IFT Institute for Production Engineering
and Laser Technology

Univ.Prof. DI Dr.techn. habil. Friedrich Bleicher

Towards Autonomous Machining

Raschendorfer A., Bleicher F.

ICSM 2018, Anting, Shanghai

TECHNISCHE
UNIVERSITÄT
WIEN

IFT - Organization and Fields of Research

Institute for Production Engineering and Laser Technology
Head: Univ.Prof.Dr. F. Bleicher

Area of Research Manufacturing Technology
Univ.Prof.Dr. F. Bleicher

Area of Research Laser Technology
Univ.Prof.Dr. A. Otto

- **Technology**
  - Cutting Technology
  - Non Conventional Machining
- **Machine Tools and Production Systems**
- **Metrology and Quality**
- **Manufacturing Automation**
  - Competence Center for Digital Production
  - Control and Automation Technology

researchTUb


RSF Zerspanungstechnik


Haas Werkzeugmaschinen


Messtechnik Möller


B&R

Pilotfabrik Industrie 4.0

IFT - Organisation and research groups

Institute for Production Engineering and Laser Technology
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Area of Research Machining Technology
Univ.Prof. Dr. F. Bleicher

Technology

- technology development and optimization
- cutting and forming technology
- electrochemical machining
- resource efficiency
- process simulation

RSF Zerspanungstechnik

Machine tools and production systems

- machine tool design and optimization
- plant design
- simulation of machine tools
- industrial handling
- metrological evaluation

Haas Werkzeugmaschinen

Metrology and Quality

- production quality
- production metrology
- development of metrology applications
- nanometrology
- GPS – geometric product specification

Messtechnik Möller

Manufacturing automation

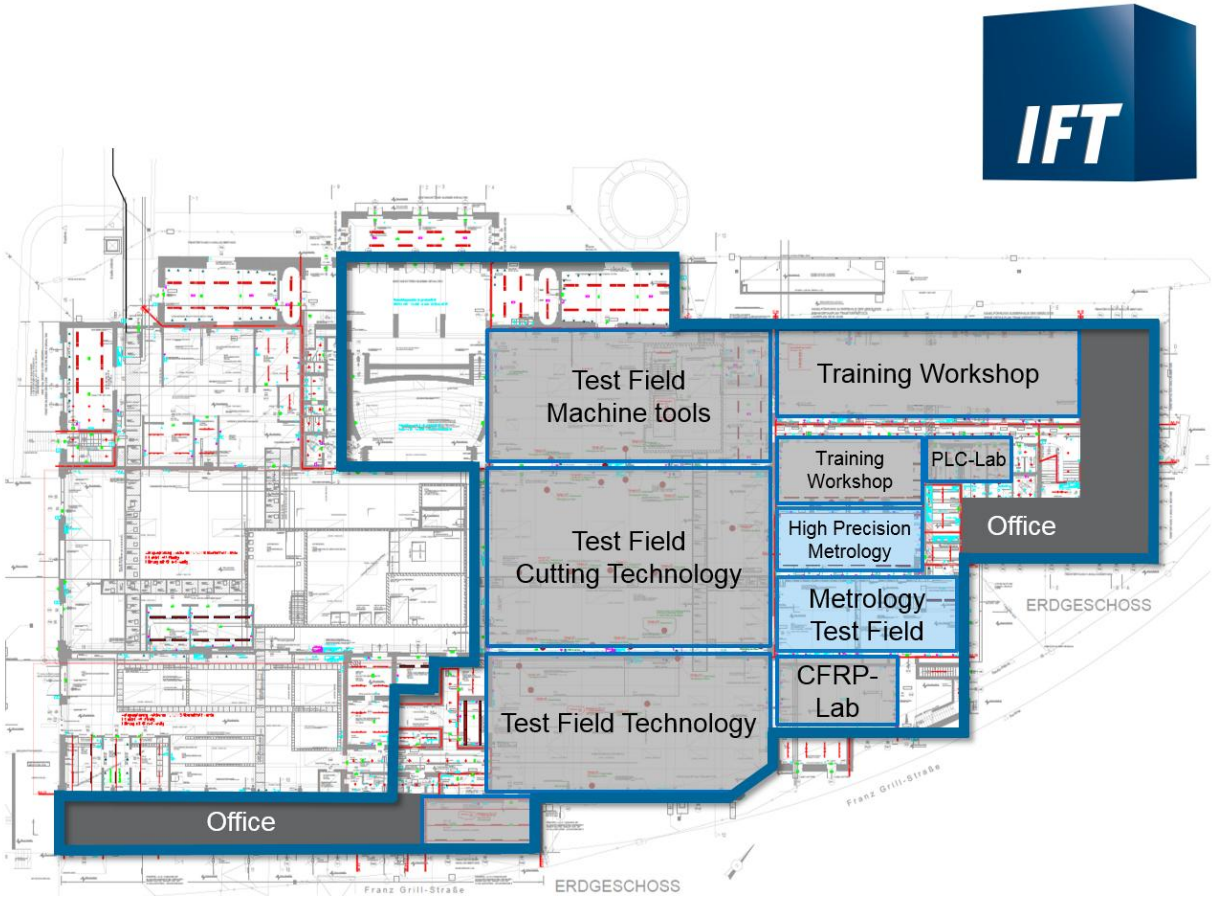
- automatization tech.
- NC-control technology
- mechatronics
- robotics
- manufacturing management
- production design and control

