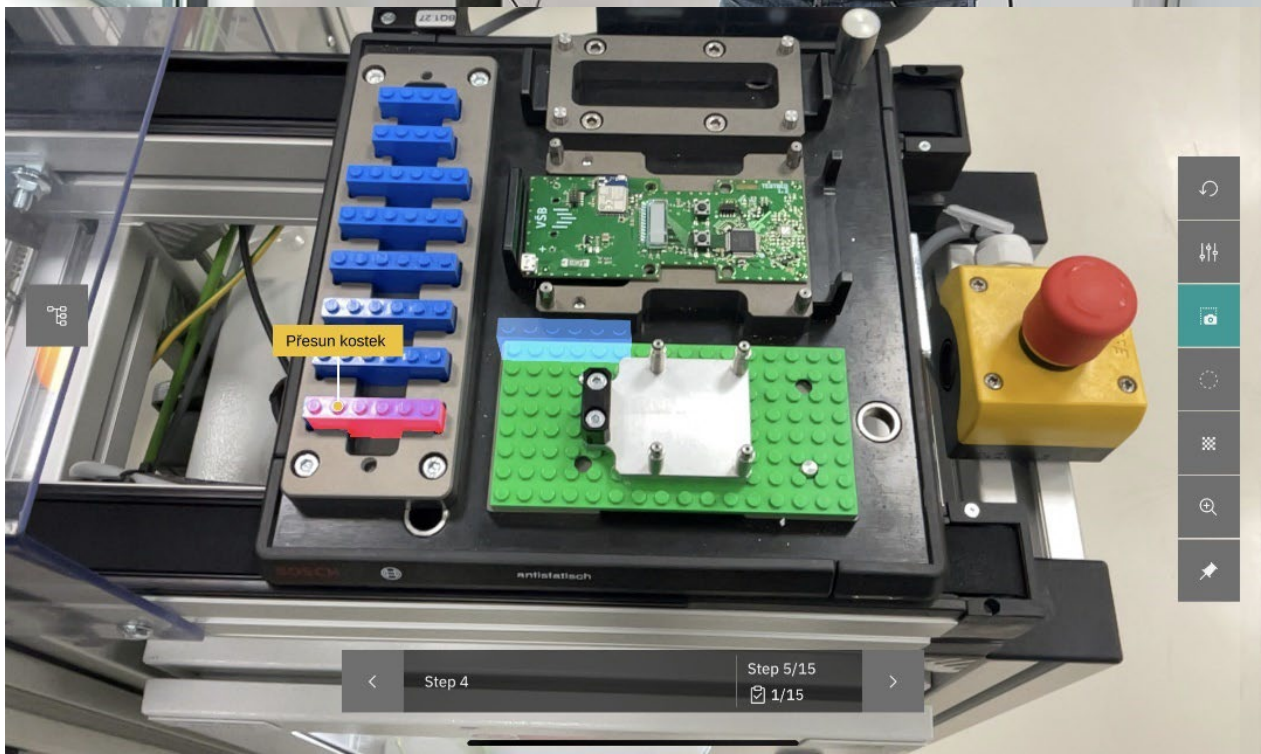
Industrial VR/AR reality applications

Smart Factory has technologies where digital models of systems can be viewed in 3D space using virtual reality to get a more detailed idea of the design and functionality before actual implementation.

Thanks to the use of the digital twin of the Smart Factory, it is even possible to have a look at the current state of the line in VR.

Technologies are also available for the use of augmented reality in machine operation, maintenance and assembly.



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Equipments

- **Robotics** – 6-axis robotic arms KUKA, 3/6-axis robotic arms Mitsubishi Electric, Fanuc.
- **Automation** – programmable controllers Siemens, BaR, Bosch Rexroth, Mitsubishi Electric.
- **Digital twin** – SW NX, NX MCD, Tecnomatix Process Simulate, Visual Components, Teamcenter.
- **Engineering SW** – TIA Portal, WinCC, Automation Studio, IndraWorks, Kuka.Sim Pro, IQ Works.
- **Machine vision** – Basler, Photoneo.
- **Mobile robotics** – MIR.
- **Transport systems and drives** – Bosch Rextorh, Siemens.
- **Functional safety** – Leuze.
- **MES** – Siemens Opcenter Execution Discrete.
- **Virtual reality** – HTC Vive.
- **Augmented reality** – Visometry, Diota.
- Laboratoř je poktyta 5G sítí.

