The role of industry 4.0 – Towards turnkey manufacturing solutions

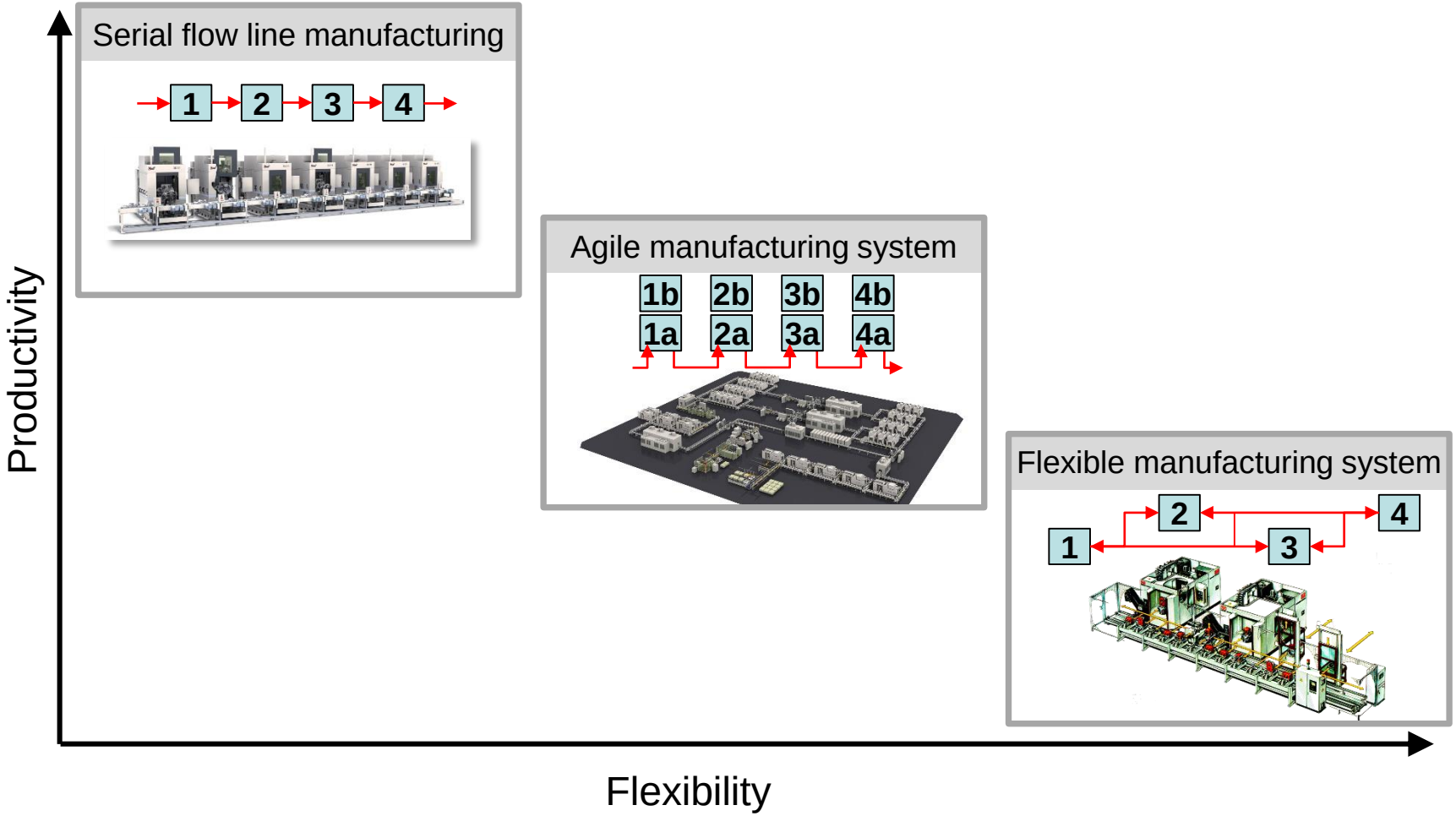
Prof. Jürgen Fleischer, KIT
Prof. Bin SHEN, Tongji University
Prof. Weimin ZHANG, Tongji University

