FESTO

10.00 Industry 4.0 implementation and qualification at Festo

- Target definition
- Flexible Automation
- Some examples of Festo Production Plant
- Technology behind Industry 4.0
- Qualification for Industry 4.0

The Spirit of Industrie 4.0

flexible

cooperative

autonomous

communicating

self organizing

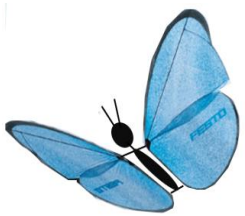
intuitive

efficient

mobile

light

easy to use



The Goal of Industrie 4.0

- for Festo internally (e.g.)

to increase the productivity of the plants

to increase Energy Efficiency

to master the complexity of variants

to improve Diagnostics and Maintenance Process

- for Festo Customers (e.g.)

to increase engineering productivity

to offer highly functional products / systems

to offer energy efficient products / systems

to offer additional services

The Festo Group

Turnover: 2.45 billion / 18.000 employees worldwide / 60 subsidiaries active in 176 countries for 300.000 clients

Innovative and self-learning: 3,000 patents, more the 100 innovations/year Education investments: 1,5% of sales

Festo Didactic

Core locations in Germany, Canada and USA

60 Festo locations / over 900 employees worldwide

active in 176 countries for 300.000 clients

The holistic approach of Festo

Automation

Productivity

Education

Components

Systems / Solutions

Machines/ Systems

Training / Consulting

Learning Systems

People / Organization

Increasing the productivity of over 300.000 clients worldwide.

Flexible Automation

"In order to secure the existence and ensure com-petitiveness of companies, it is absolutely necessary that production planners and those responsible for factory organisation learn how they can compensate for market turbulences without interfering with running production",
says Prof. Engelbert Westkämper,
Director of the IFF at the University of Stuttgart
and
of the Fraunhofer Institute for Production Technology
and Automation (IPA – In-

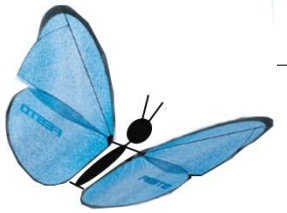
Reference IFF
http://www.lernfabrik-aie.de/aktuelles/

Universität Stuttgart IFF
Institut für Industrielle Fertigung und Fabrikbetrieb

…
Wandlungsfähigkeit muss zum Bestandteil der betrieblichen Kulturen und
Standards werden.
…
In technischer Hinsicht kommt der flexiblen und konfigurationsfähigen
Automatisierung eine zentrale Rolle zu.
…

aus: Forschung stärken, Produktion sichern
Autor: Prof.Dr.-Ing. Prof.e.h.Dr.-Ing.e.h.Dr.h.c.mult.Engelbert Westkämper

Flexible Automation



What is Flexible Automation?

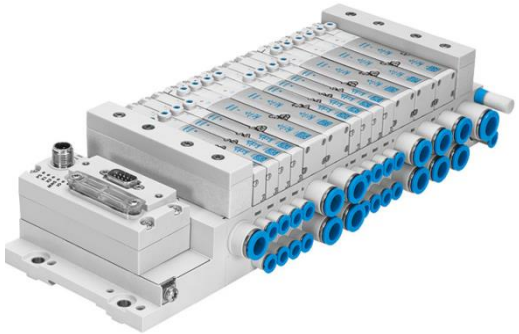
Flexible Automation is the ability for a robot or system to be quickly and easily re-tasked to change product design for both low and high mix manufacturing. When properly utilized, a Flexible Automation cell can evolve with your process and demand, reduce and fix production costs, improve quality, and eliminate

Steve Dickerson

Flexible Automation

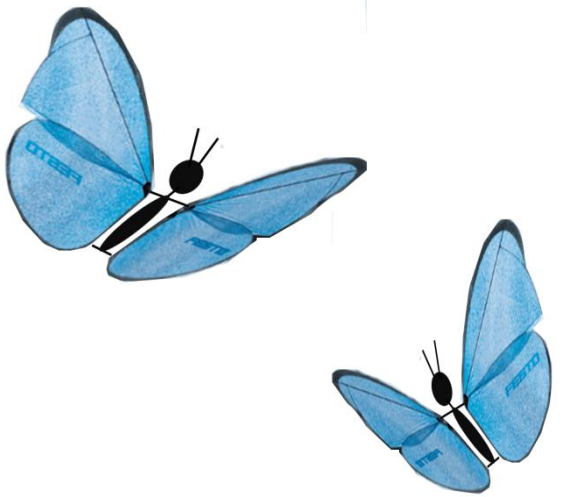
Example:
Tesla Production

Flexible Automation

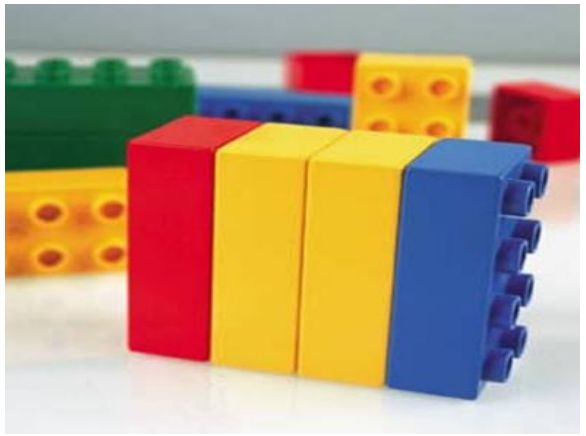


no panacea for flexible automation

Flexible Automation



- simple bricks
- many bricks
- clear grid
- well defined interfaces
- intuitive handling



Flexible Automation

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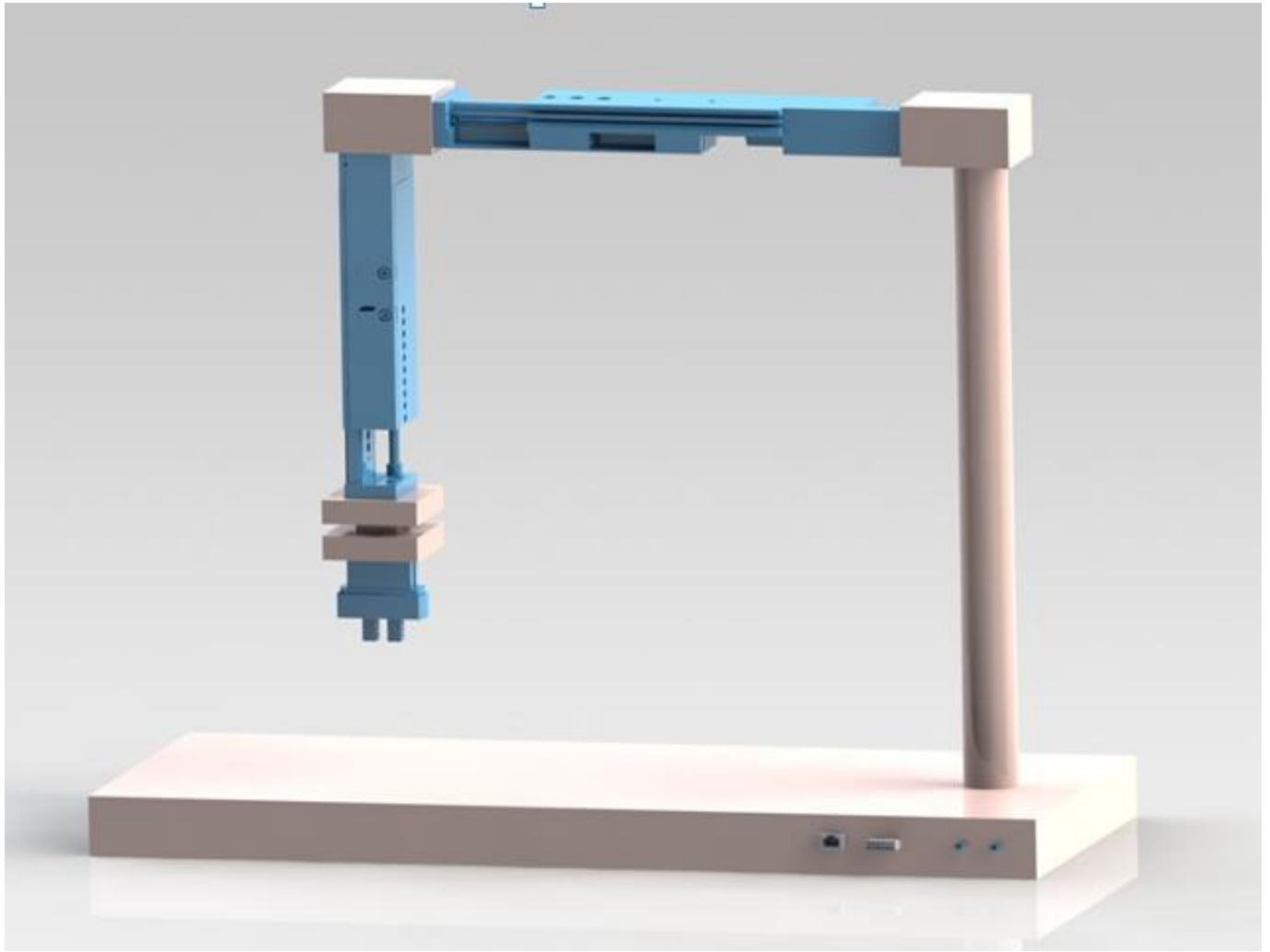

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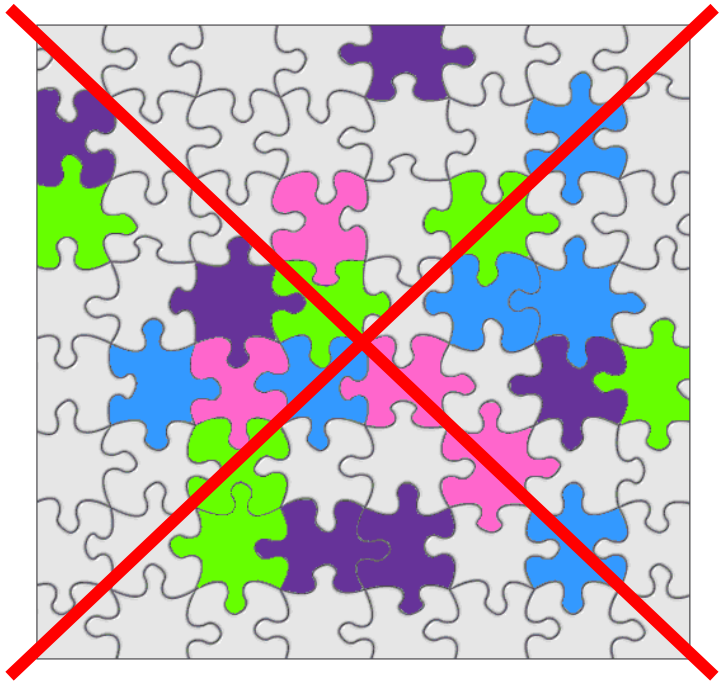

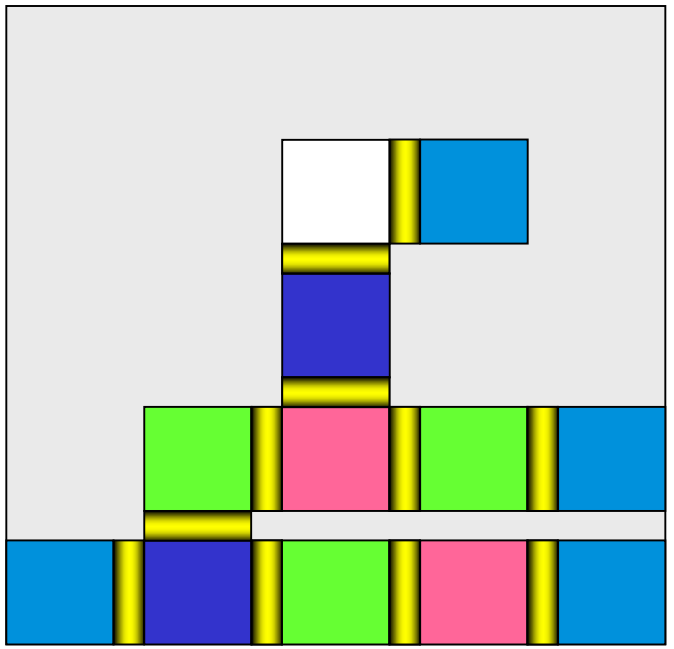

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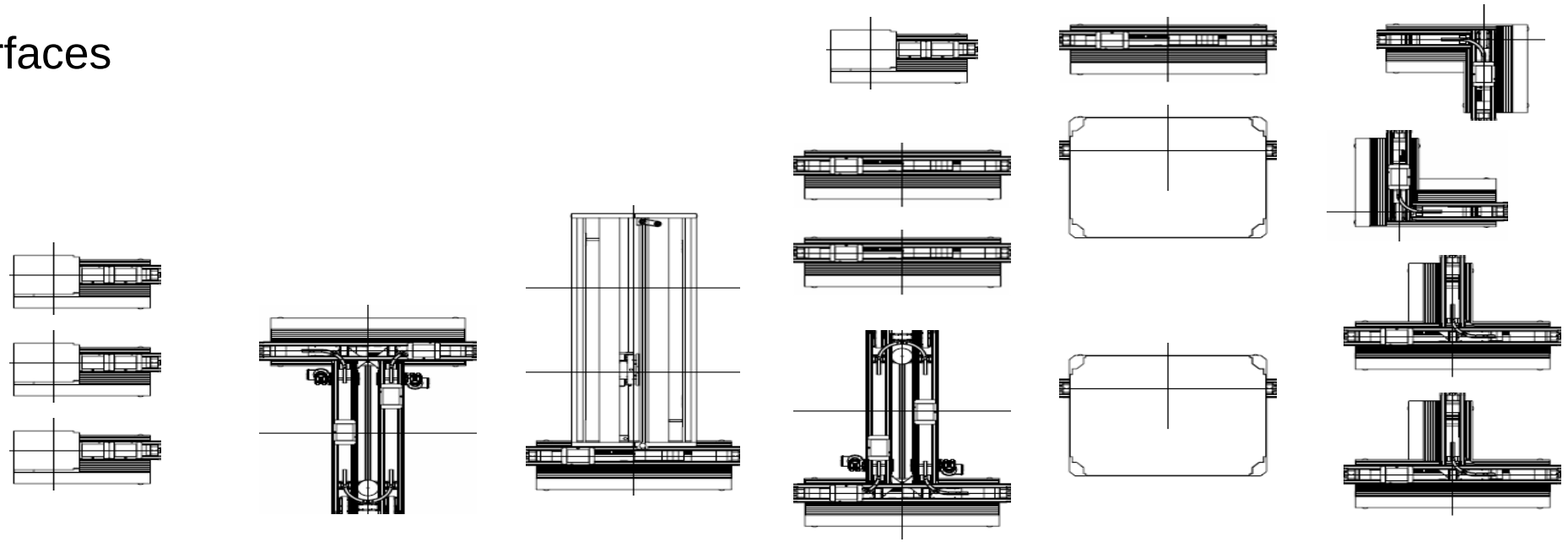
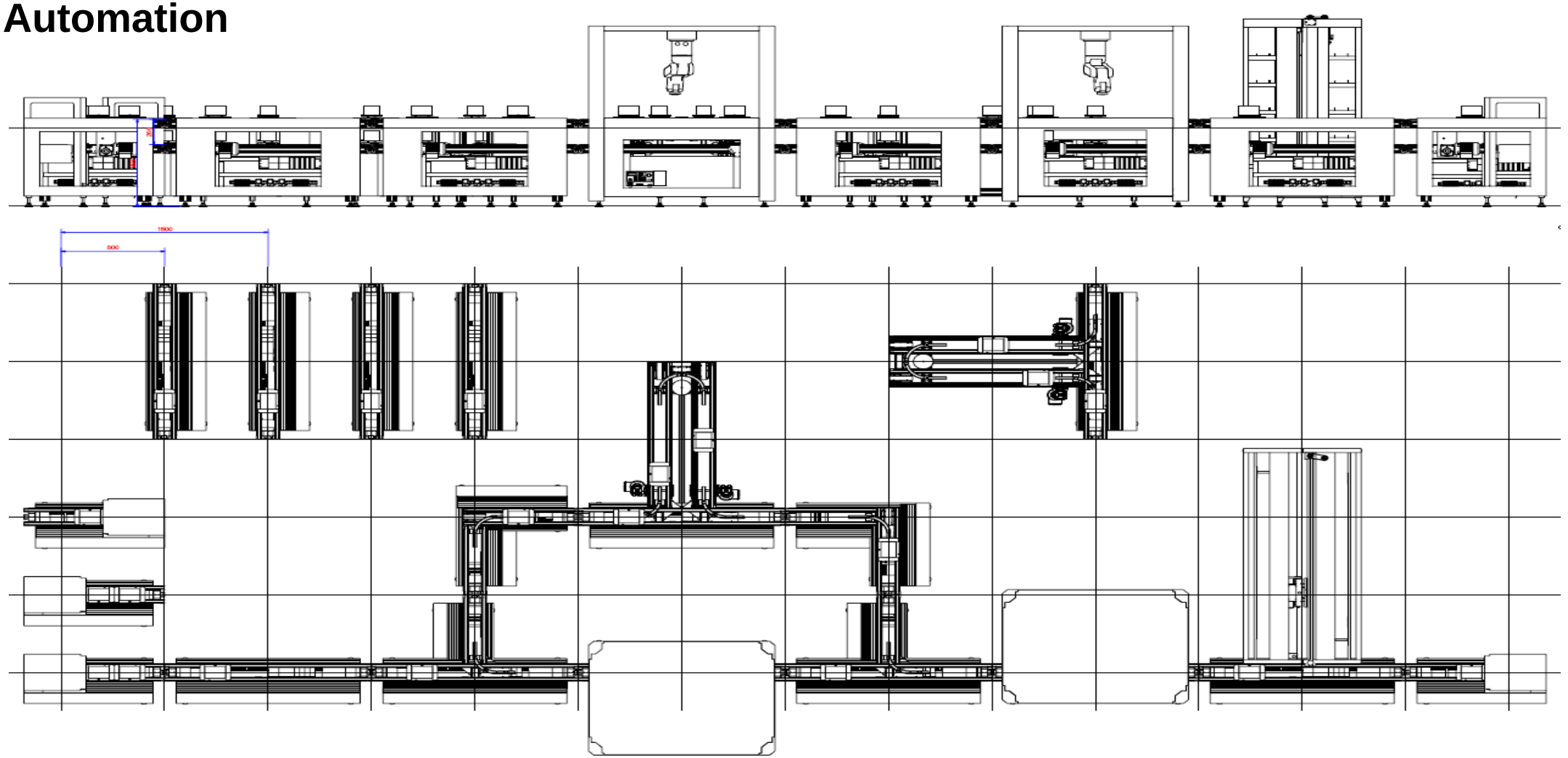