B&R

IFT - Laboratory for Manufacturing Technology

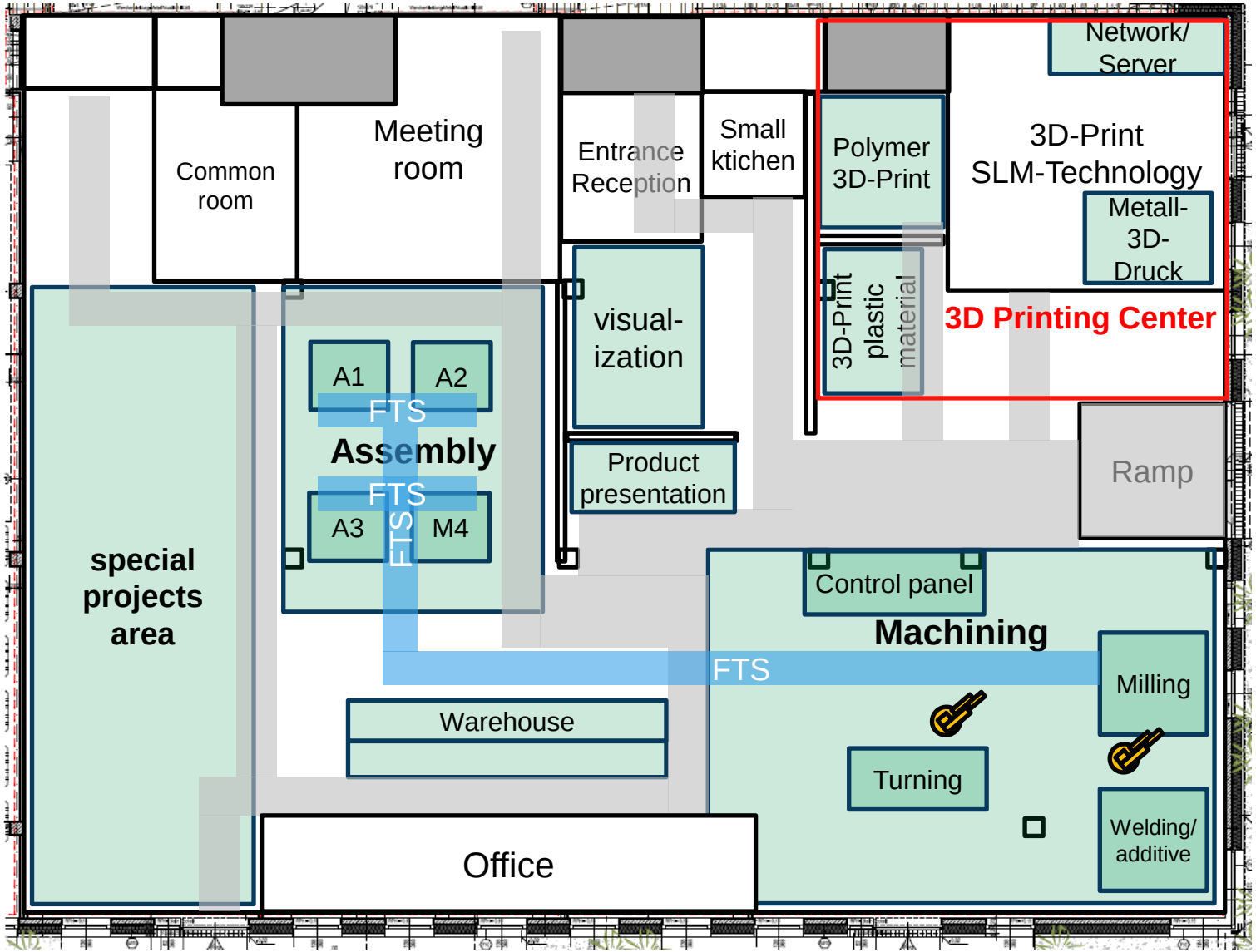
TEC-Lab

Franz-Grill-Straße 4, Obj. 221
A-1030 Vienna, Austria



3 750 m² (40 365 ft²) building space, 30 workplaces for scientific staff, 3 conference rooms, lecture hall, training workshop for student education, cleanroom (ISO 6)