AMTC – Advanced Manufacturing Technology Center

Agenda

Industry 4.0 – Introduction

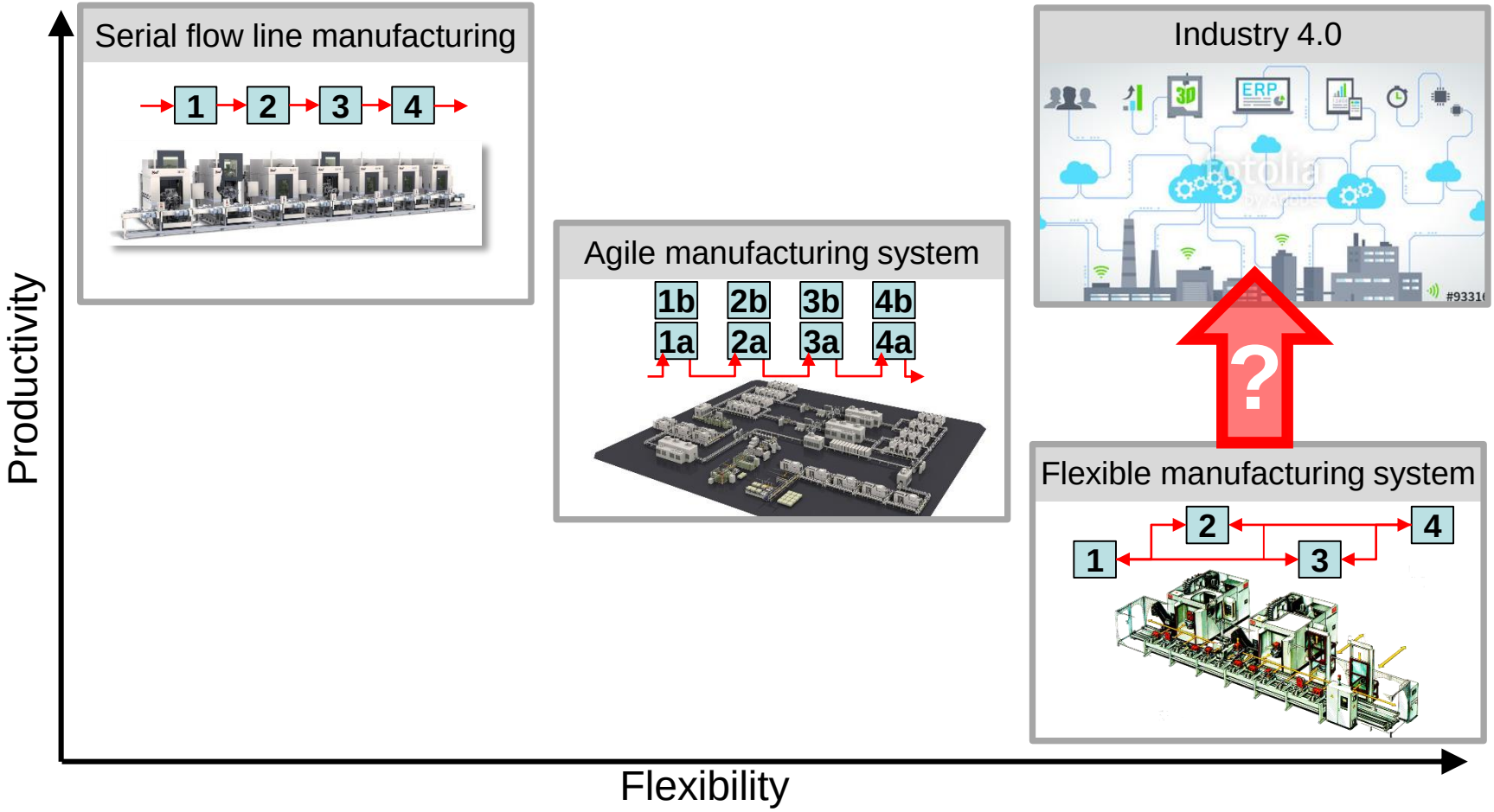
Production today



MAG, Traub ; Pr-x.de

Industry 4.0 – Introduction

Vision



Industry 4.0 – High flexibility combined with high productivity

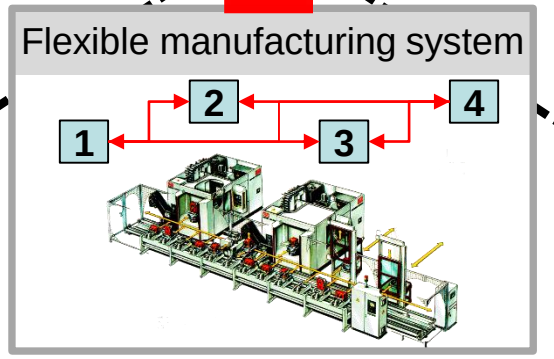
MAG, Traub ; Pr-x.de; Fotolia

Industry 4.0 – Introduction

Challenges

Low setup time

Low storage



Direct link between manufacturing and assembly

Reduction of waste through integrated QA

Traub ; Fotolia

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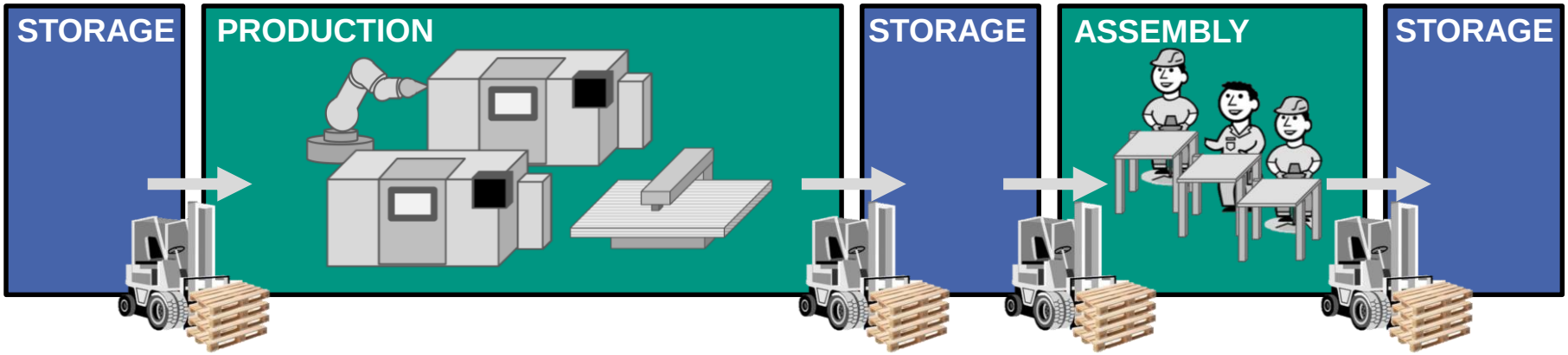
Introduction

Presentation of the demonstration line

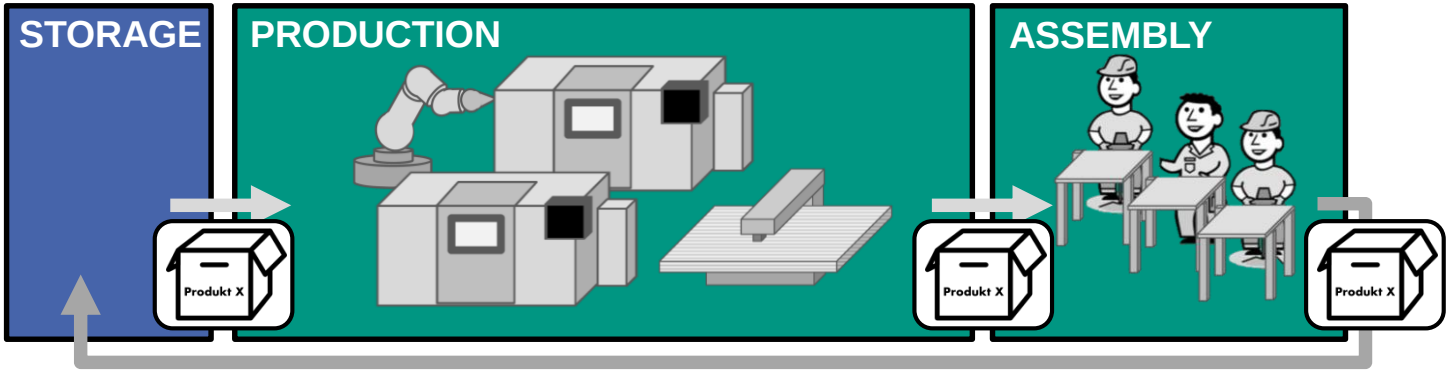
Goal:

- Demonstration line for the production for batch size 1+ with i4.0 technologies

Actual production



New production with with i4.0 technologies



Pictures: Stricker N. wbk 2013

Introduction

Presentation of the demonstration line

Goal:

- Demonstration line for the production for batch size 1+ with i4.0 technologies

Expected results:

- Autonomous manufacturing with real time control
- Accelerated troubleshooting during production processes
- Networking of machines with OPC UA
- Smart automation of machines, operations and handling equipment
- Data collection during manufacturing to improve the global process
- Highly reduced inventory in the production

Demonstration product:

Bosch-Rexroth hydraulic valve

Introduction

Presentation of the demonstration line

Approach:

Valve spool

valve block

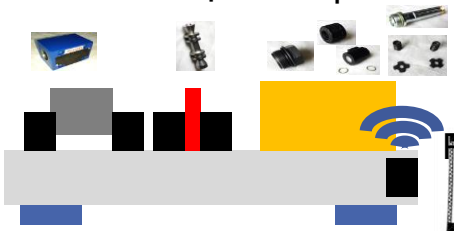
Additional parts

Workpiece carrier

Clamped valve block

Valve spool

Additional parts



RFID

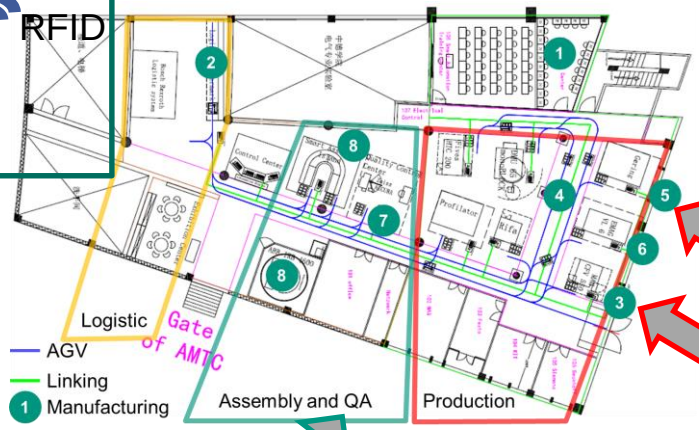
Zero point clamping

Conveyor

Logistic

Cloud

Control



Milling

Turning

Assembly & QA

Information and material flow are transported on the workpiece carrier

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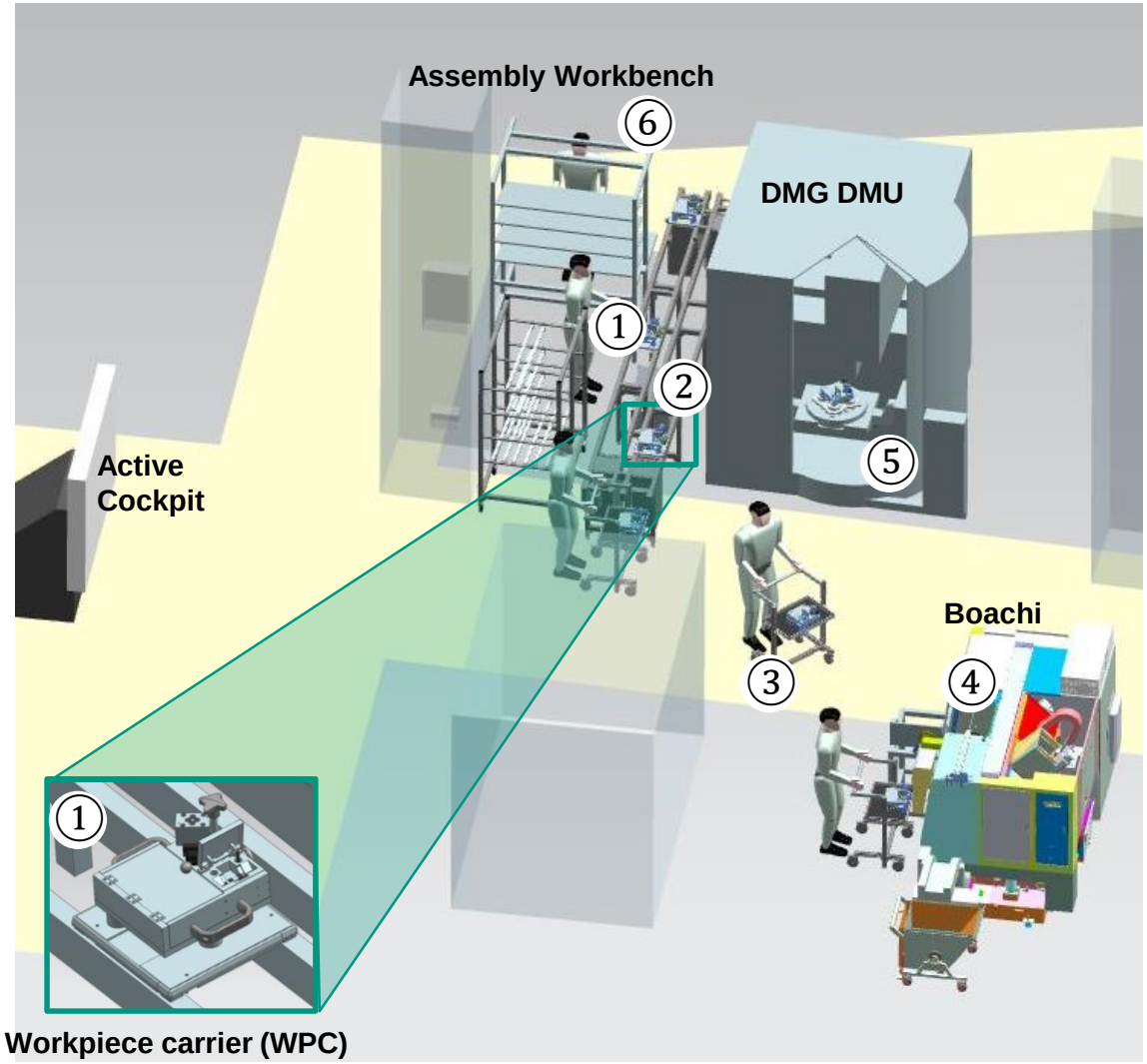
Material Flow



Step ① - Workpiece carrier:
- Loading of the valve parts at the Supermarket
- Identification through RFID
- Clamping of the valve block
- Transport of valve spool

Step ② - Transportation system TS2
- Registration via RFID
- System status via OPC-UA
- Docking of transport vehicle

Step ③ - Transportation system vehicle
- Hand driven vehicle
- Docking into reference position @Baoji and @TS2 via zero-point-clamping

Step ④ - Baoji
- Docking of transport vehicle
- Workpiece (spool) handling via robot
- Registration via RFID
- Machining status via OPC-UA

Step ⑤ - DMU
- Clamping of workpiece carrier via Zero-Point Clamping
- Loading by hand
- Registration via RFID
- Machining status via OPC-UA