Flexible Automation



Flexible Automation

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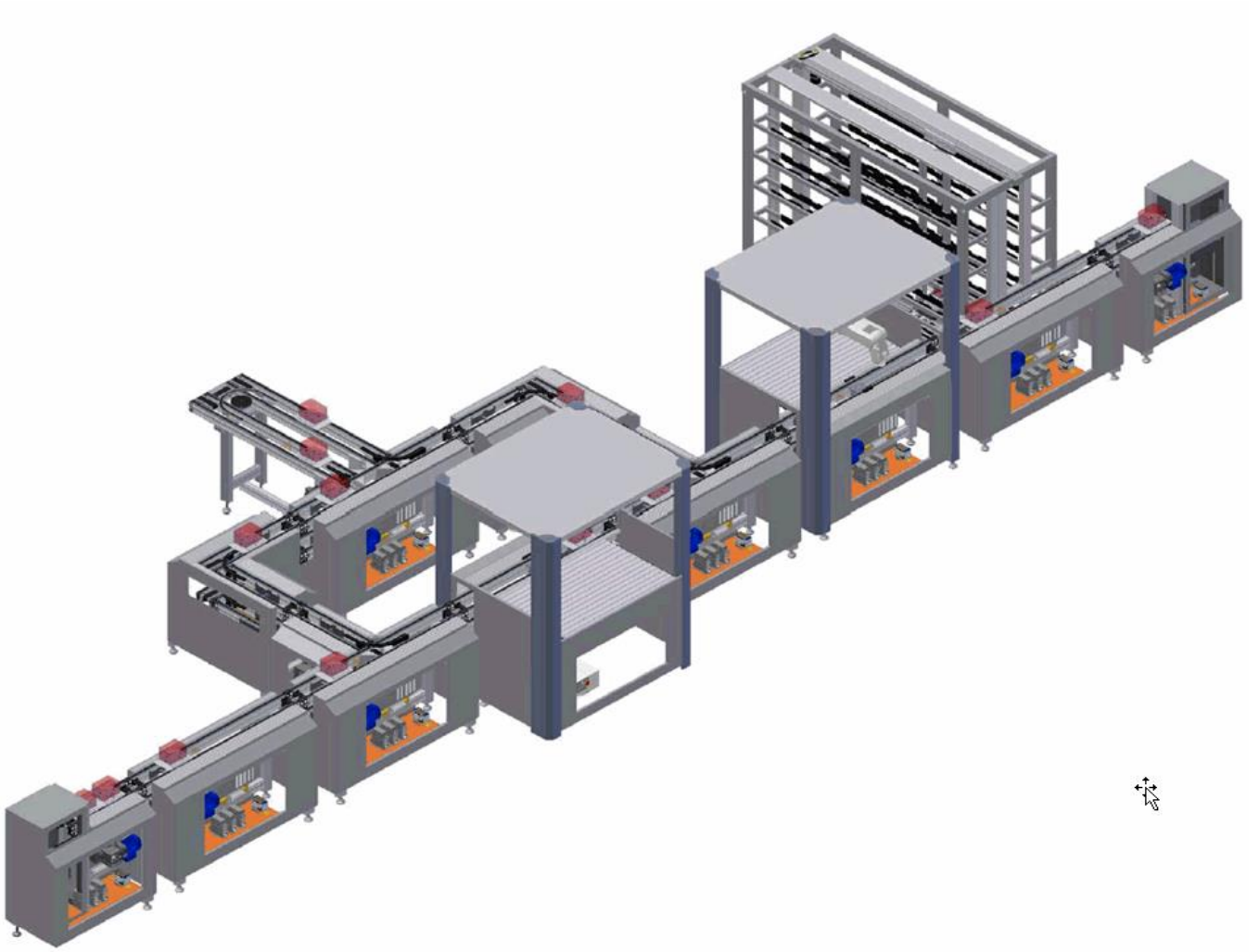

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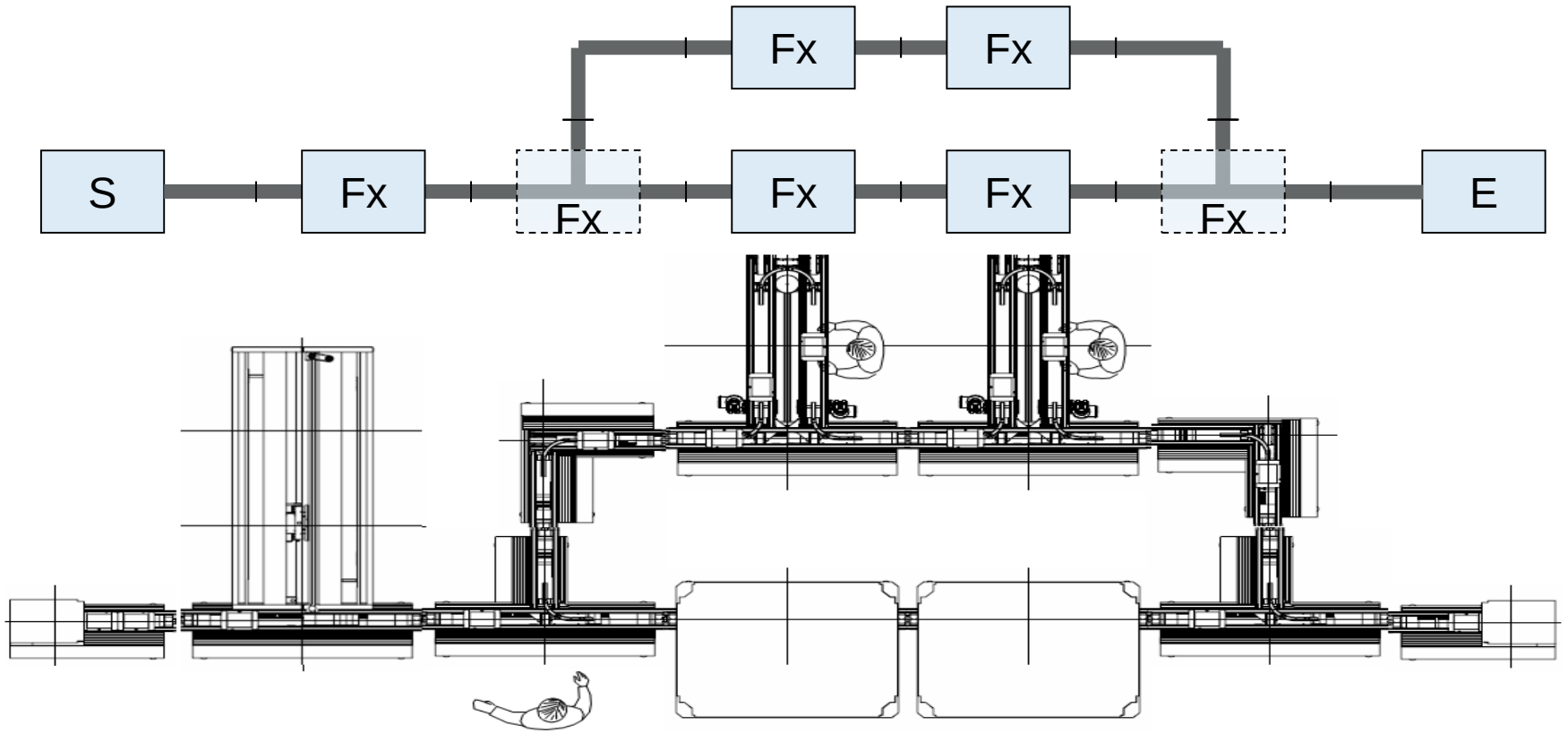
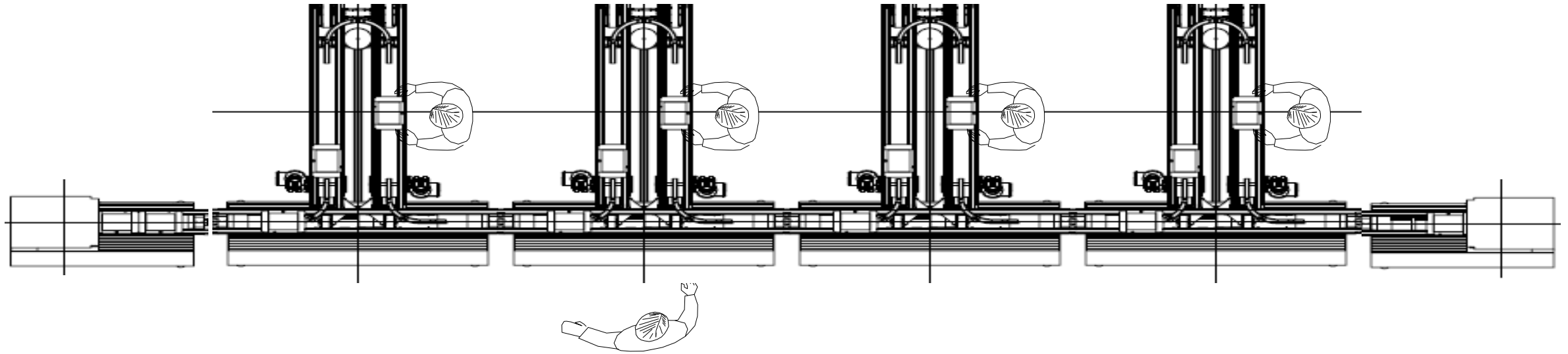


Flexible Automation



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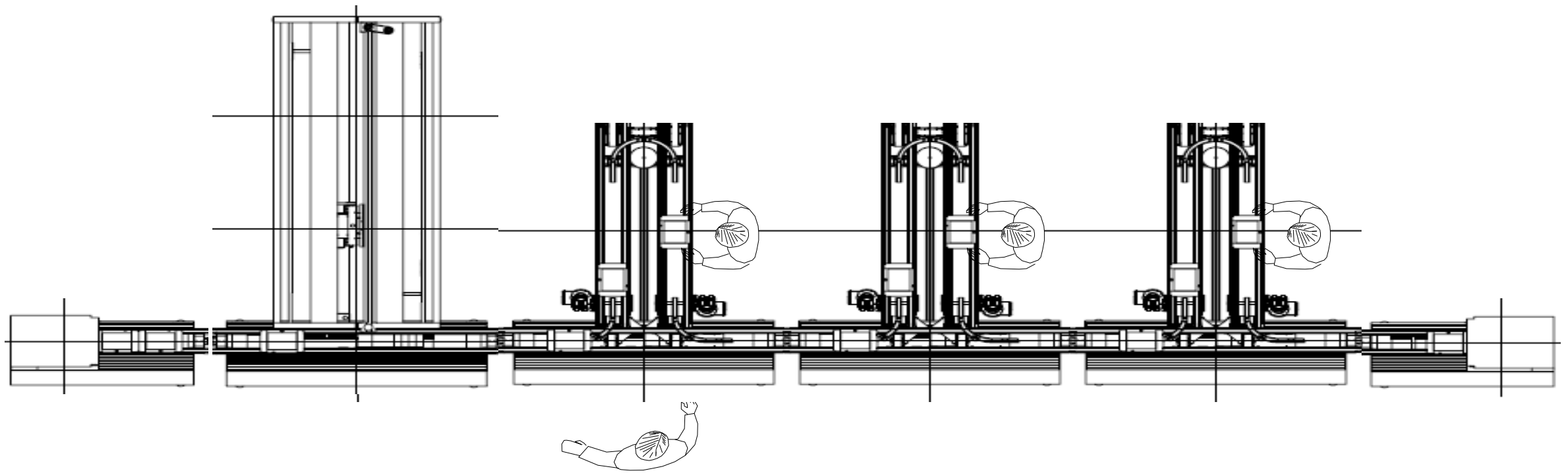
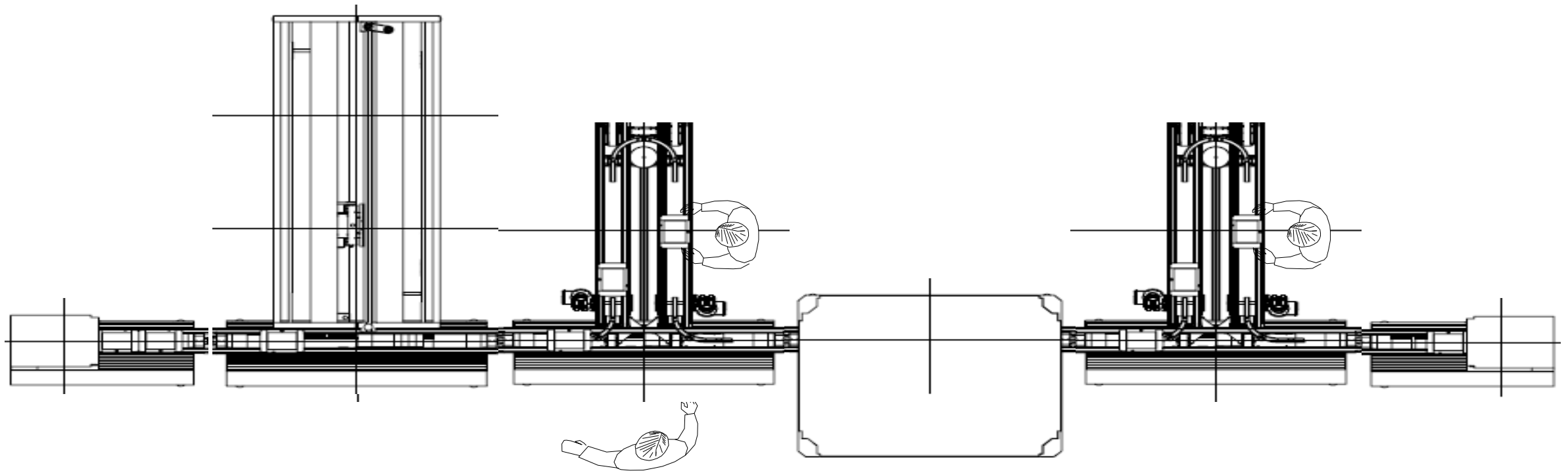
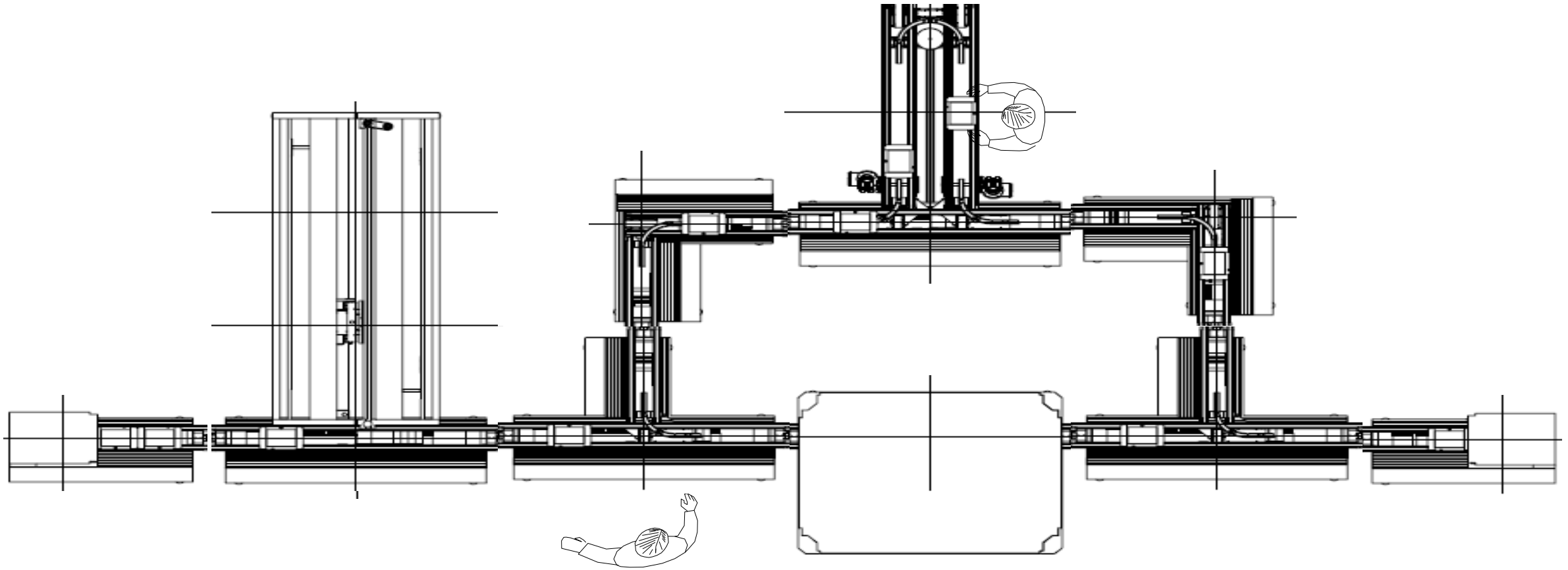