Pilot factory of TU Wien



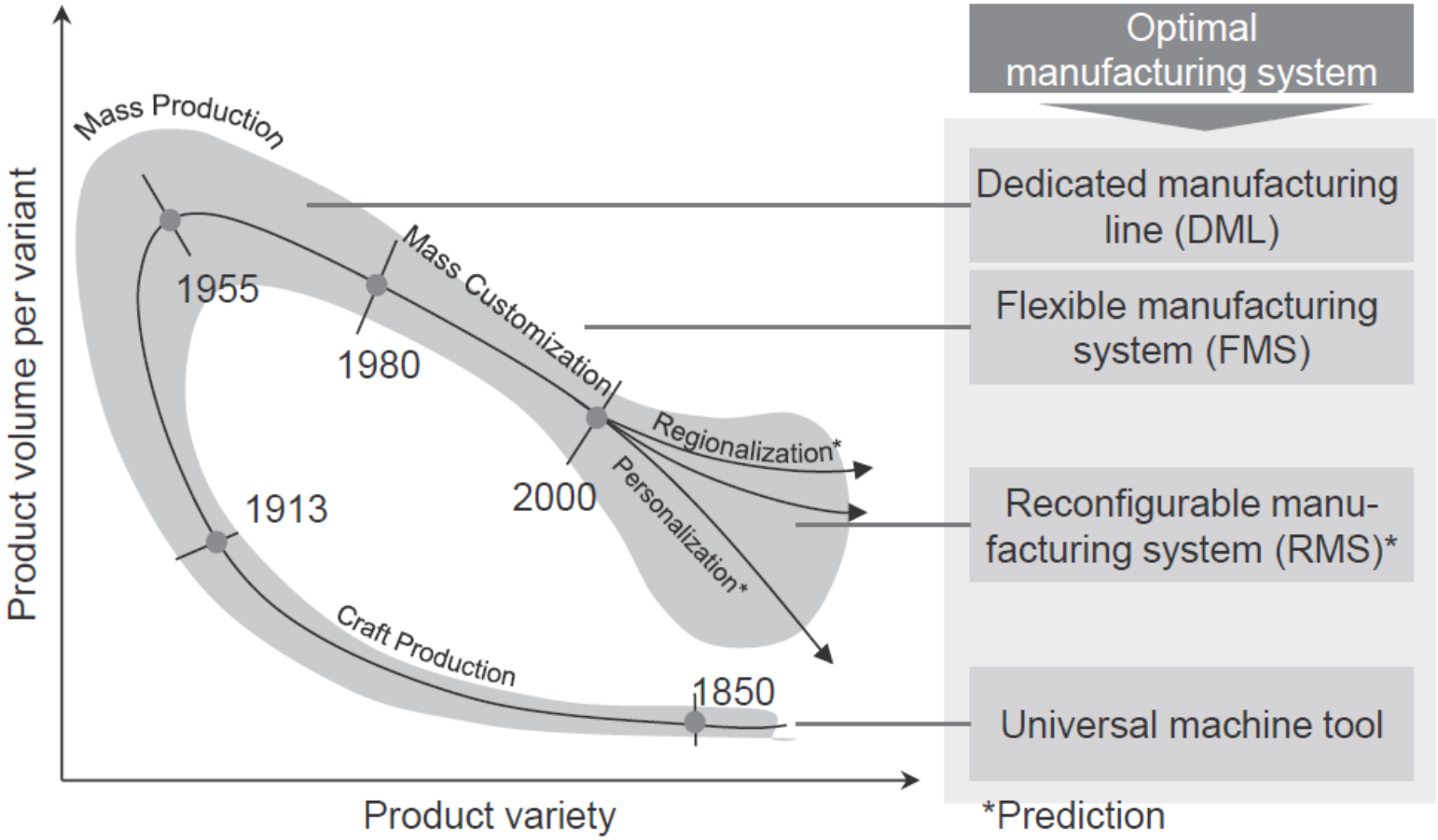
Pilotfabrik Industrie 4.0

Pilot factory of TU Wien

Machning cell with robots and agv
milling – turning – welding/additive

Pilotfabrik
Industrie 4.0

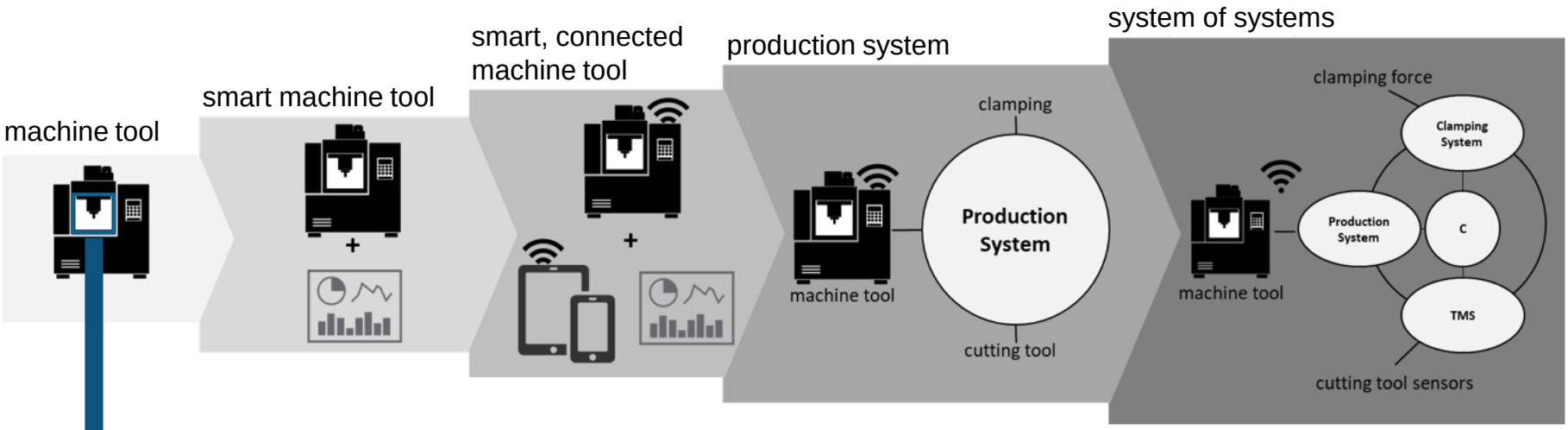
Trends in Manufacturing



Source: Koren Y.: The global manufacturing revolution. Product-process-business integration and reconfigurable systems, Hoboken, NJ: Wiley, 2010

Fields of Research

- develop the manufacturing systems of the future



overcome existing process limitations

CDP – Center for Digital Production

The CDP is supported by a network of more than 30 companies and 20 research institutions