Step ⑥ - Assembly
- Registration via RFID
- Assembly status via OPC-UA

Information Flow

Active Cockpit

- PC with OPC-UA Client

LAN

Workbench

- IndraControl L45 with OPC-UA Server

DMG DMU 65

- Integrated OPC-UA Server

Baoji lathe

- IndraMotion with OPC-UA Server
- XM21 with OPC-UA Server

Schunk LWA Robot

- Robot Control Unit

TS2

- XM21 with OPC-UA Server

Concept highlight: unified communication via OPC-UA

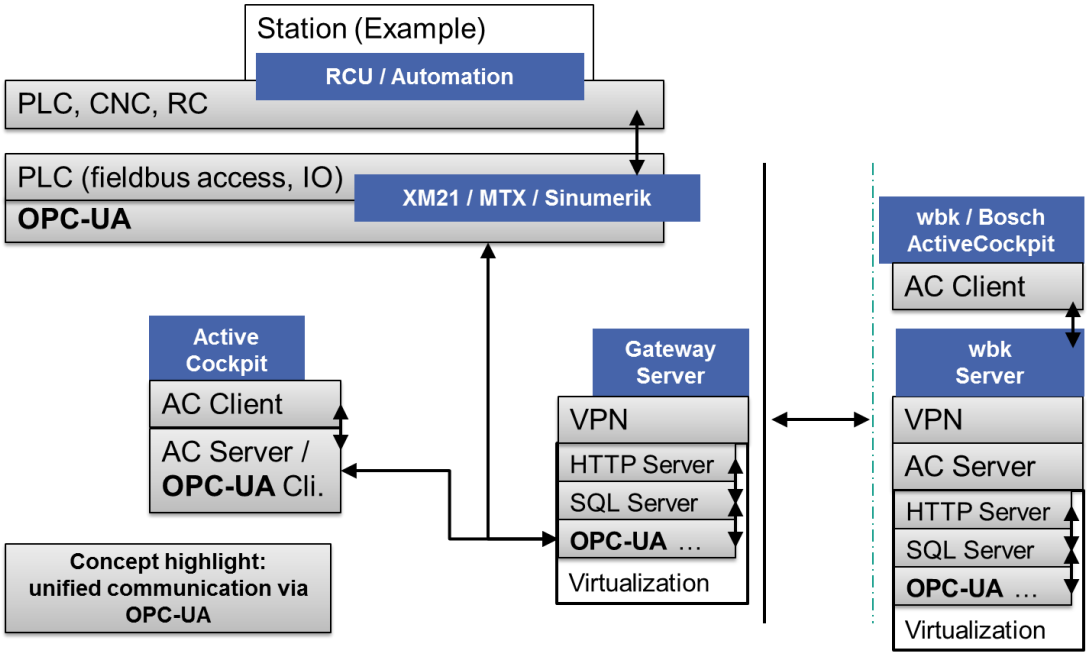
Concept – Services

Server:

- Each machine or station is equipped with its own OPC UA Server
- The OPC UA server provides live information about the station available
- The OPC UA server provides methods that allow control of the station

Client:

- Counterpart to the server is an OPC UA client
- The OPC UA client is on a computer in the local Ethernet network, it can access the information from the stations and control the production process
- The OPC UA client is live information to the Active Cockpit further, for the visualization and monitoring of the production process