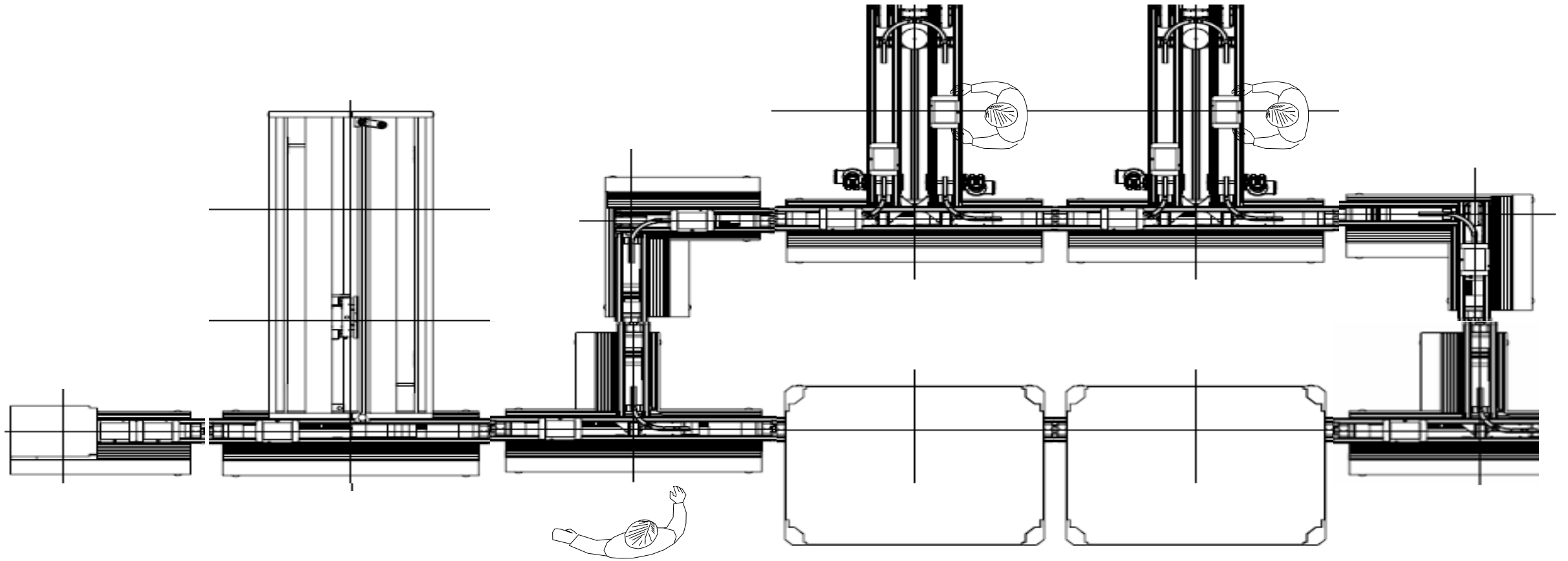
Flexible Automation



Flexible Automation



Flexible Automation



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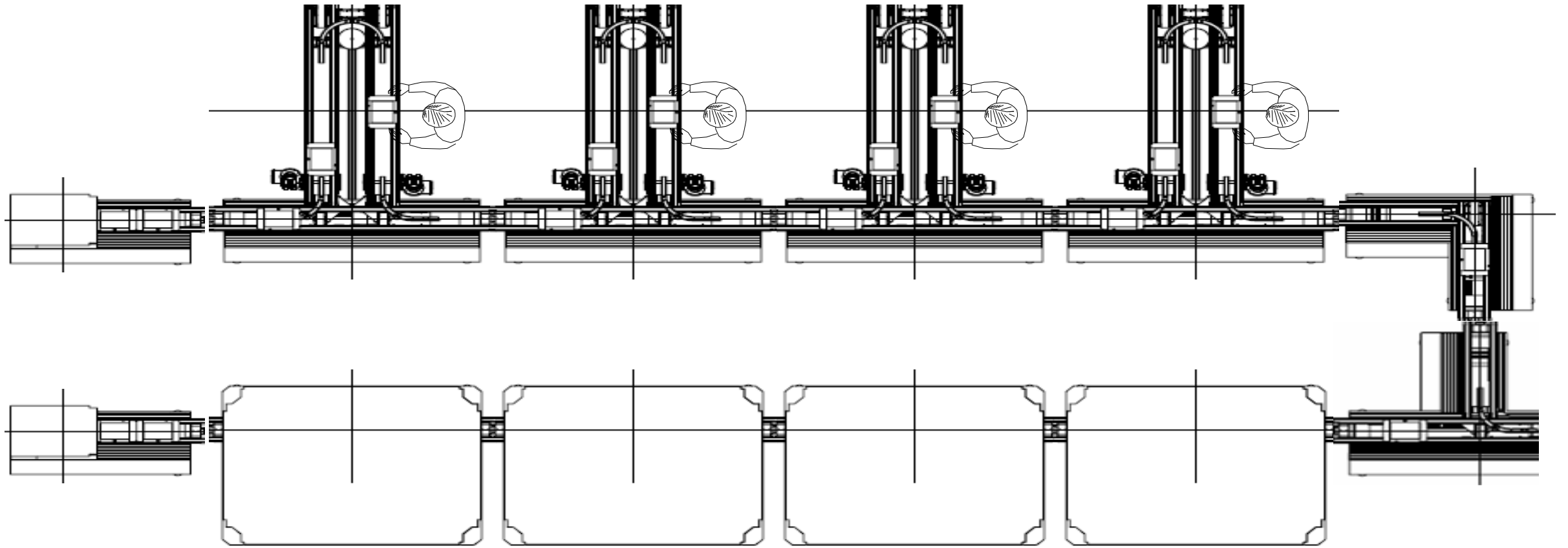

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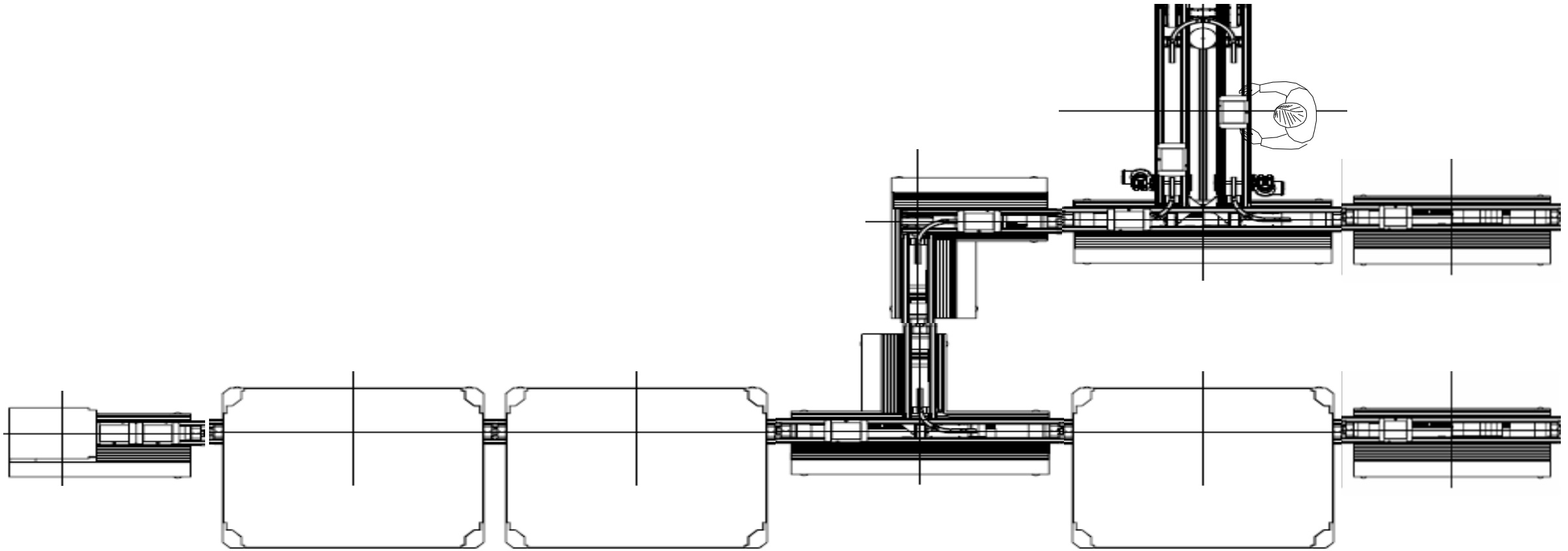
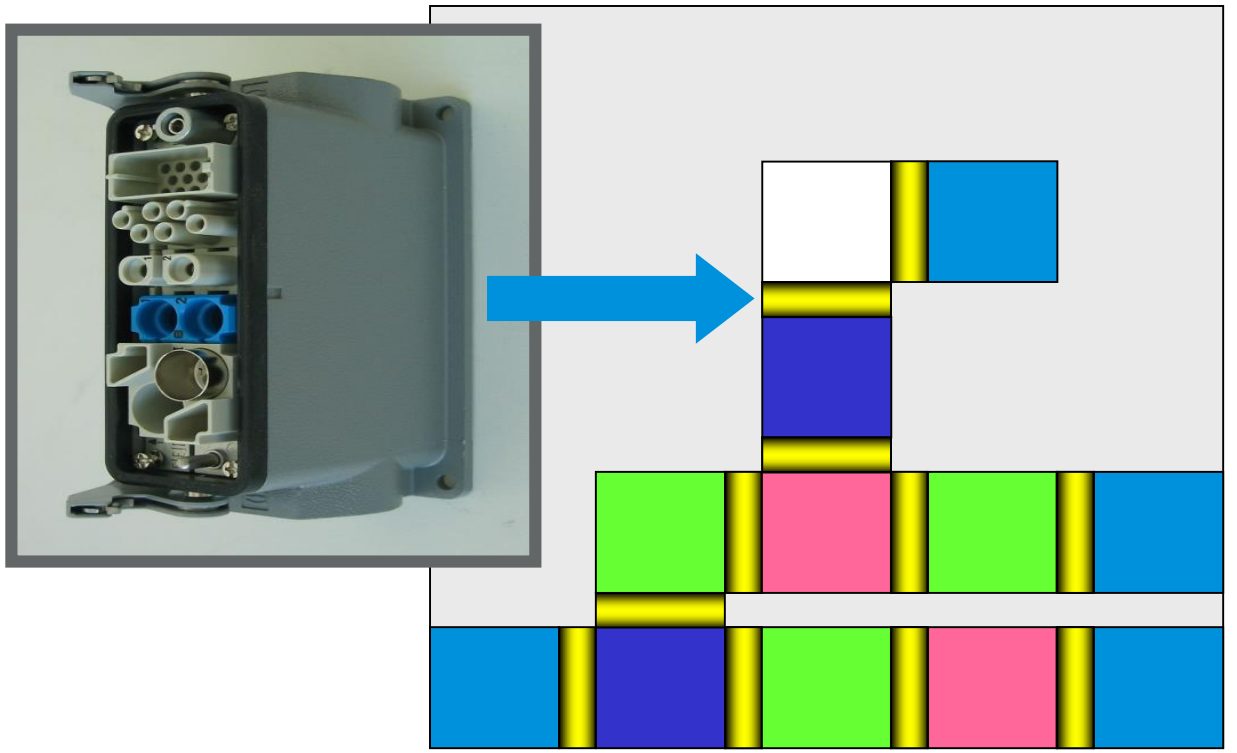


Flexible Automation

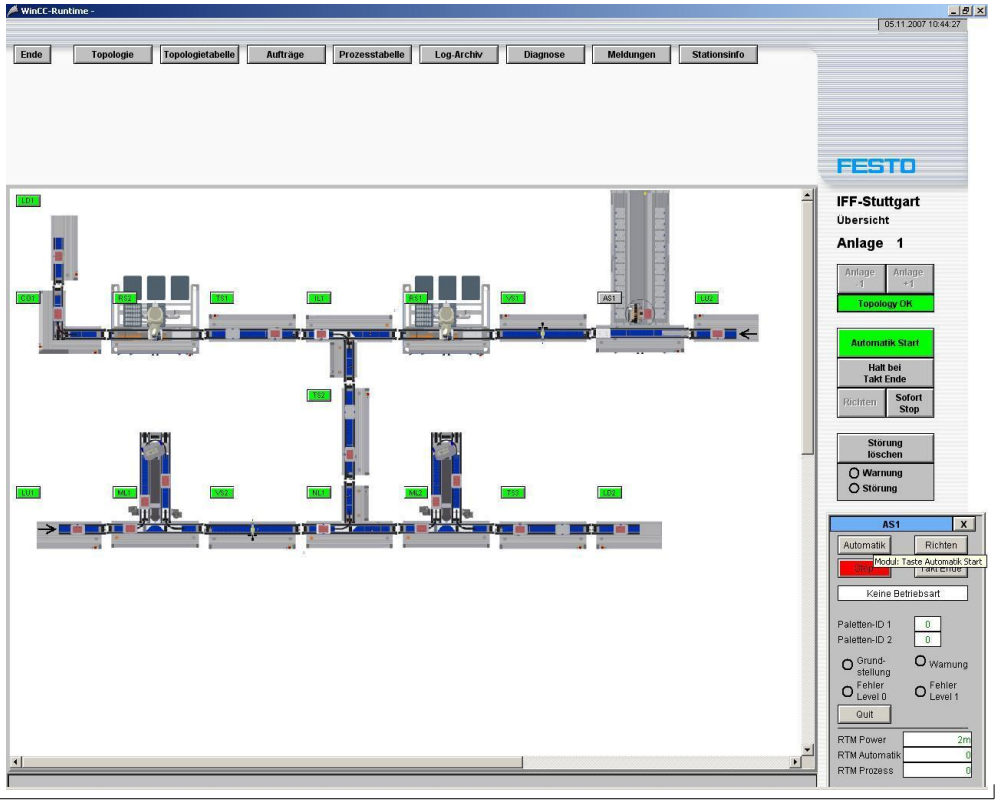
System Plug*

- Power 400 V
- Pressed Air
- Ethernet
- Safety
- Potential



* Bei hohem Energieverbrauch lokale Einspeisung

Flexible Automation



Flexible Automation

Flexible Automation

Flexible Automation

Example:
Research Project OPAK

Projektdaten

- Projektlaufzeit 3 Jahre
- Auftraggeber BMWi
- Projektträger DLR
- Budget knapp 5 Mio. €
- Projektstart 01.10.2013