M2M – Communication:
Standardised and real time capable M2M communication mechanisms allow sensing and reconfigurable machining infrastrucutres

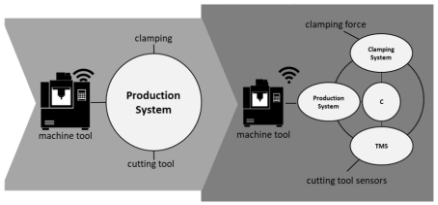
Data Analytics:
Comprehensive and in-depth data aquisition allows im-mediate improvements of processes, and shopfloor and quality management

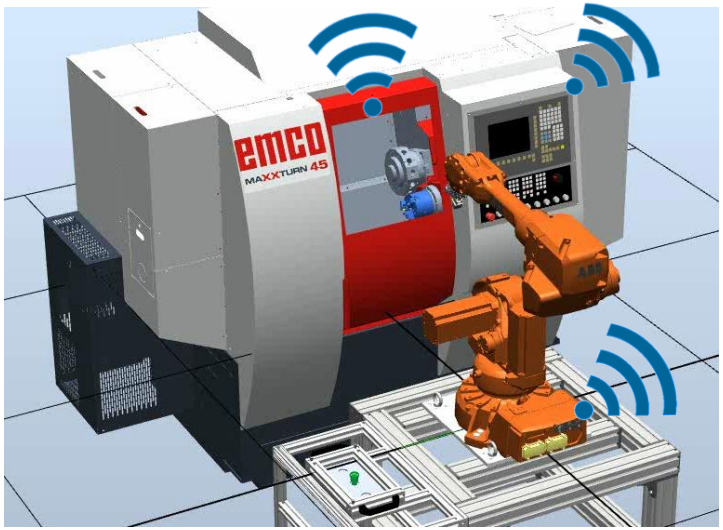
Automated Lot Size 1:
Integrating design automation with M2M enabled machinery allows single part production with a cost footprint of high volume production.

Dyn. Production Networks:
Interconnecting individual automated shopfloors allows the creation of virtual factories anables higher valued production.

Fields of Research

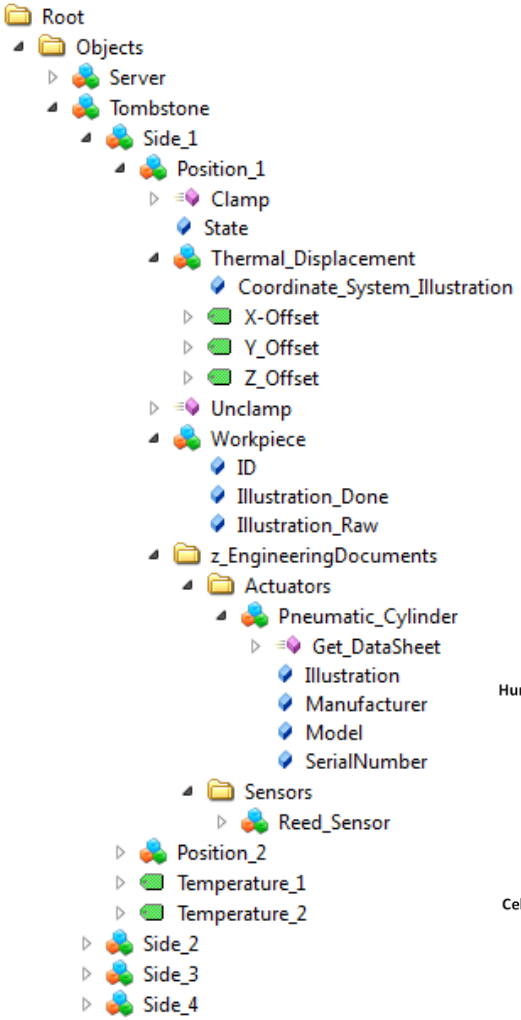
- collect, store, visualize & analyze data
- orchestration and integration of hardware (sensory tool holder, etc.)