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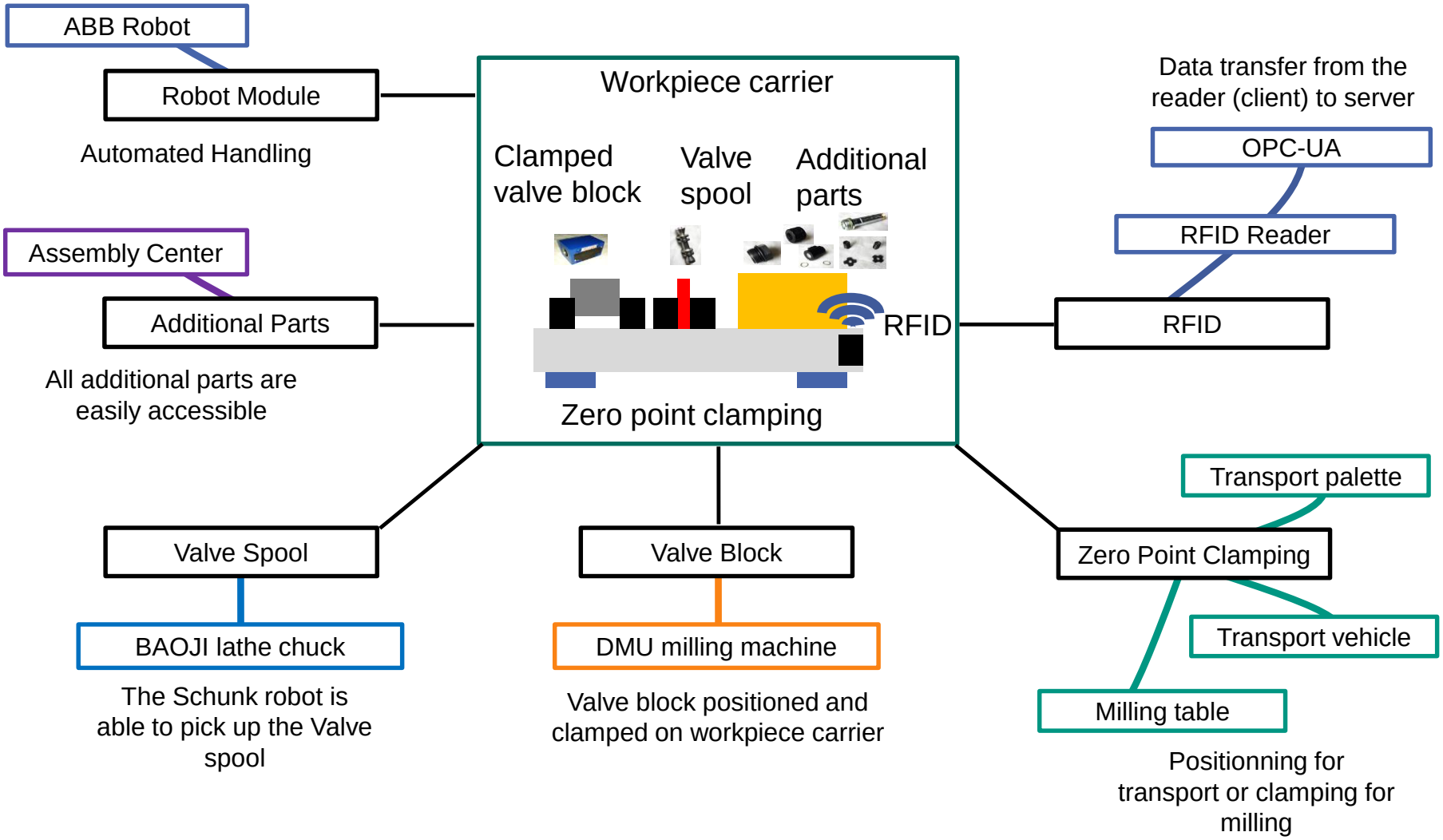
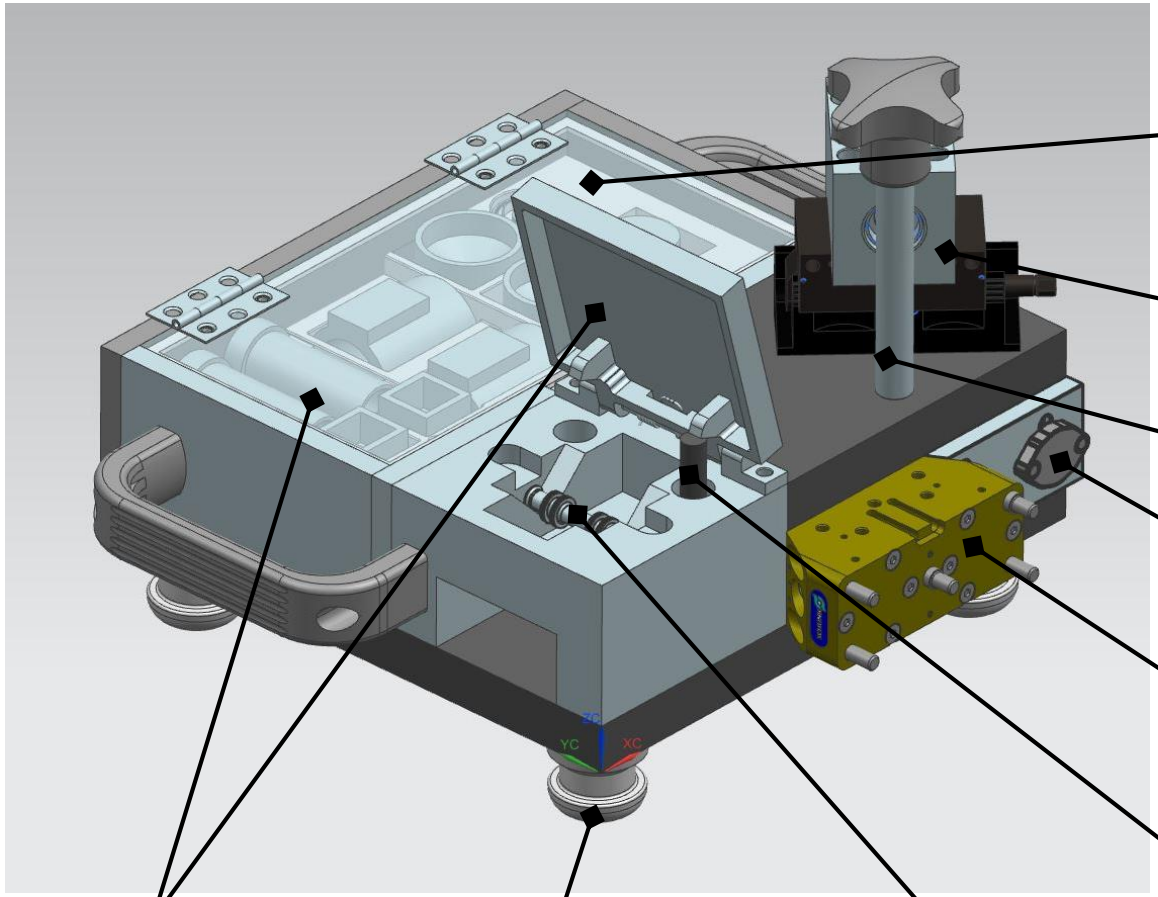
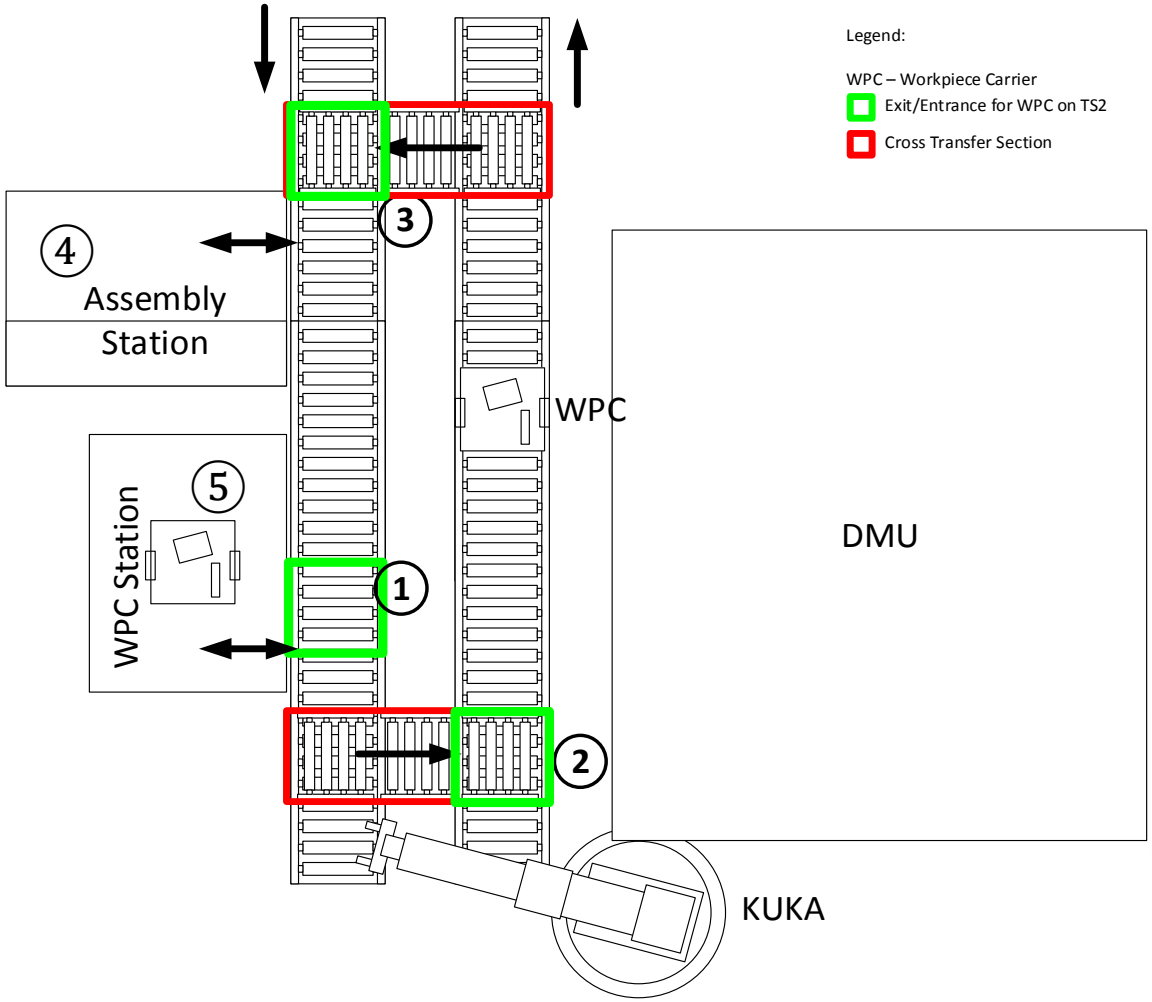
Workpiece carrier
Function Structure