AUTONOMIK FÜR INDUSTRIE 4.0

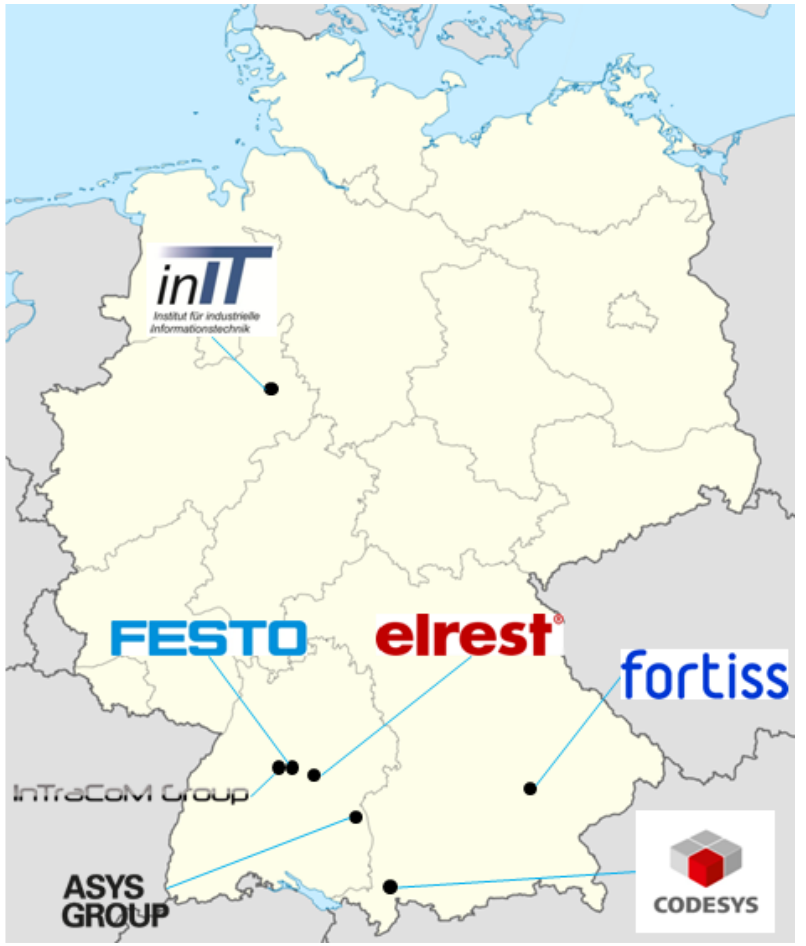
OPAK

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

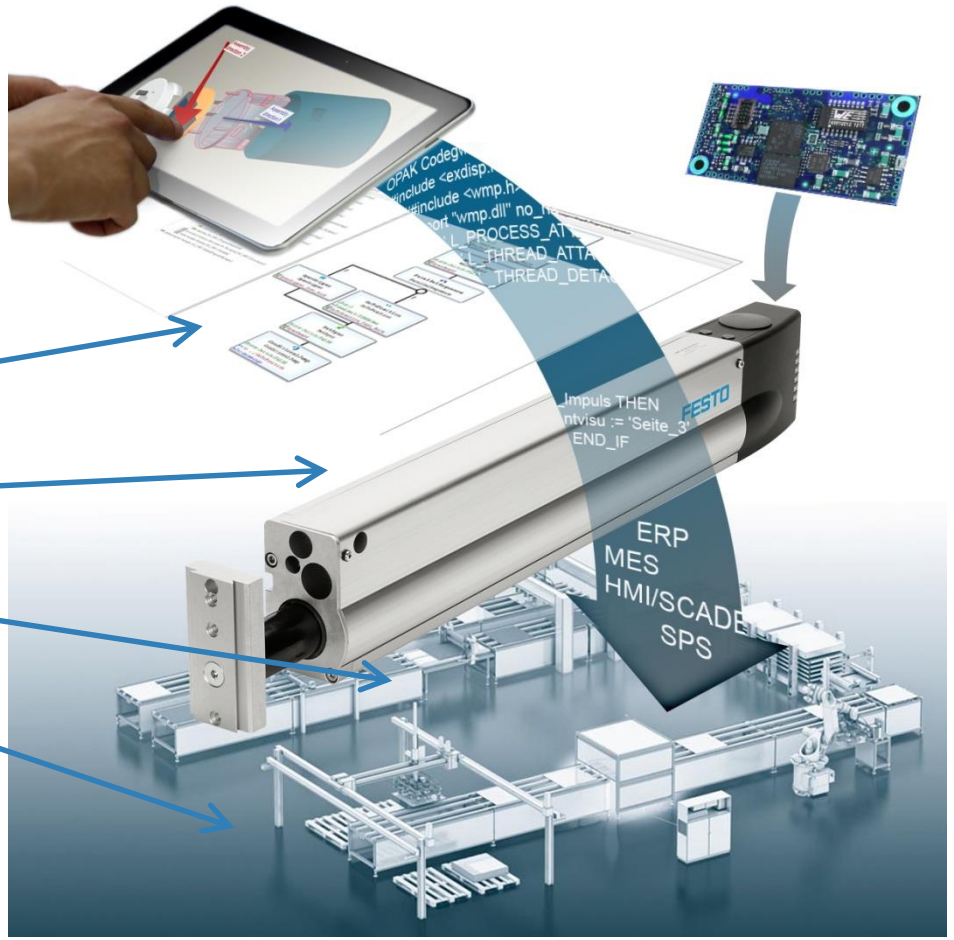
DLR



Flexible Automation

Example:
Research Project OPAK

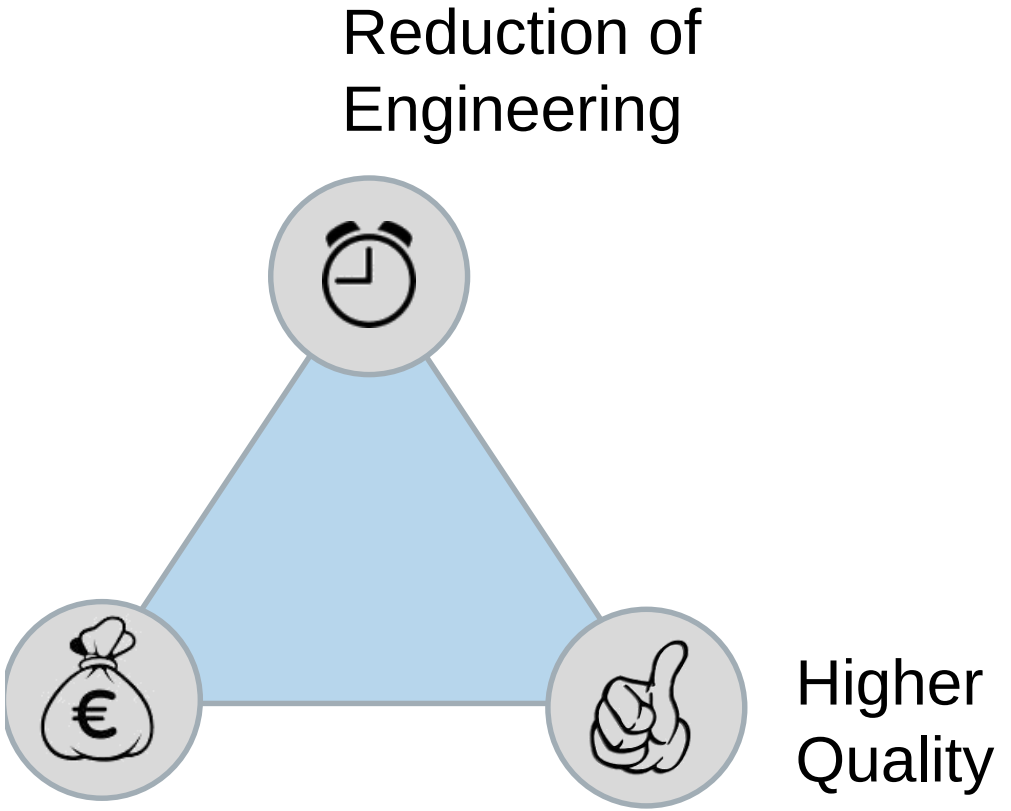
- Interaction
- Engineering
- Components
- Code Generation
- Systems



Flexible Automation

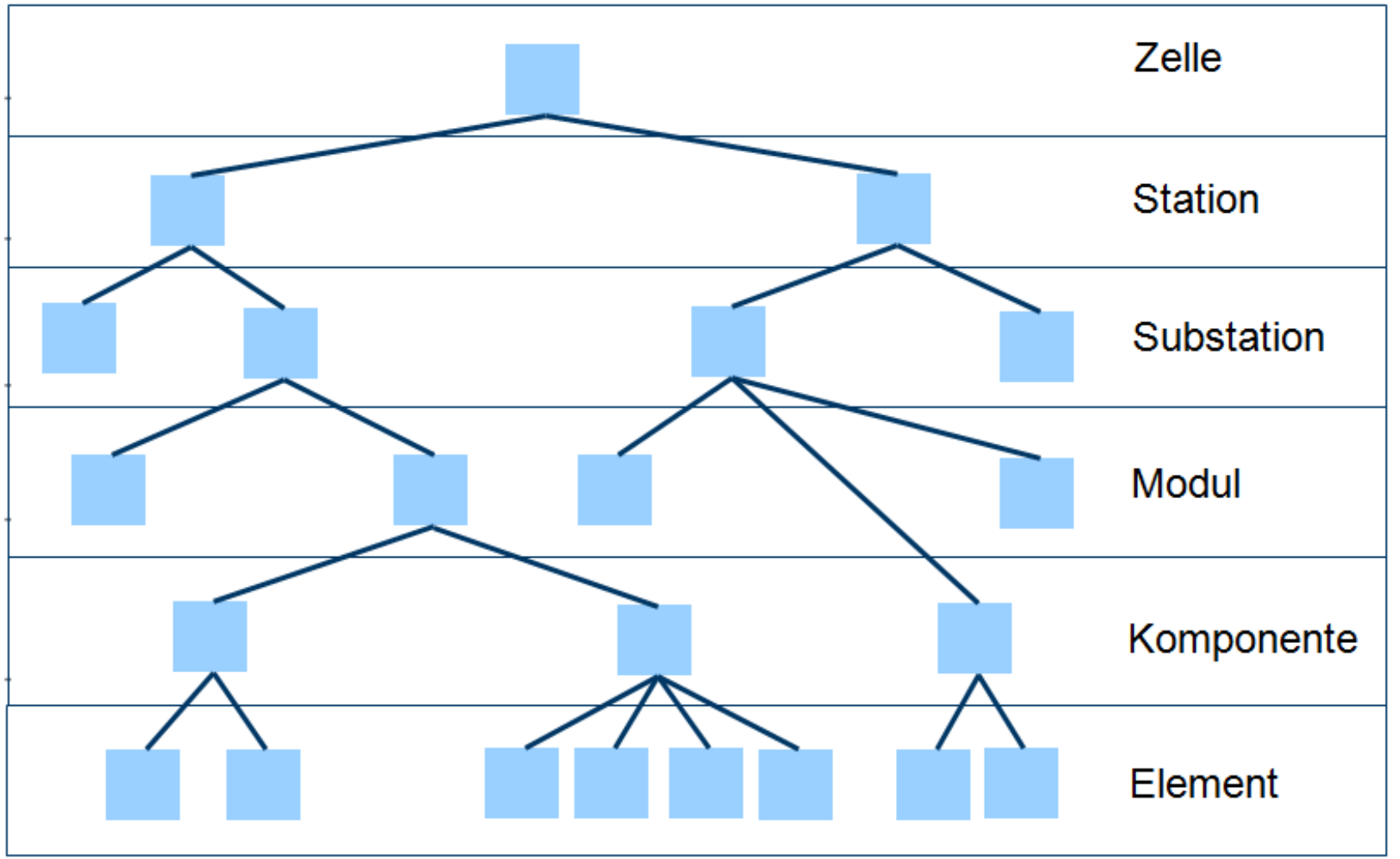
Example:
Research Project OPAK

Expectations:



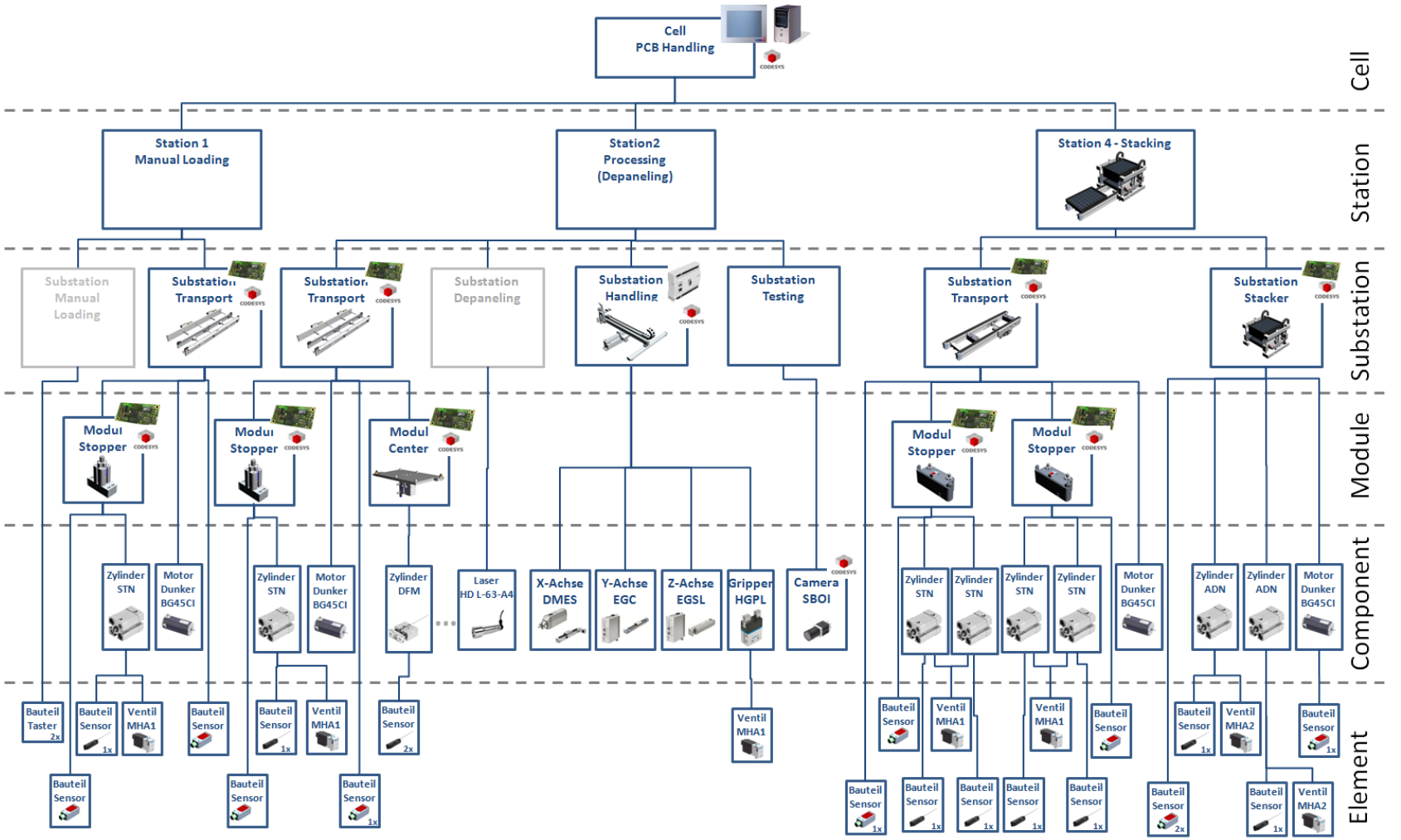
Flexible Automation

Example:
Research Project OPAK



Flexible Automation

Example:
Research Project OPAK



Flexible Automation

Example:
Research Project OPAK

Flexible Automation

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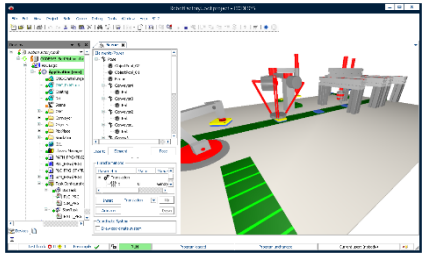
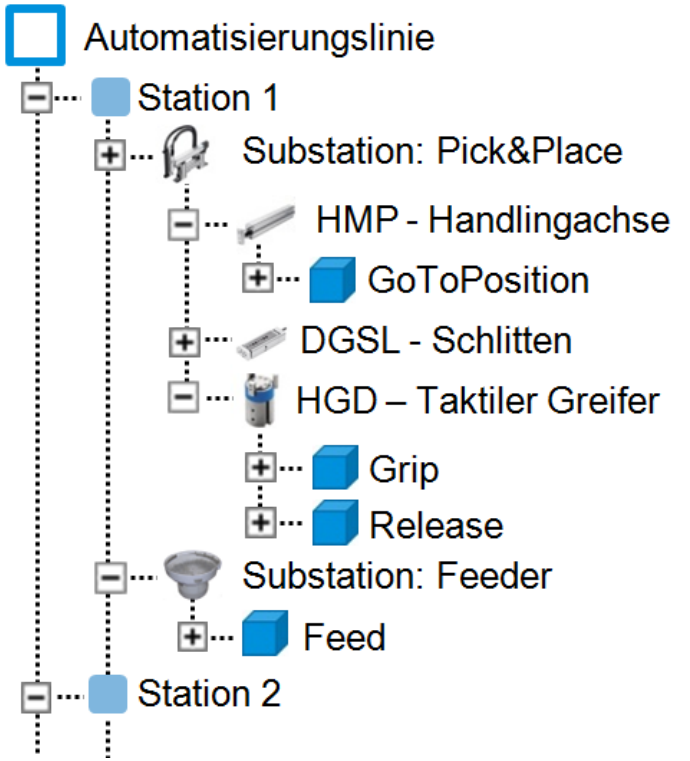
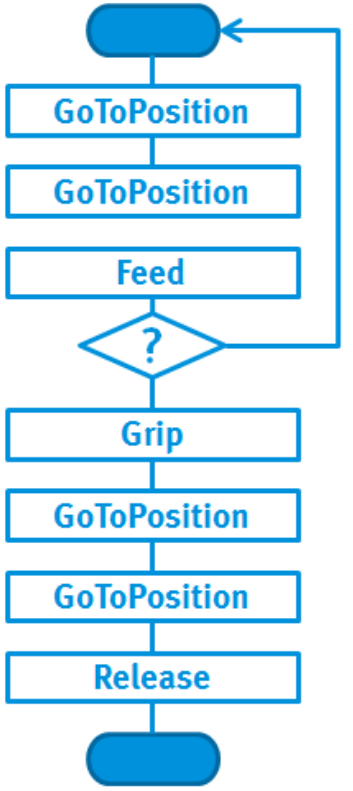
Research Project OPAK