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Partners

Automation systems producers

- Siemens, BaR, Bosch Rexroth, Kuka, Mitsubishi Electric, Phoenix Contact, Leuze, General Electric, Visometry…

Engineering companies

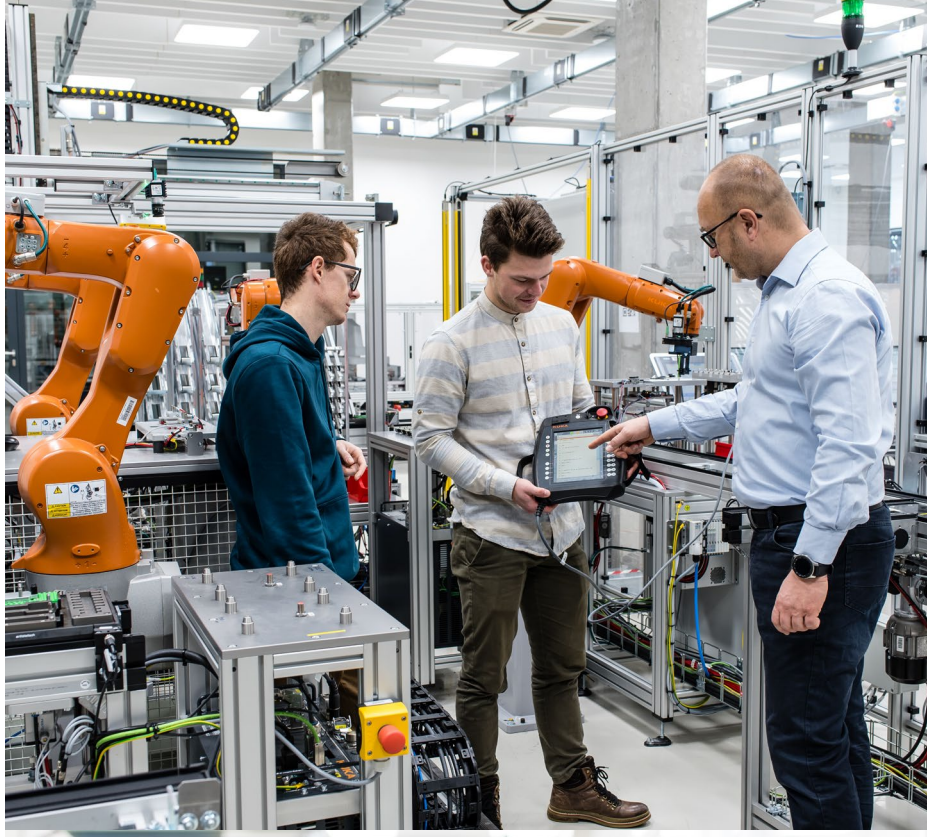
- Elvac, Ingeteam, Temex, CBG Automation, ECM, Taurid …