Work piece carrier
concept



Work piece carrier
Transport on TS2



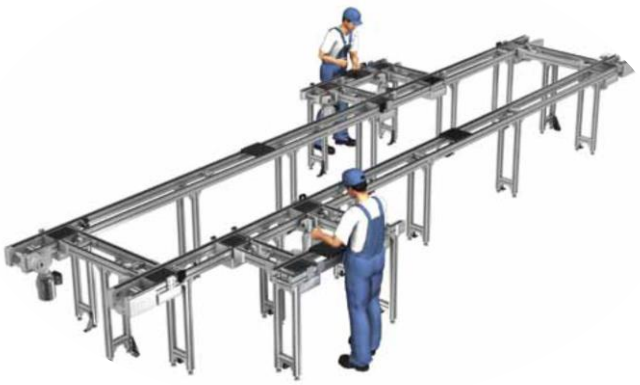
① Entrance Point for new WPC onto TS2 Conveyor Belt

② Loading/Unloading of WPC from WT2

③ Unloading of WPC onto Assembly Workbench

④ Assembly Workbench

⑤ Supermarket/WPC Mounting station

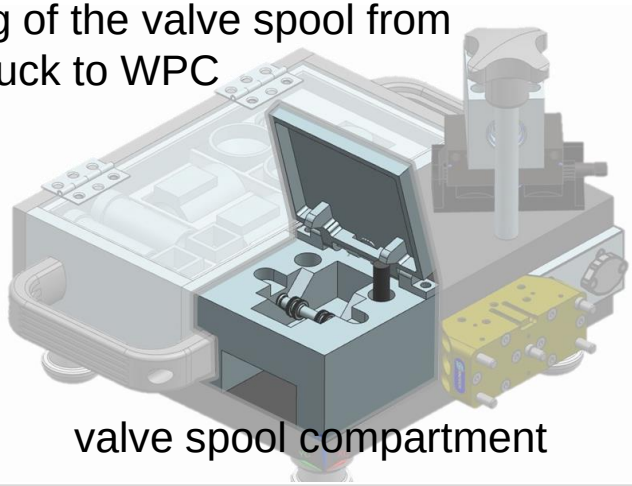


Automation Concept for BAOJI

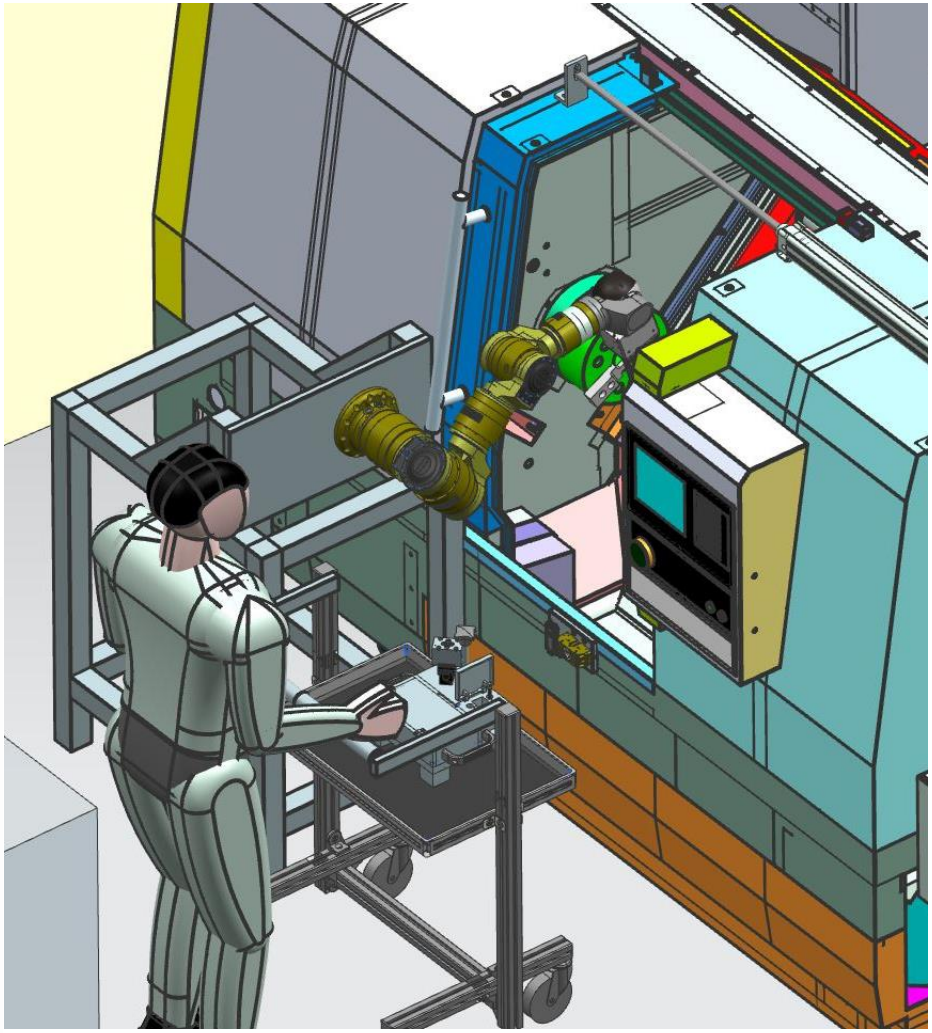
Automation of Baoji with the robot LWA 4D from Schunk

Automation steps:

- Docking of the vehicle
- Opening of the valve spool compartment
- Handling of the valve spool from WPC to Baoji chuck
- (Turning)
- Handling of the valve spool from Baoji chuck to WPC



valve spool compartment



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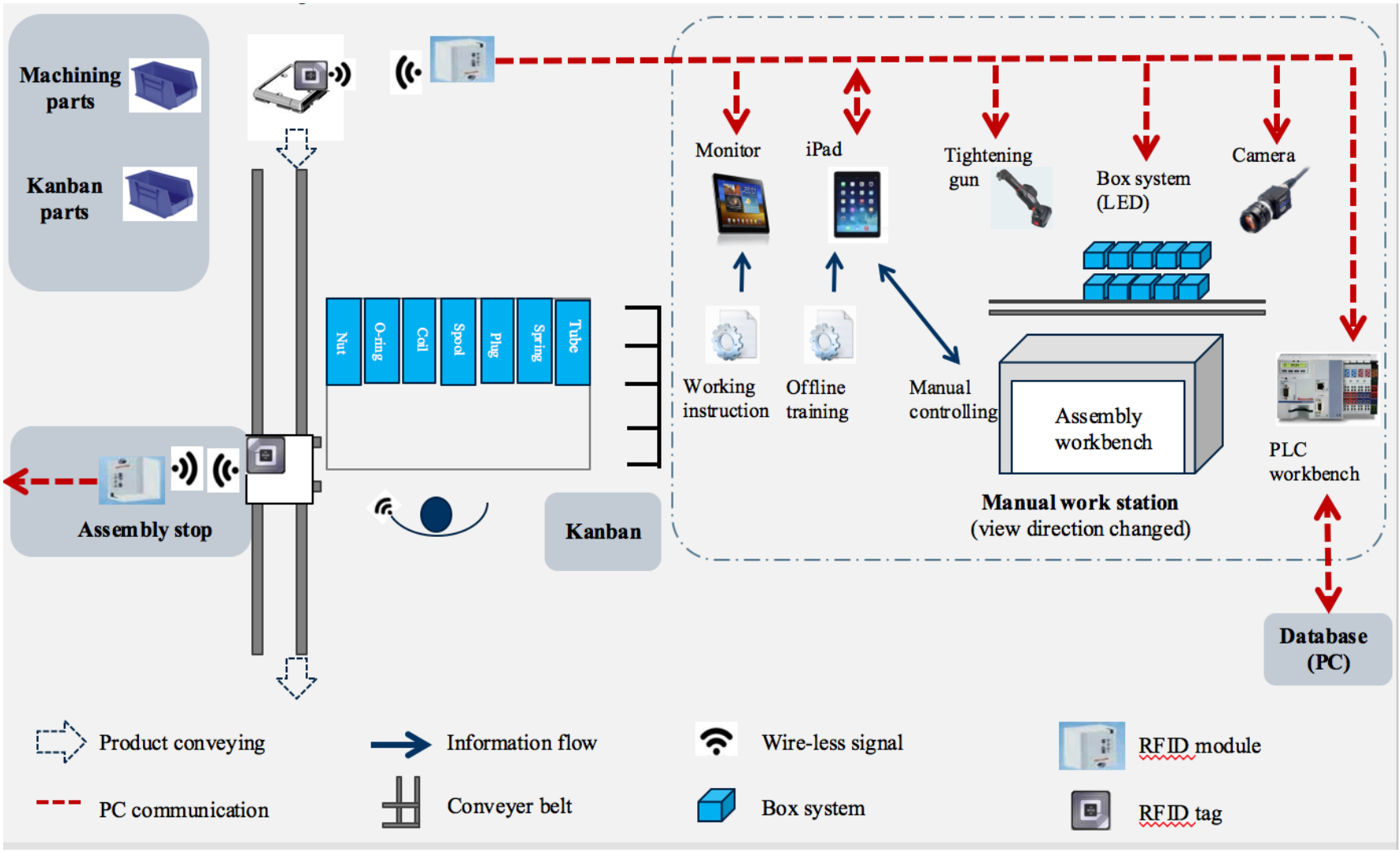
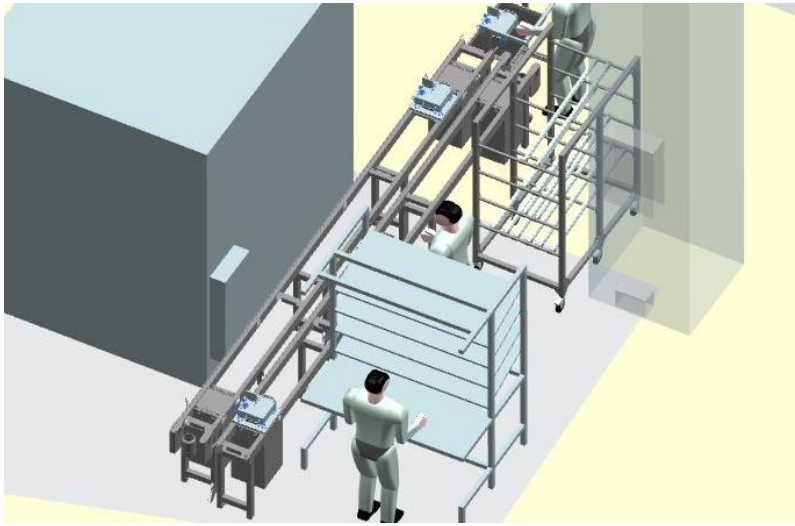
Smart assembly



Smart assembly

- The valve variant (block, spool, additional parts) are entered on a tablet or detected via RFID
- Possibility of virtual training for employees to practice the assembly sequences
- The next assembly step is displayed as soon as the camera mounted above the workbench determines that the assembly step has been successfully completed
- Pick by light: the PLC activates the LEDs in the Workbench for the next step
- Nexo intelligent tightening guns are used to tighten the screws, allowing control of tightening torque and wireless communication
- The assembly is monitored at the Active Cockpit. Following Data are to displayed:
  - times per workpiece and per operation,
  - torque figures,
  - warnings and errors,
  - digital stock overview



Quality assurance

The entire workpiece carrier is set on the coordinate measuring machine

Following tolerances are tested:

- diameter of each section of the valve spool

- the size of the different boring diameters of valve block

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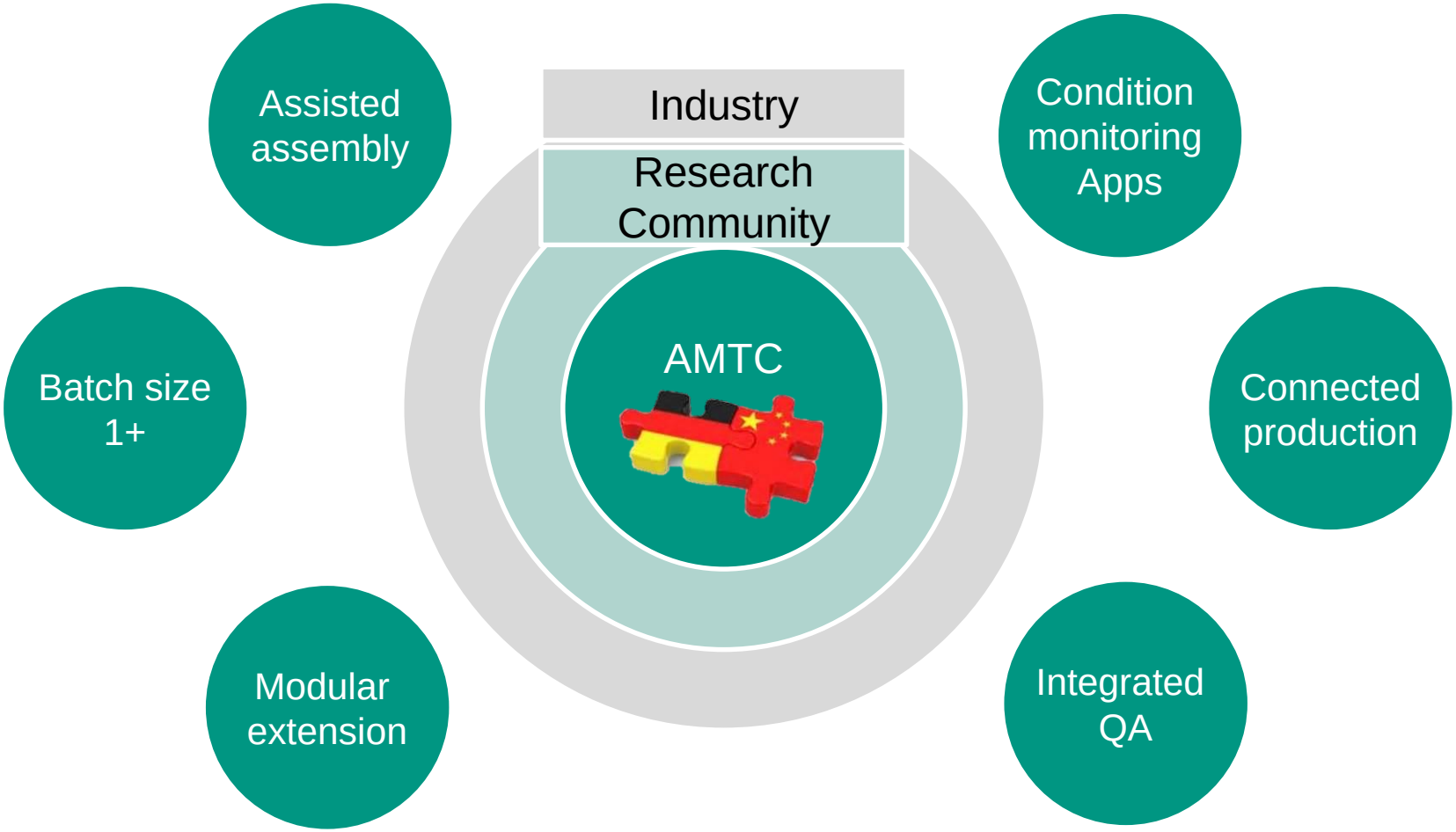
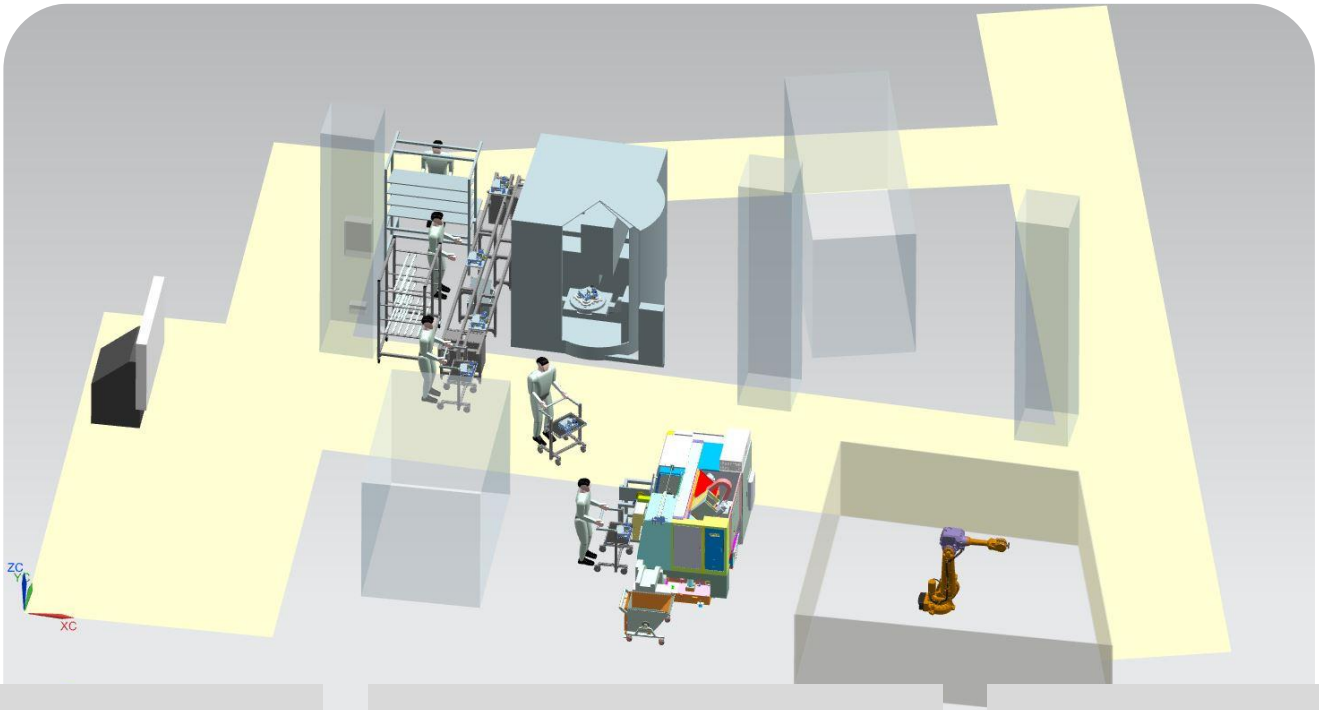
Next steps: Set up of a Sino-German cooperation platform



Customized production solutions with high OEE

Thank you for your attention



Prof. Dr.-Ing. Jürgen FLEISCHER
wbk Institute of Production Science

Kaiserstr. 12, 76131 Karlsruhe
Tel.: +49 721 608 44011
Juergen.Fleischer@kit.edu
www.wbk.kit.edu

Prof. Dr.-Ing. Bin SHEN
AMTC

Cao An Gong Lu 4800, Jiren Lou,
Room 217, 201804 Shanghai
Tel.: +86 21 6958 8715
bshen@tongji.edu.cn

Prof. Dr.-Ing Weimin ZHANG
AMTC

Cao An Gong Lu 4800, Jiren Lou,
Room 218 201804 Shanghai
Tel.: +86 21 6958 8981
iamt@tongji.edu.cn