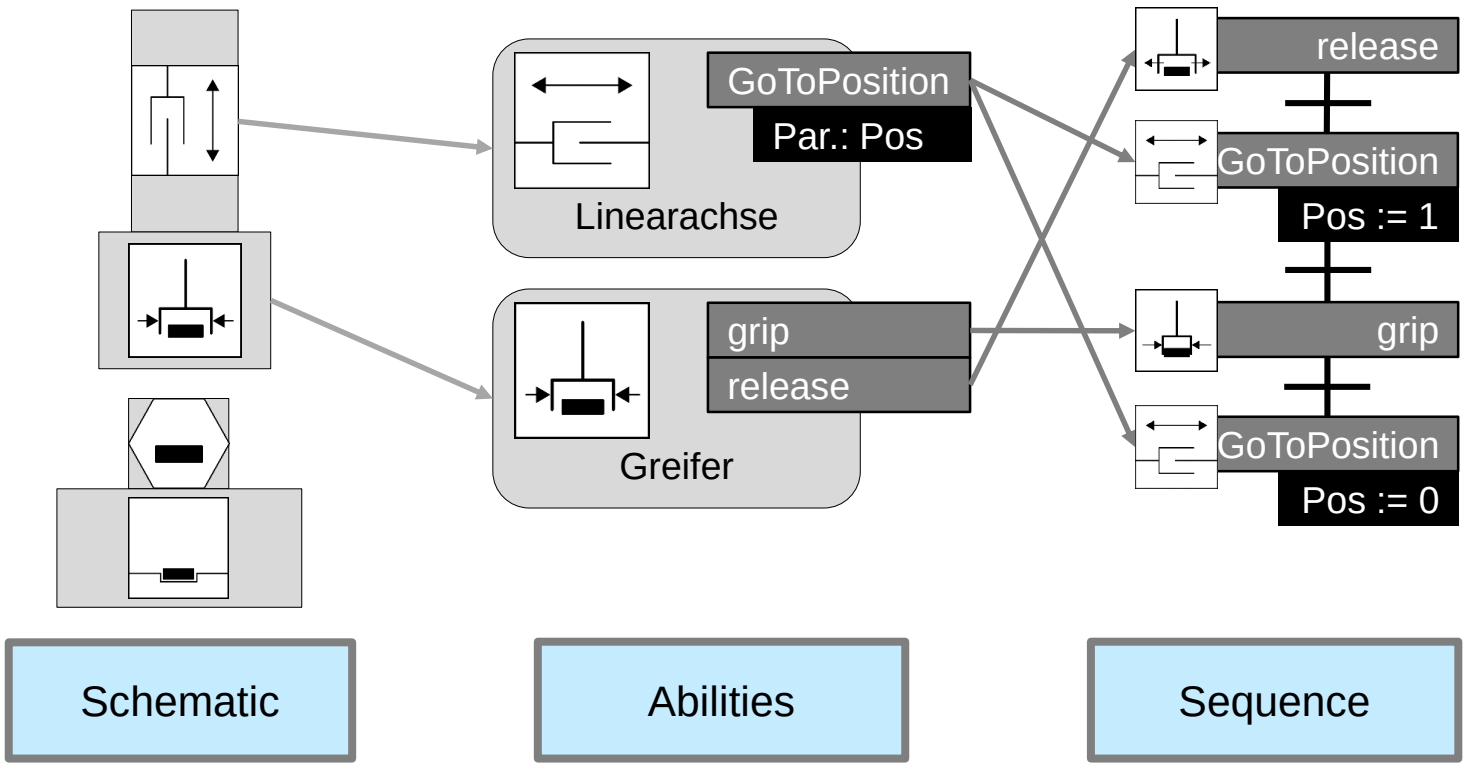




3D Engineering → **Automation Architecture** → **PLC Code / Sequence**

Flexible Automation

Example:
Research Project
OPAK

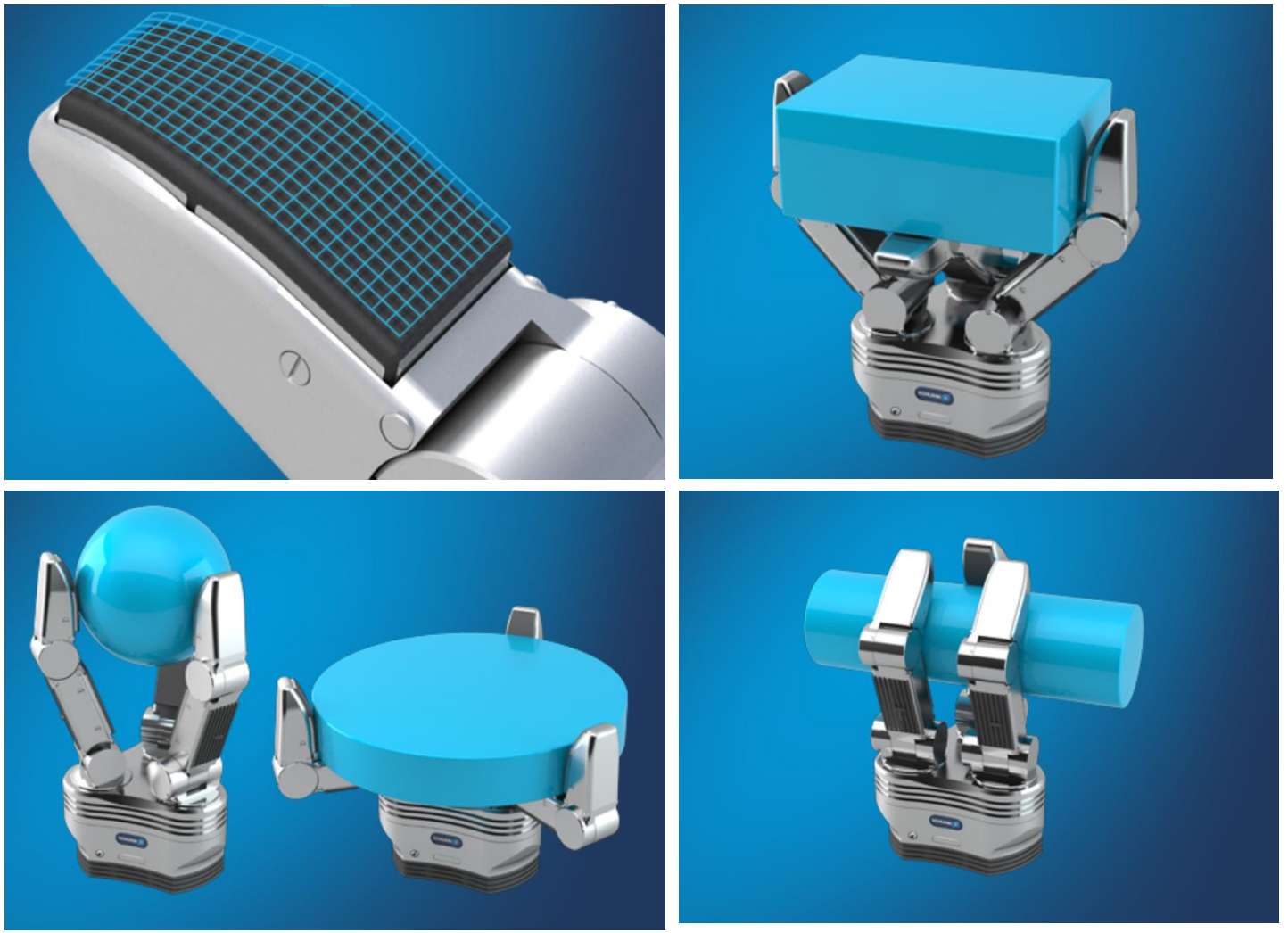


Flexible Automation

Example:
Research Project
OPAK

Flexible Automation

Grippers
Enabler for Flexibility



Flexible Automation

Grippers
Enabler for Flexibility

Flexible Automation

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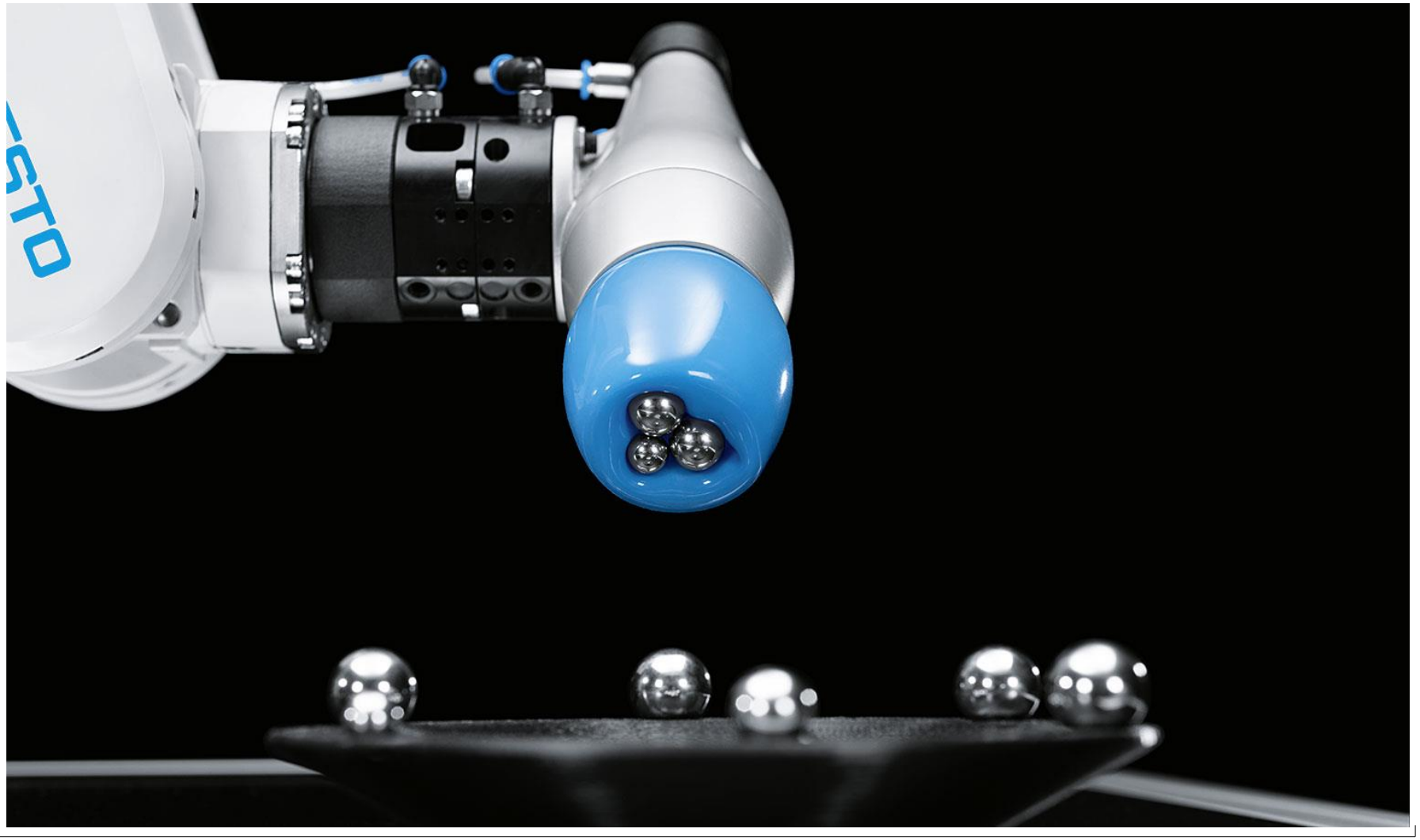
Enabler for Flexibility