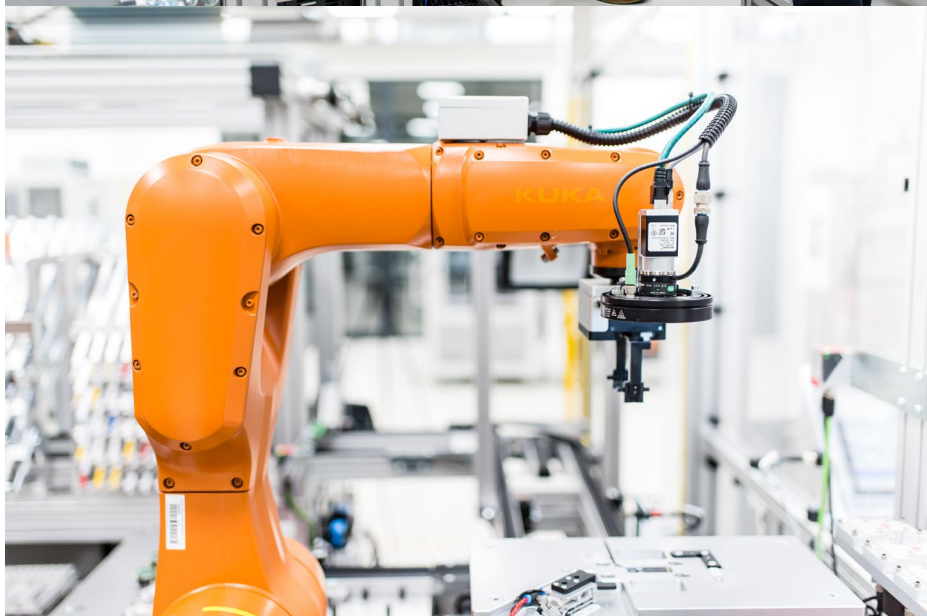
Manufacturing companies

- Siemens ,Brose, Vitesco, NC Line, Maxion Wheels Czech, Vítkovice Cylinders, Technotron Metal, Varroc …

Others

- Fraunhofer Institut IWU, ICT, NCP 4.0, MSIC…





Running projects in 2023/2024

- **EDIH Ostrava**, European Digital Innovation Hub Ostrava, Test-before-Invest activities
  - Elvac – Automated control applications design.
  - Technotron – Digitalization of warehouse management.
  - NC Line – Virtualization and optimization of production lines.
  - CTBC Investment – Automatization of mice breeding.
- **OP ST, REFRESH** - Research Excellence For REgion Sustainability and High-tech Industries (2023-2027)
- **CET Partnership, Call 2022. NewHeatIntegrated** - Highly flexible and modular PCM based thermal energy storage system for efficient heating applications in the built environment (project partner, partners – Fraunhofer Institut, University of Vaasa, nollaE, BME 2023–2026)
- **TAČR Delta, GUMES** - GreenUrbanMobilityEcoSystem (project partner, partners – FIBRES, Fraunhofer Institut, STRATOS, PFEIFER, 2024–2026)
- **H2020-WIDESPREAD-2018-03**, program Twinning, CSA, 856670, **GeoUS** – Geothermal Energy in Special Underground Structures (coordinator, partners – Fraunhofer Institut, University of Vaasa, 2020–2023)
- **OP PIK Aplikace**. Automated calibration system for end gauges up to 100 mm. (partners – TLO, VSB-TUO, ECM Systém Solutions, 2022–2023)
- **TAČR Trend**, Robotic experimental workstation for precise evaluation of product quality. (partners – ELVAC, VSB-TUO, 2020–2023)

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http://smartfactory.vsb.cz/

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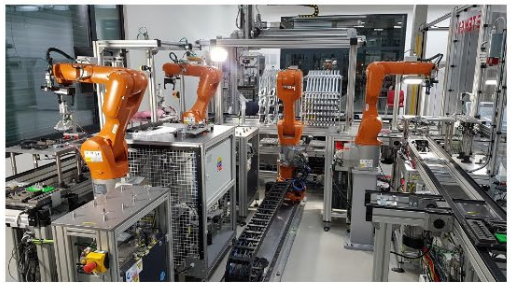
CPIT TL3 - Smart Factory

Smart Factory is a platform built in accordance with the principles of the Industry 4.0 concept. Smart Factory is a comprehensive, well equipped laboratory for teaching, demonstration, testing and research of technologies used in the digitization of industry. Smart Factory is a space for academia to meet and cooperate with industrial partners. Smart Factory was built at VŠB-TU Ostrava within the project "Platform of new technologies FEI CPIT TL3", CZ.02.2.67/0.0/0.0/16_016/0002467 and launched in autumn 2020.



Smart Factory

The heart of Smart Factory is an assembly line equipped with industrial robots, a distributed control system based on PLCs, HMI / SCADA visualization systems. The line is extended by a comprehensive

Mobile robotics

Mobile industrial robots are used to transport finished products within the Smart Factory, enabling autonomous movement throughout the laboratory. The laboratory is ready for demonstration and testing

Industrial robotics

10 industrial robots are installed within the Smart Factory in various types of tasks. Each installation enables the solution of typical tasks with industrial robots as well as special robotic tasks as precise

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