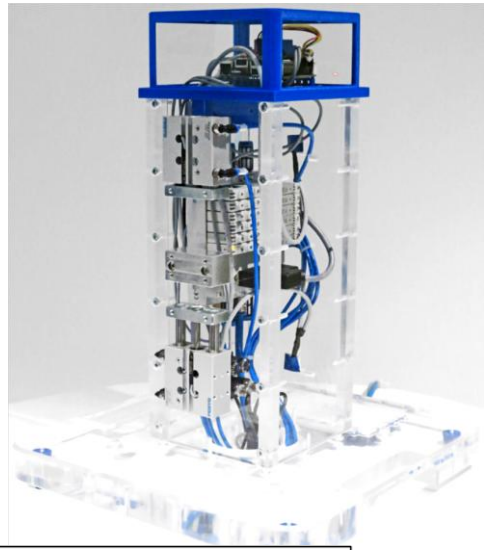


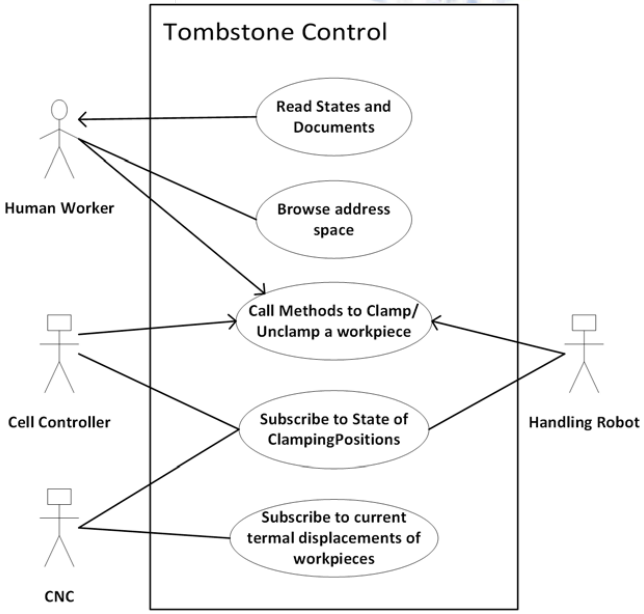


Cyber-Physical Systems

- Clamping device as a showcase
- Tombstone offers data and functions using OPC UA
  - Engineering data
  - Sensoric data (temperature, stresses, clamping force)
  - communication by means of OPC UA
  - Calculation of the thermal distortion due to temperature change