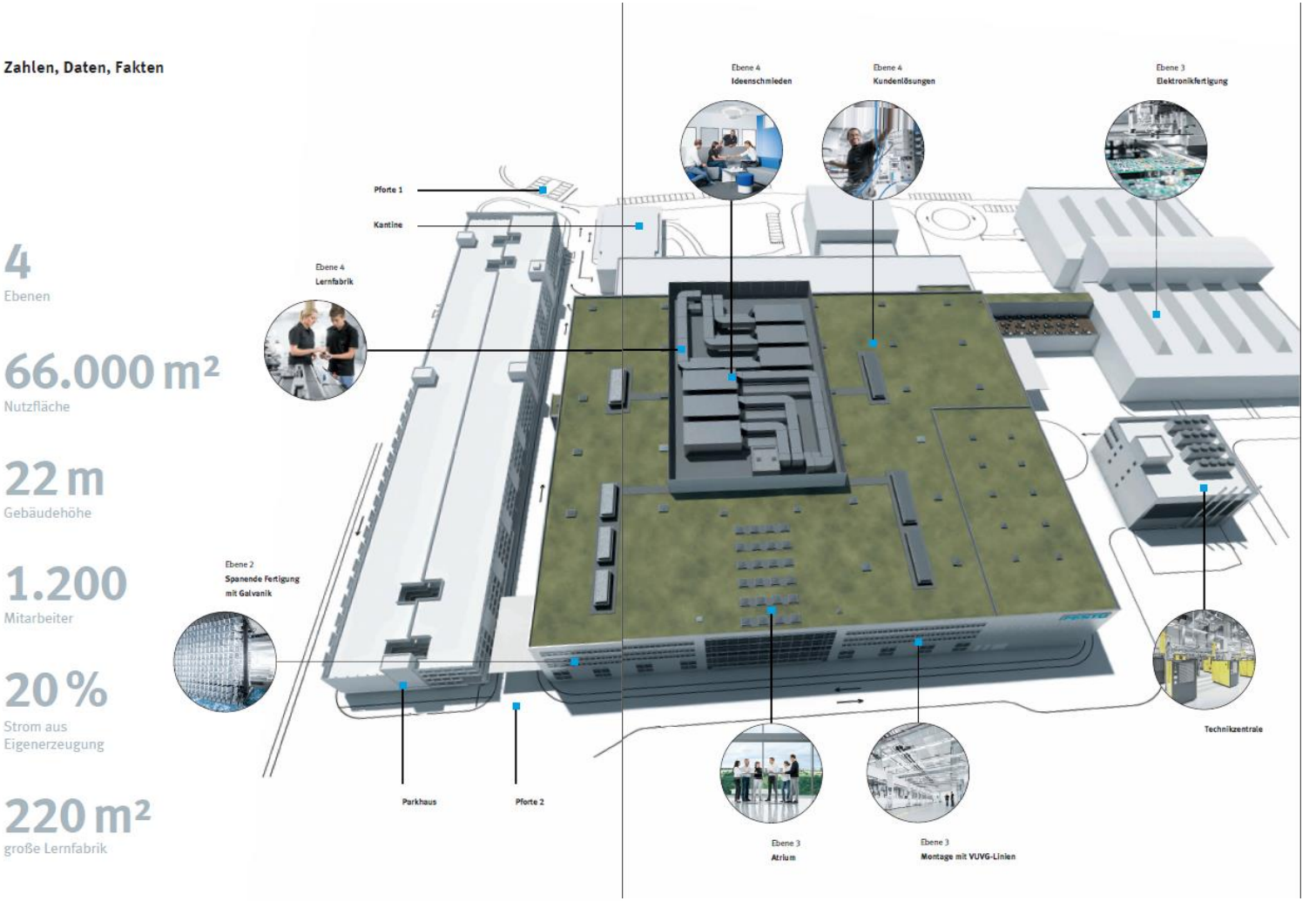


Some examples of Festo Plant

Some examples of Festo Plant

Valve Production

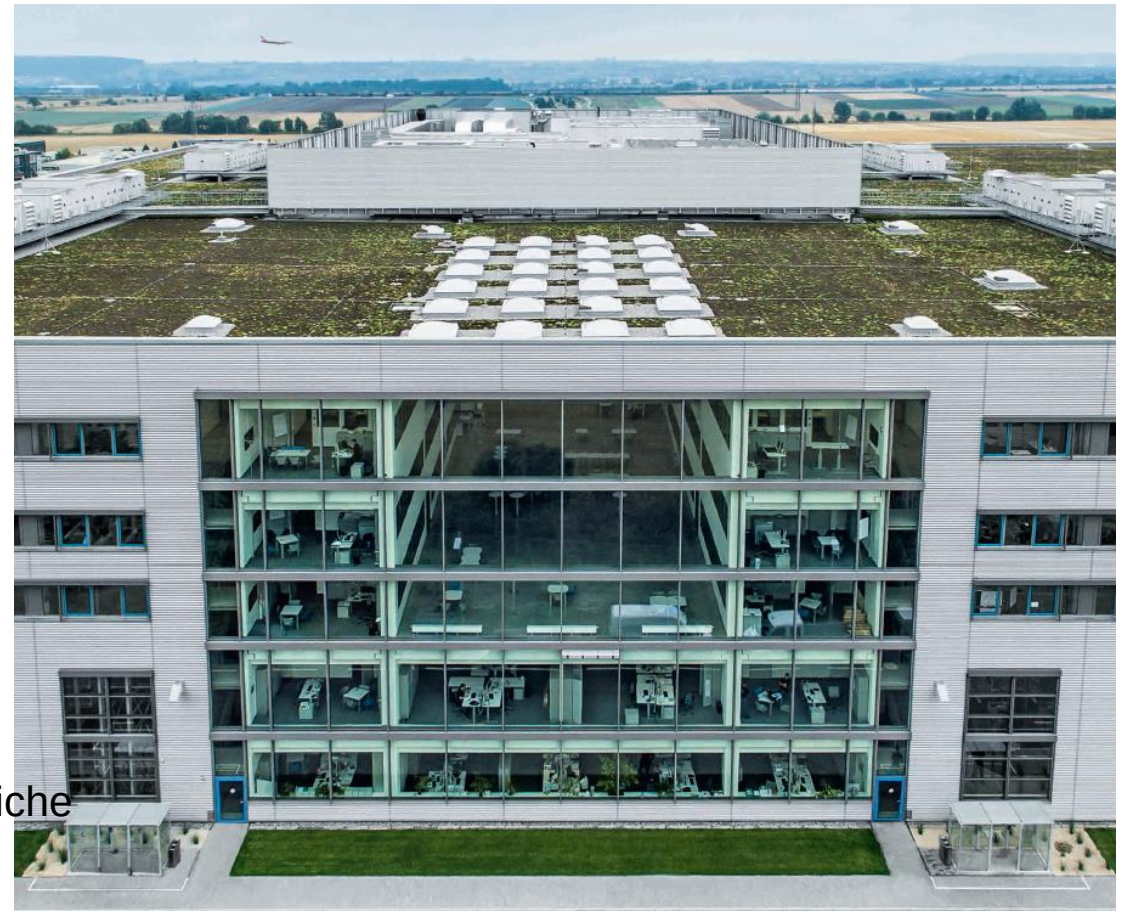
Optimized Production Layout



Some examples of Festo Plant

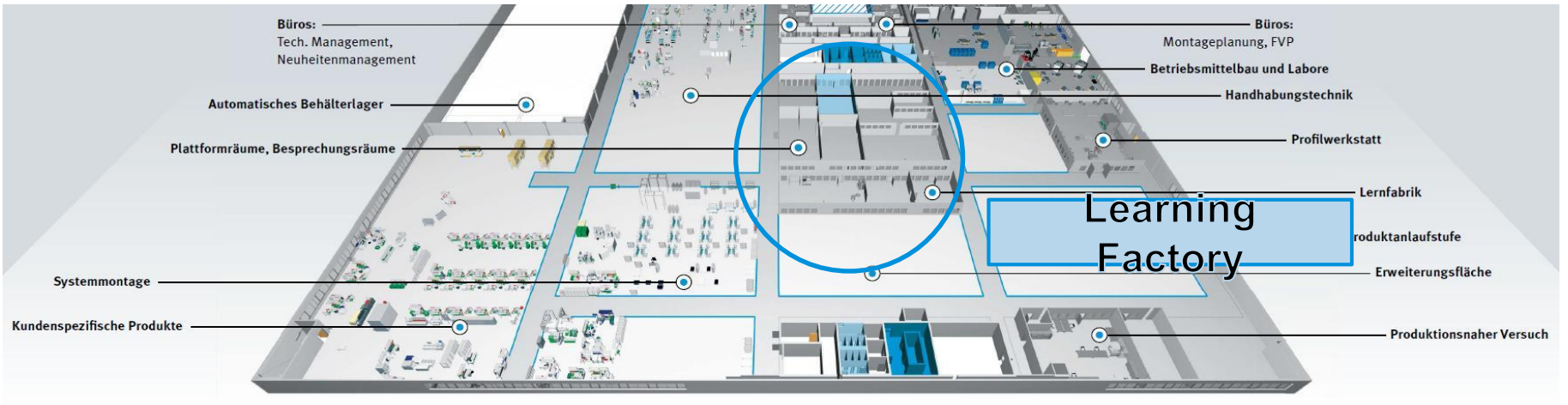
Details of the Building

- 9.000 Lamps
- 125 km Kabel und Druckluftleitungen
- 70 km Datenleitungen und 6,5 km Glasfaserkabel
- 28 km Rohre für Heizung und Kühlung
- 1.000.000 m³/h Frischluft 2,5 x ausgetauscht pro Stunde
- 40.000 m² Produktionsfläche
- 22.000 m² Logistik
  - 80.000 Stellplätze Kleinteile (12 Gassen)
  - 3.000 Stellplätze Paletten
  - 1500 – 2000 Einlagerungen täglich
- 1.200 Mitarbeiter (3 Schichten) + ca. 500 IT und weitere Bereiche



Some examples of Festo Plant

Layout:
Learning Factory



Some examples of Festo Plant

Layout:
Optimized Logistics Flow

Some examples of Festo Plant

Flexible Assembly Lines

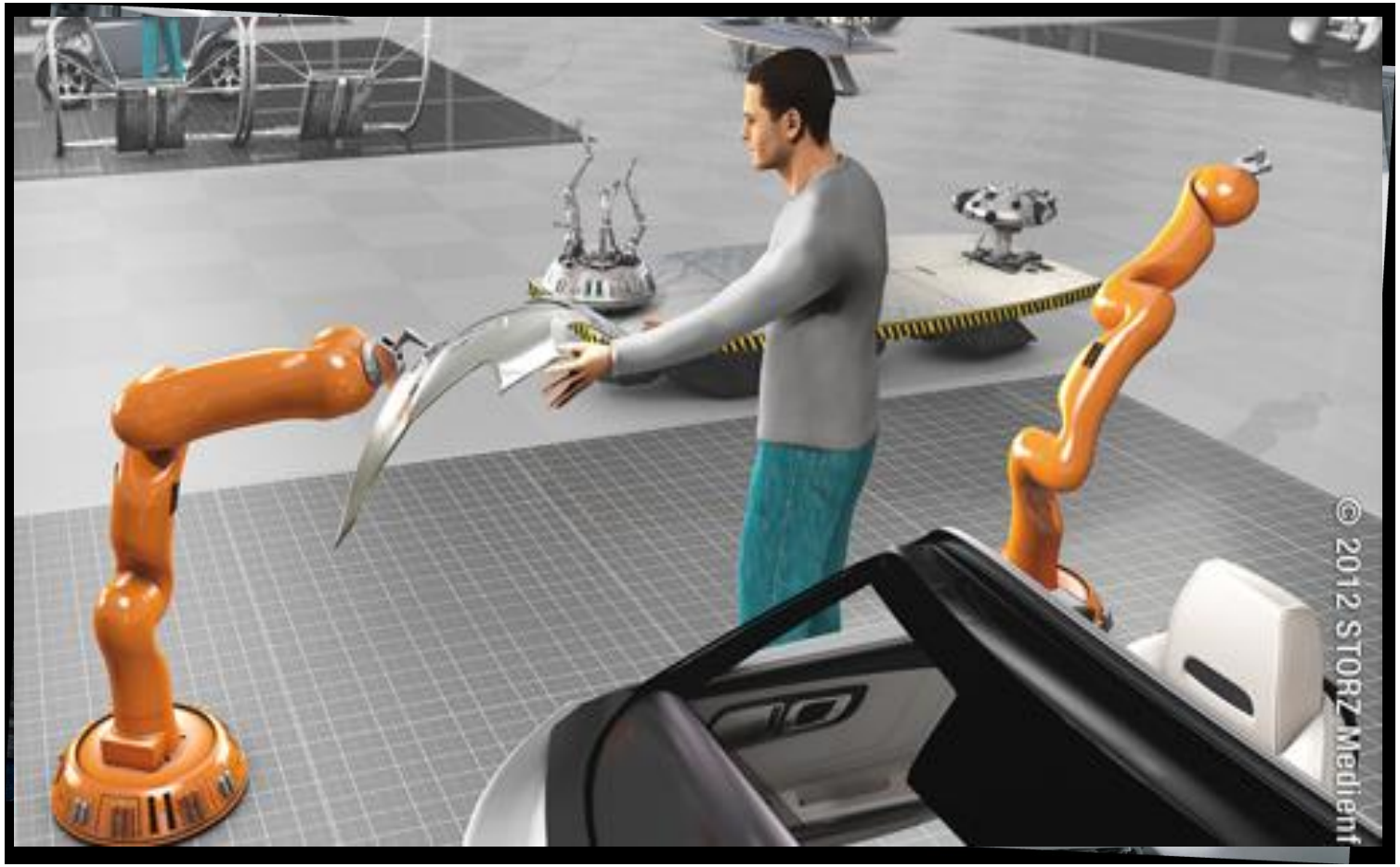
More than 1 Million Valves /a
Few Seconds Cycle Time
Integrated Test
Highly flexible / many variants

Some examples of Festo Plant

Cooperative Robotics

No fence,
a lot of positive effects….

e.g.
- Savings for integration
- Multiuse



Some examples of Festo Plant

Energy Efficiency

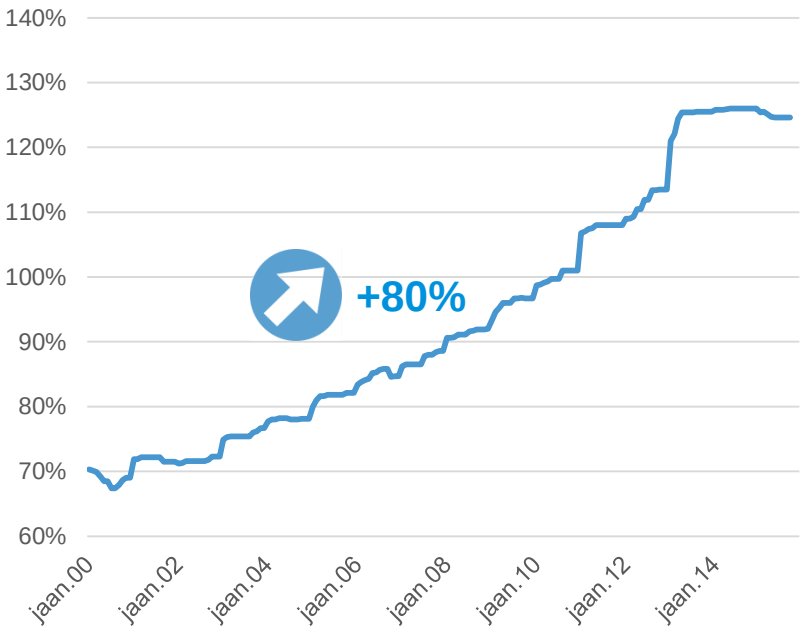
Some examples of Festo Plant

Energy Efficiency

Energy Management

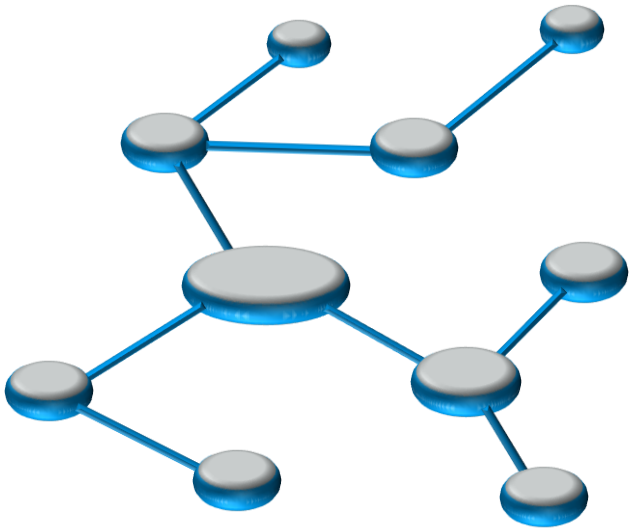
Increased Importance of Energy Efficient Production

New Possibilities for Energy Management utilizing Communication



Strompreise bei gewerblicher Nutzung, bezogen auf 2010

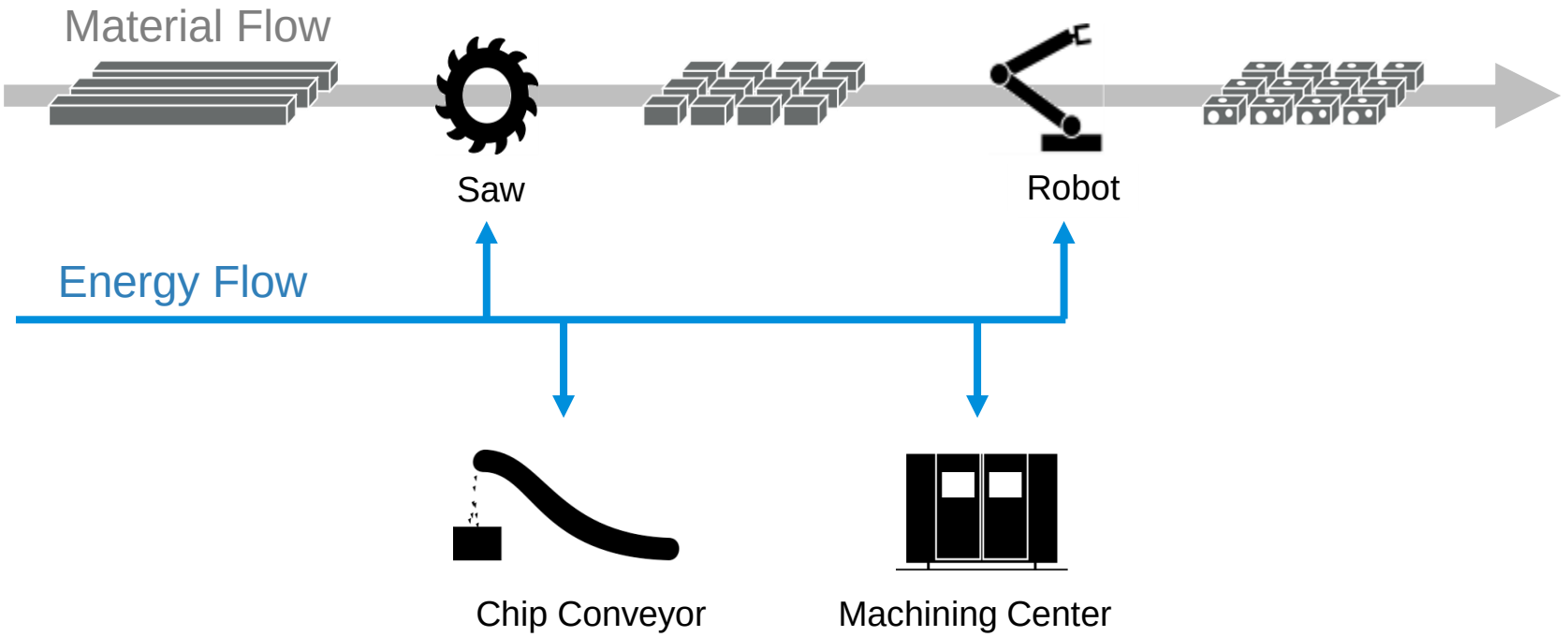
Quelle: Statistisches Bundesamt



Some examples of Festo Plant

Energy Efficiency

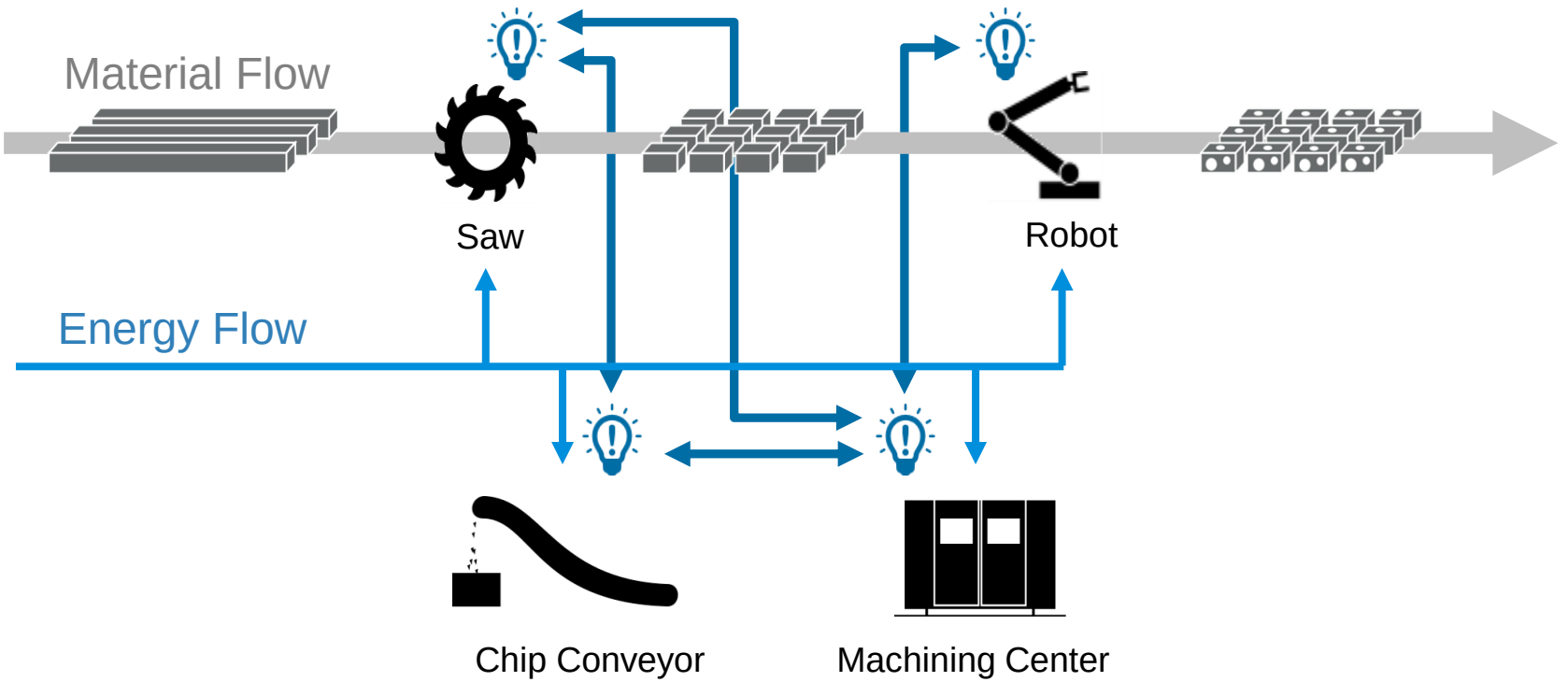
Energy Management



Some examples of Festo Plant

Energy Efficiency

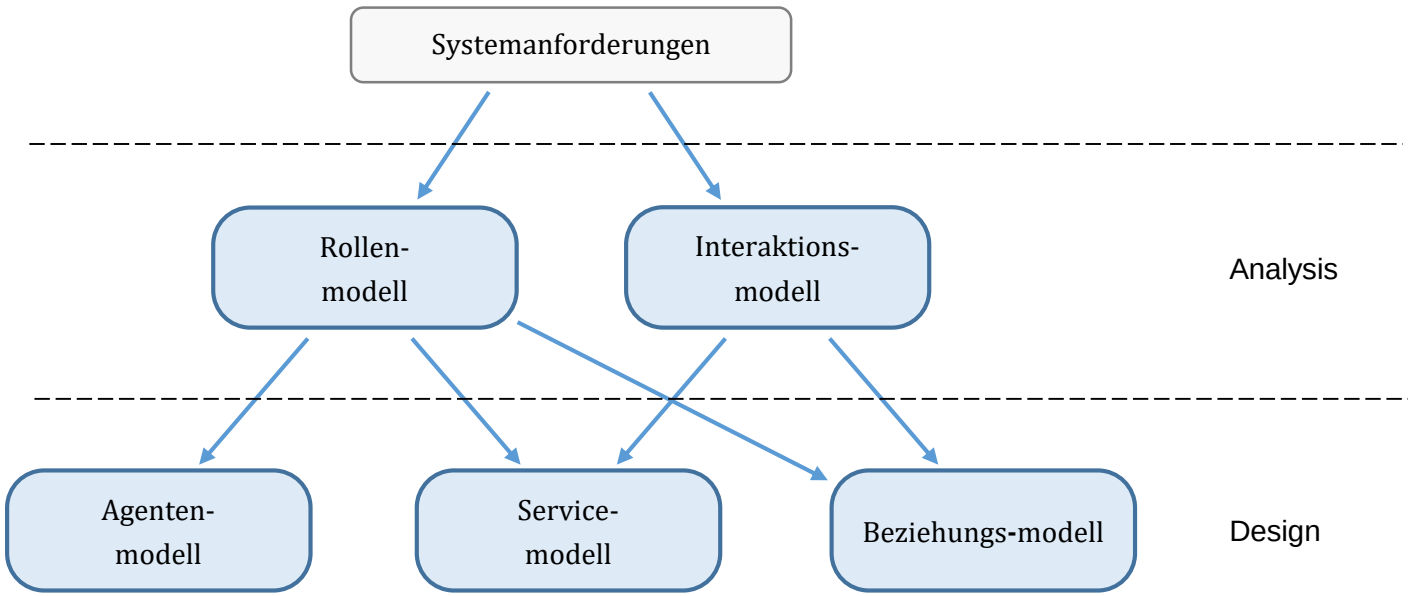
Distributed
Energy
Management
System



Some examples of Festo Plant

Energy Efficiency

Energy Management utilizing GAJA Methods for Design of Agent-Systems



[Wooldridge, Jennings, Kinny 2000]

Some examples of Festo Plant

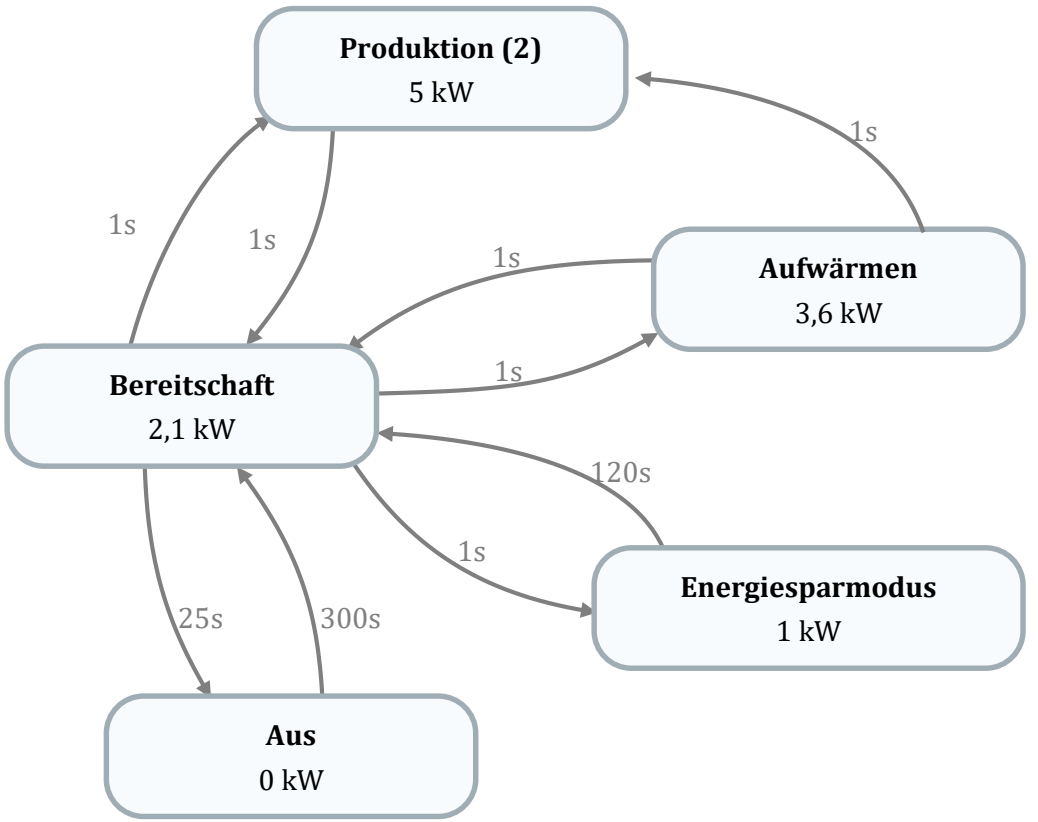
Energy Efficiency

Interaction Model

Some examples of Festo Plant

Energy Efficiency

Energy Management on the Base of a State Model of the Machining Center



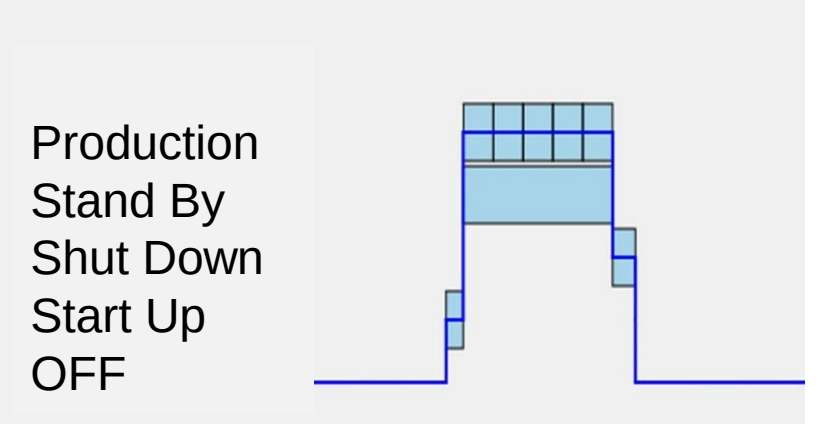
Some examples of Festo Plant

Energy Efficiency

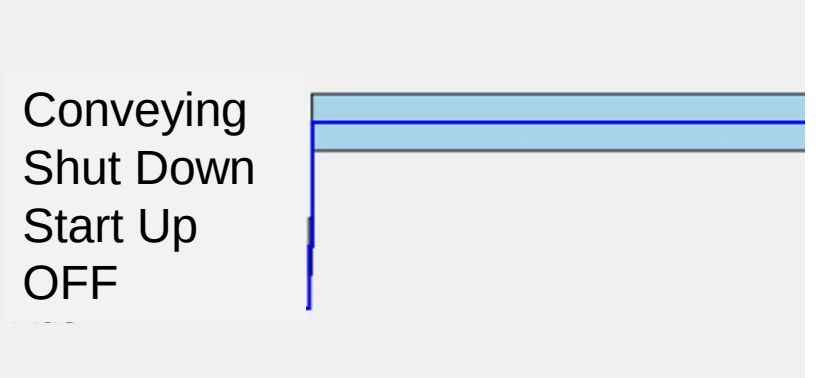
optimized utilization of Auxiliaries by **Logon / Logoff**

without Logon and Logoff

Machining Center



Chip Conveyor



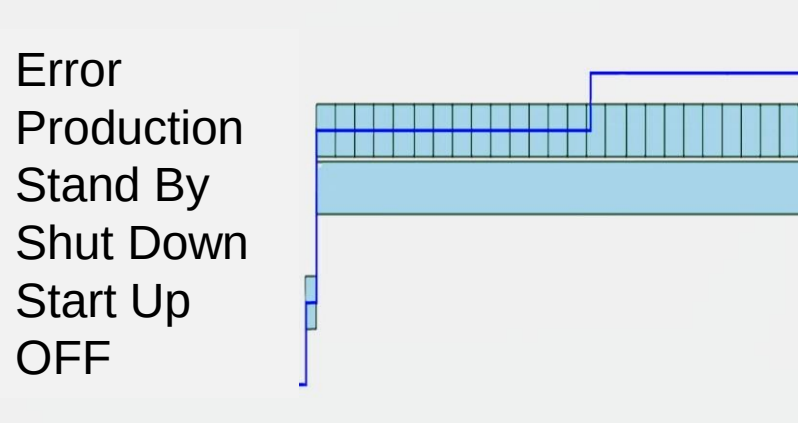
Some examples of Festo Plant

Energy Efficiency

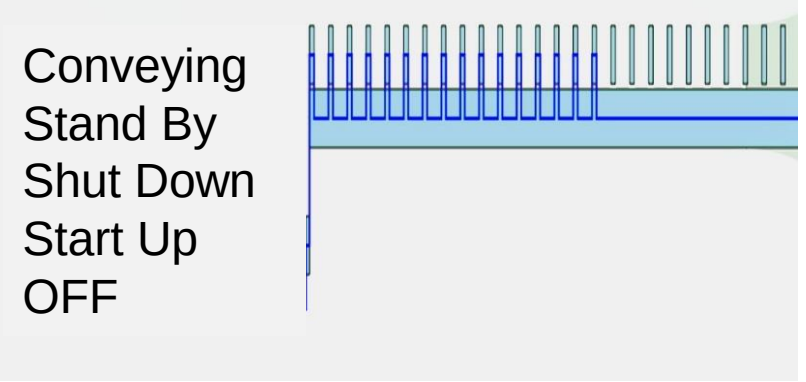
optimized utilization of Auxiliaries By **Error-Handling**

Machining Center

without error-handling



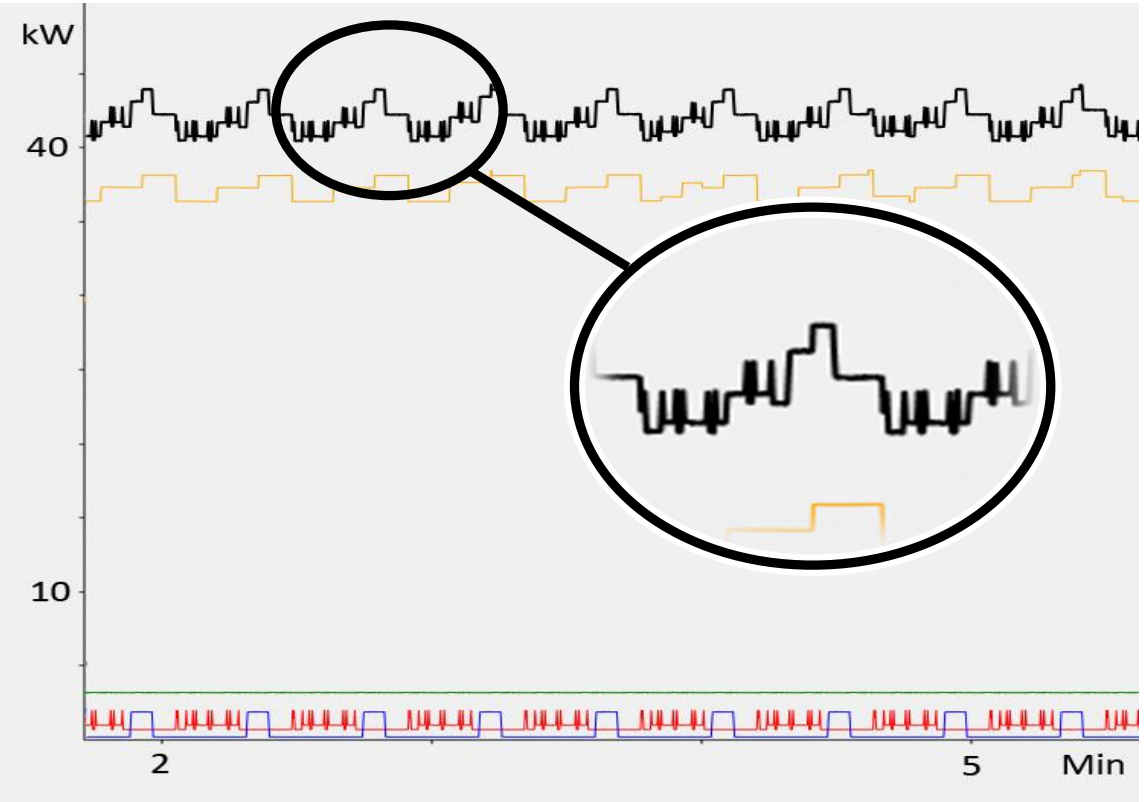
Chip Conveyor



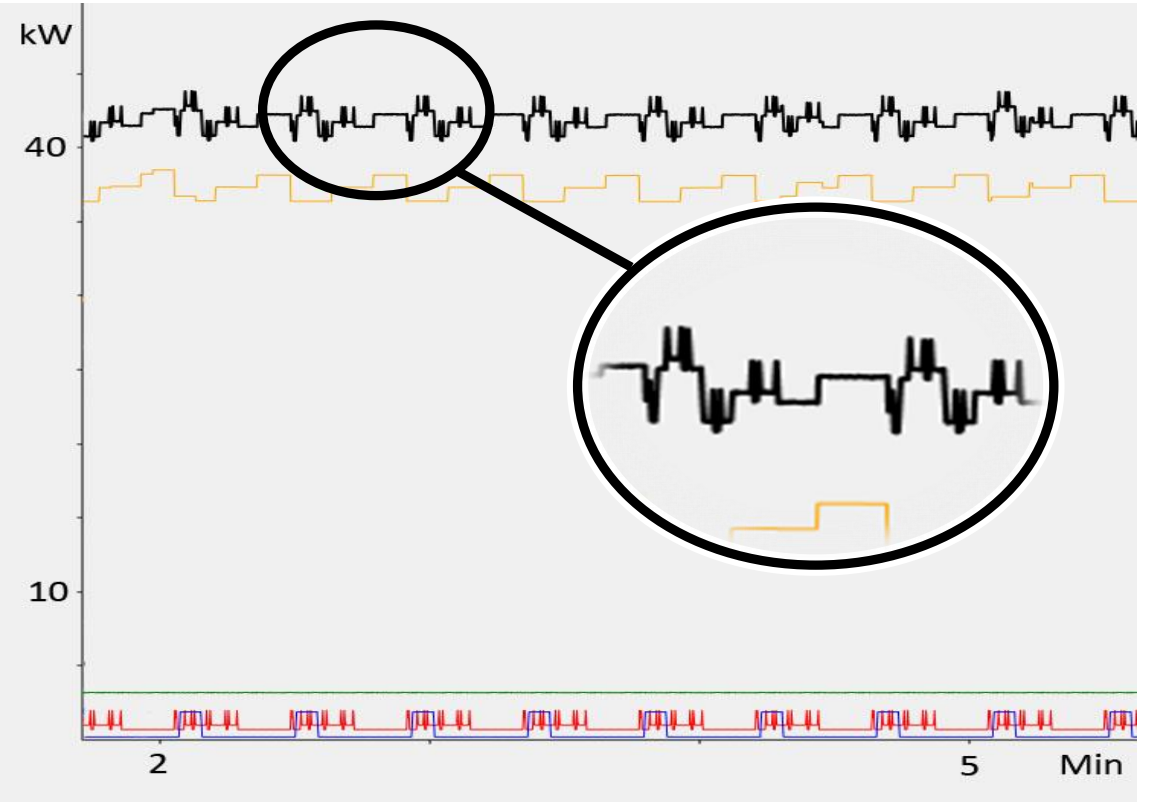
Some examples of Festo Plant

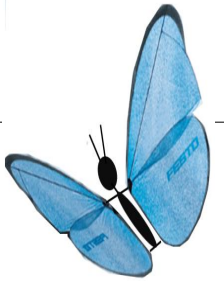
Leveling

without leveling



with leveling





Some examples of Festo Plant

Innovation

Innovation needs **Creativity!**

Rooms which offer creative atmosphere and tools to be creative.