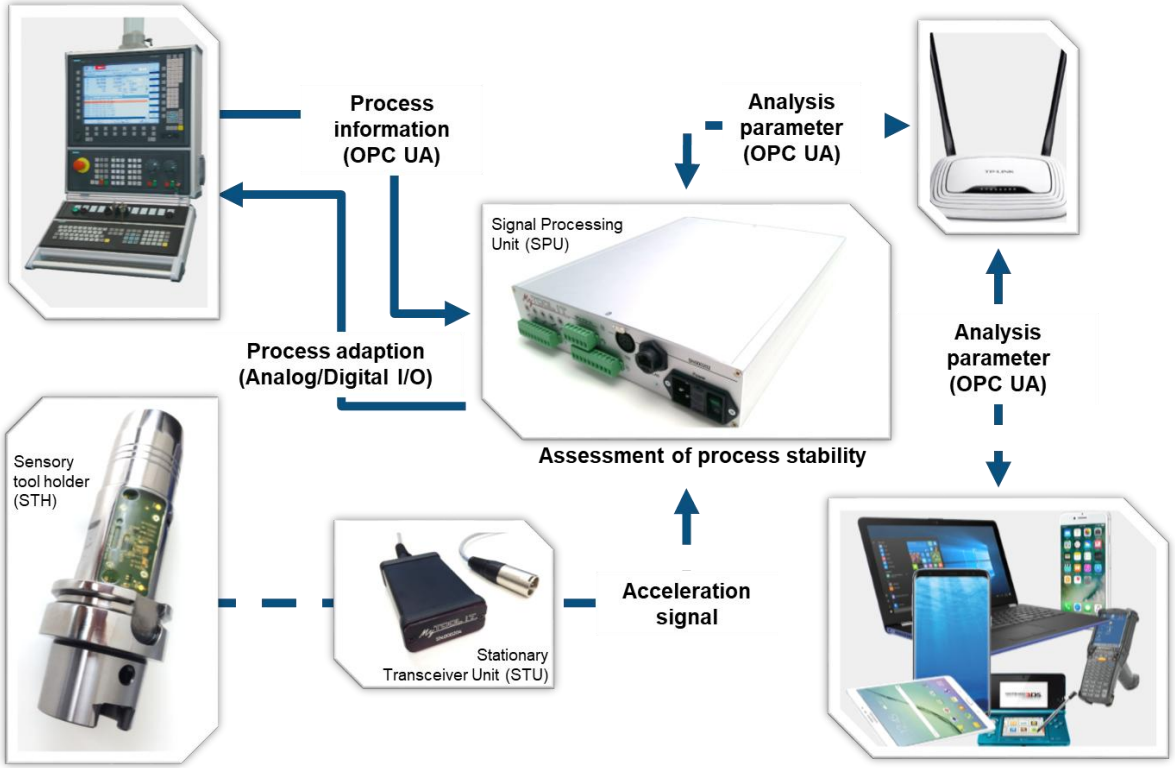




Adaptive control system with a sensory tool holder

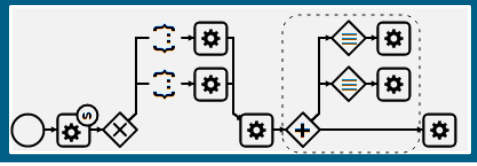
- Detect and avoid milling process instabilities like “chatter”
- Active control system to allow in-process adaption of machining parameters
- Sensory tool holder with acceleration sensor and wireless data transmission
- Signal processing unit is coupled to the NC-control of the machine in real time
- In-process regulation of feed rate and rotational speed depending on strategies

- Cooperation with



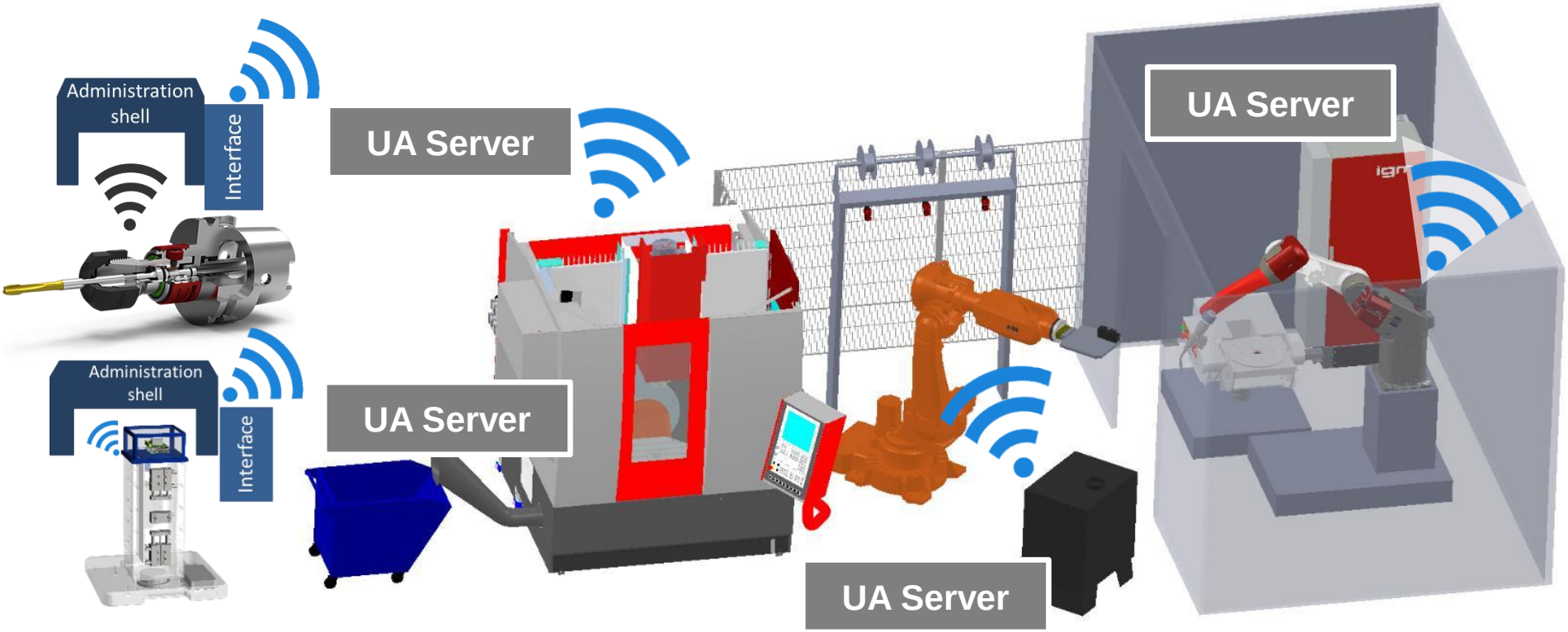
Composing Production Systems

Process Engine



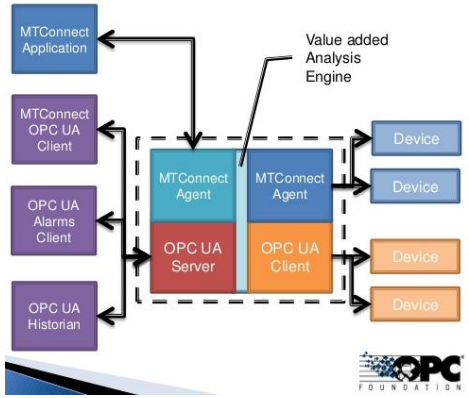
Endpoint-Drivers

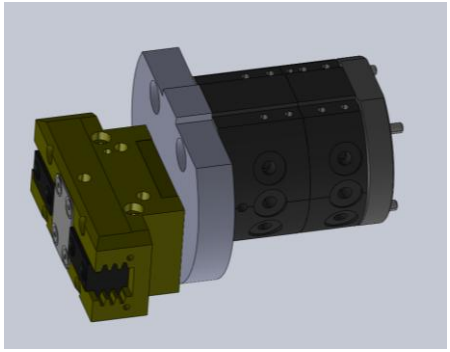
UA Client

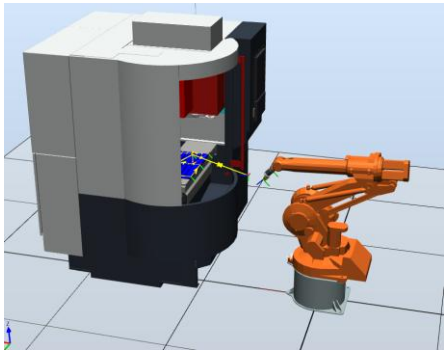


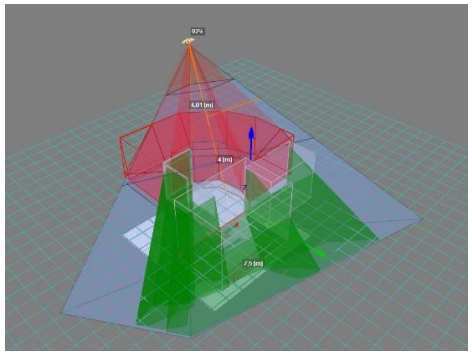
Demonstration cell at AMTC

- Collaborative work between AMTC, CDP, IFT, KIT
- Automation
  - Layout
  - Simulation
  - Robot handling
- Development of manufacturing orchestration
  - Interfaces
  - Transformation to machine layers
- Adaptive security system









Demonstration cell at AMTC

- EMCO Concept Mill 260
  - Table size: 520 x 300 mm
  - Table load: max. 100 kg
  - Spindle drive power: 7 kW
  - 20 tool stations

- ABB IRB 1410
  - 6 axes
  - 5 kg handling capacity
  - Reach of 1.44 m

- Work piece provided by an AGV

- Step 1: Full automated production cell using quick change systems for grippers and pallet systems

- Step 2: Flexible and autonomous manufacturing cell using an orchestration software (Centurio, OPC UA)

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