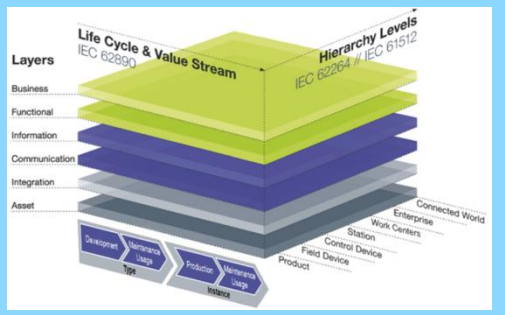
Technology behind I 4.0

Technology behind I 4.0

Architecture
Transformation

Technology behind I 4.0

Software	Communication	Factory
Cloud Technologies	Internet / Industrial Internet	Control / Embedded
Security Technologies	STANDARDS	RFID / NFC
Big Data and Analytics		Mobile Devices / APPs
Wireless Technologies		Functional Integration
Semantic Technologies		OPC-UA
Virtual Reality	Seamless Engineering	Augmented Reality



Technology behind I 4.0

IoT
Semantics

talk to the devices

Technology behind I 4.0

IoT
Semantics

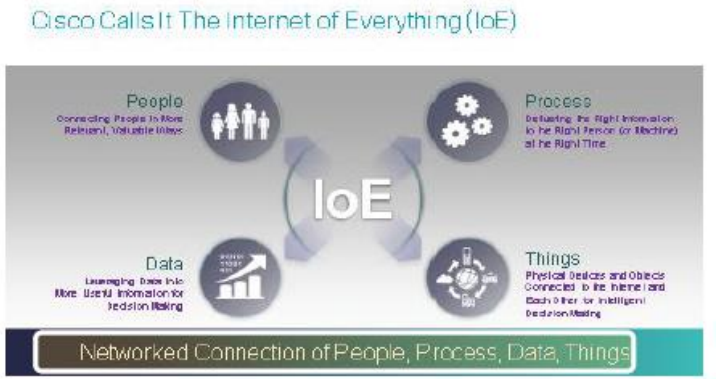
and listen to them

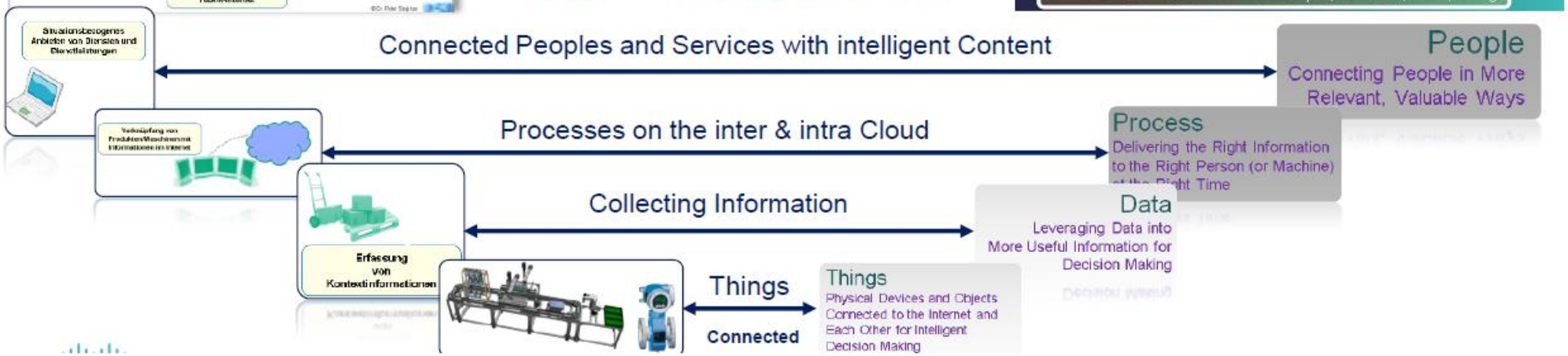
Technology behind I 4.0

IoT
Networks

The Network and Computing is the Foundation

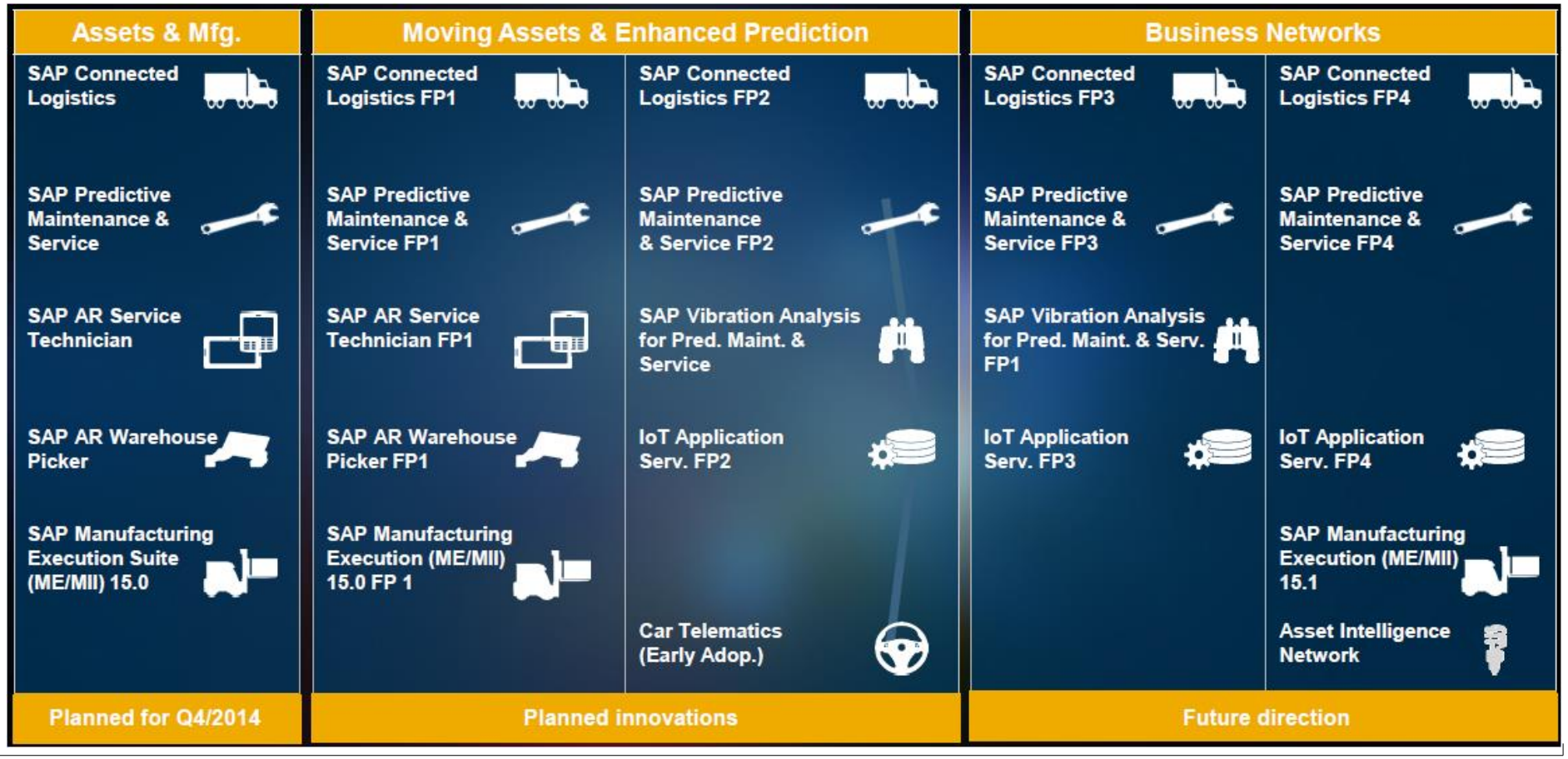
IoE = Industrie 4.0





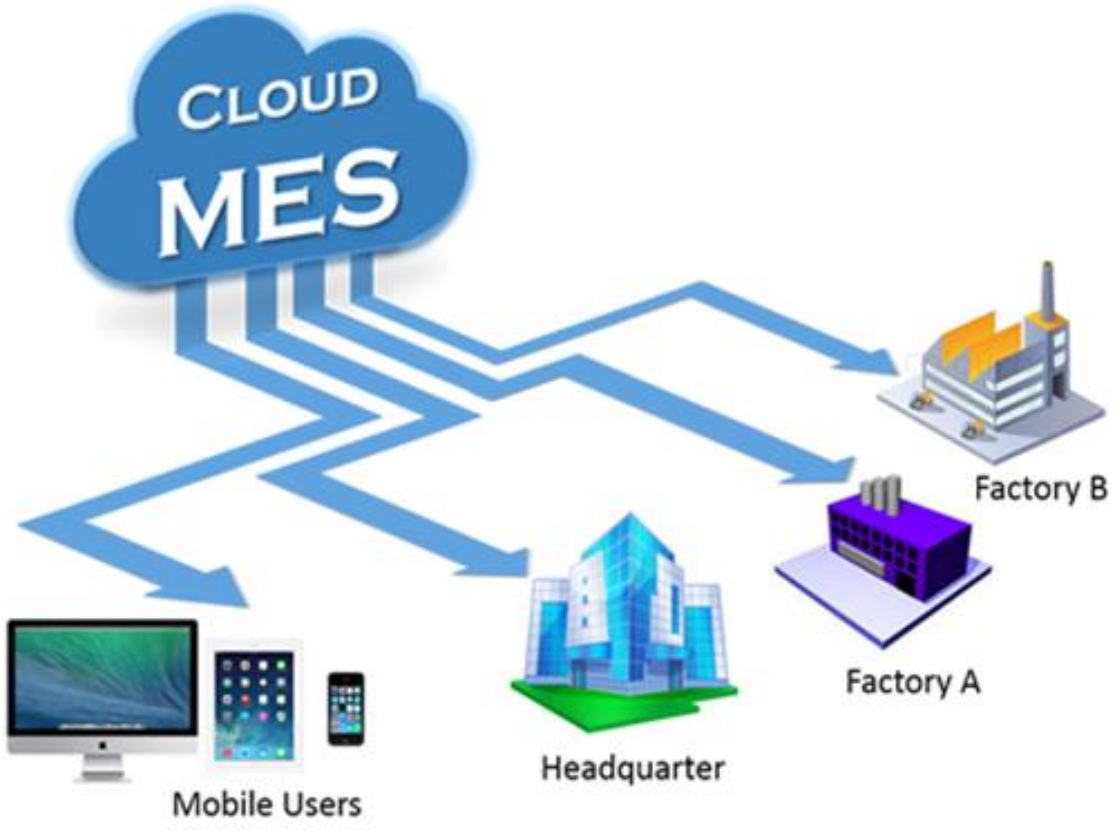
Technology behind I 4.0

Big Data
Analytics



Technology behind I 4.0

Cloud
PaaS
SaaS



Technology behind I 4.0

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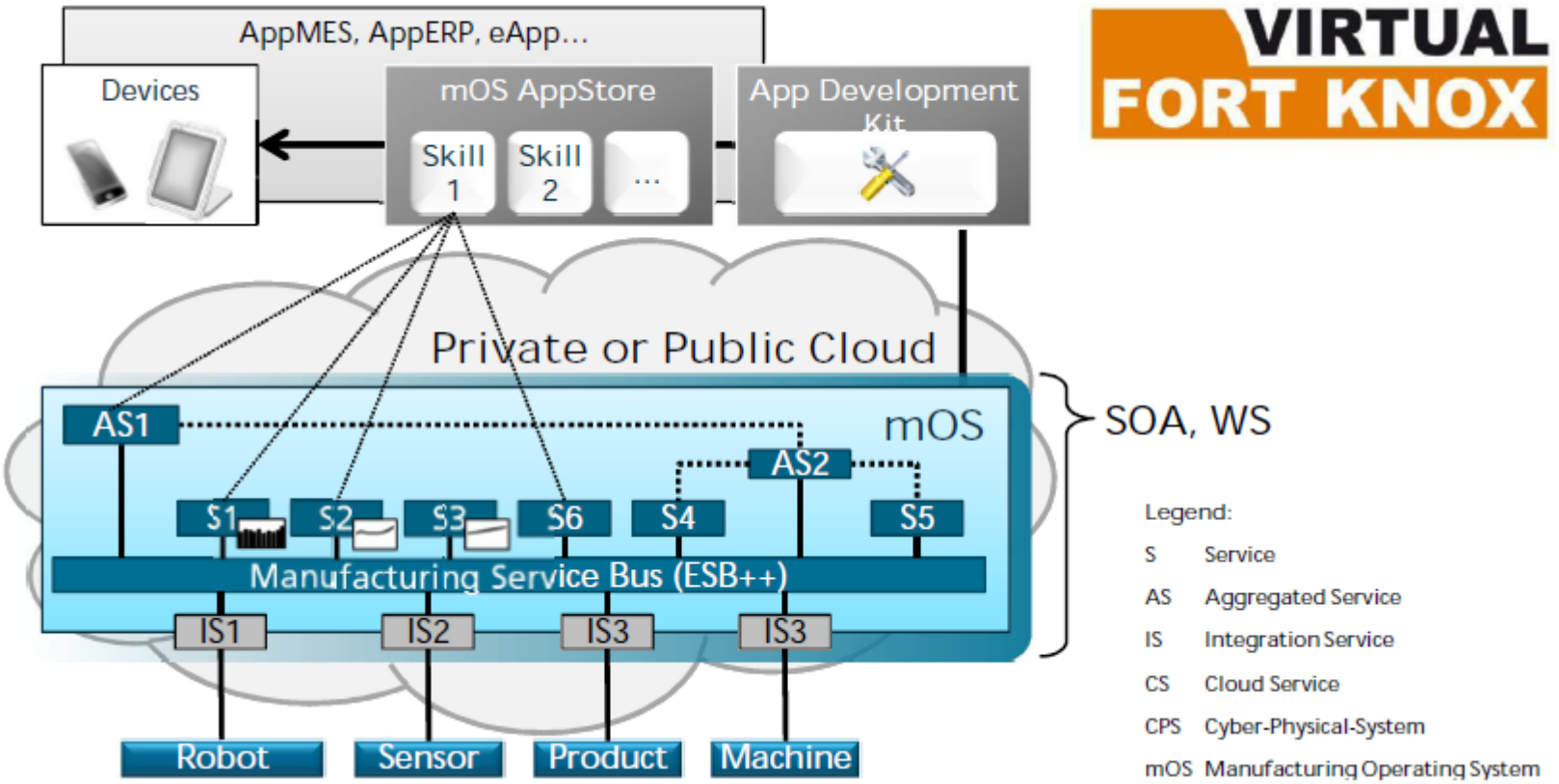
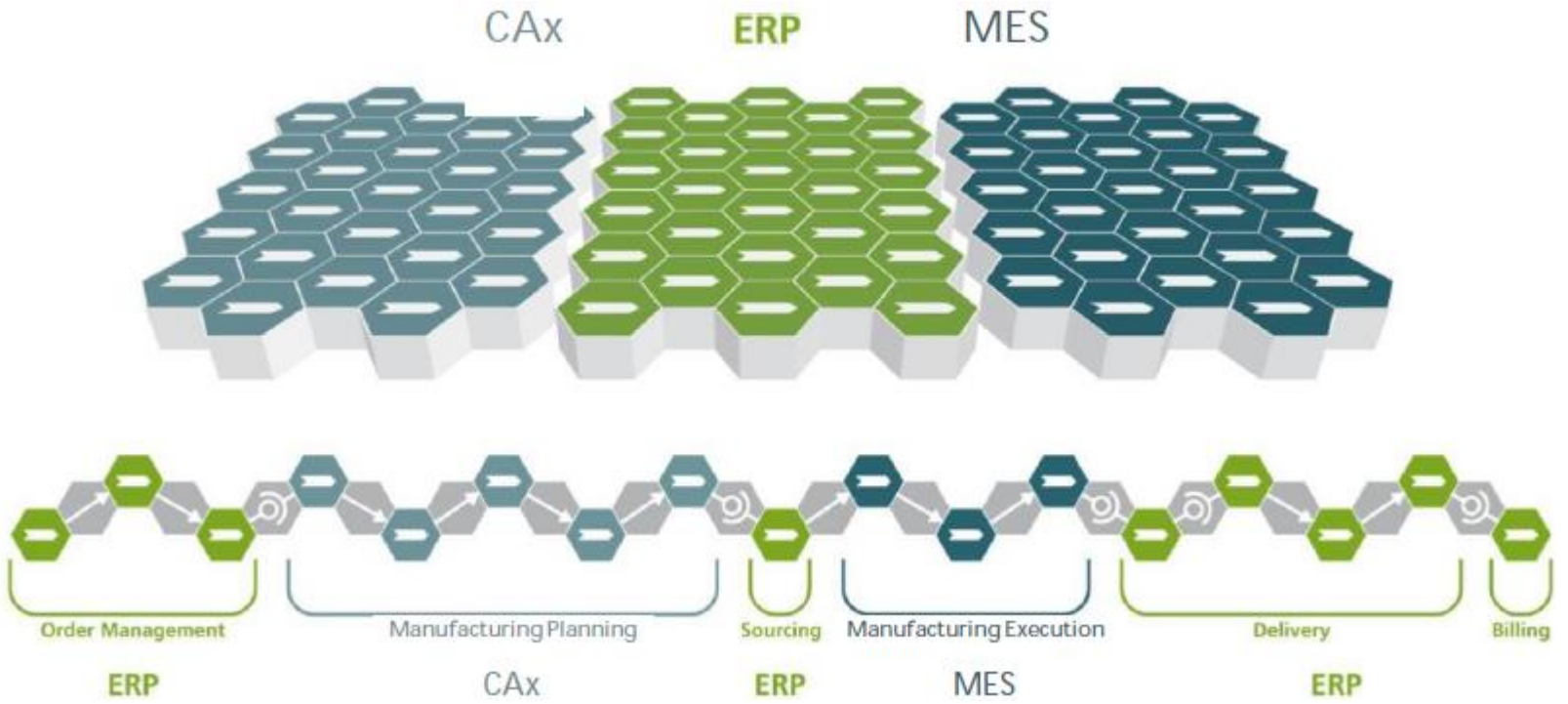
SaaS



VIRTUAL FORT KNOX

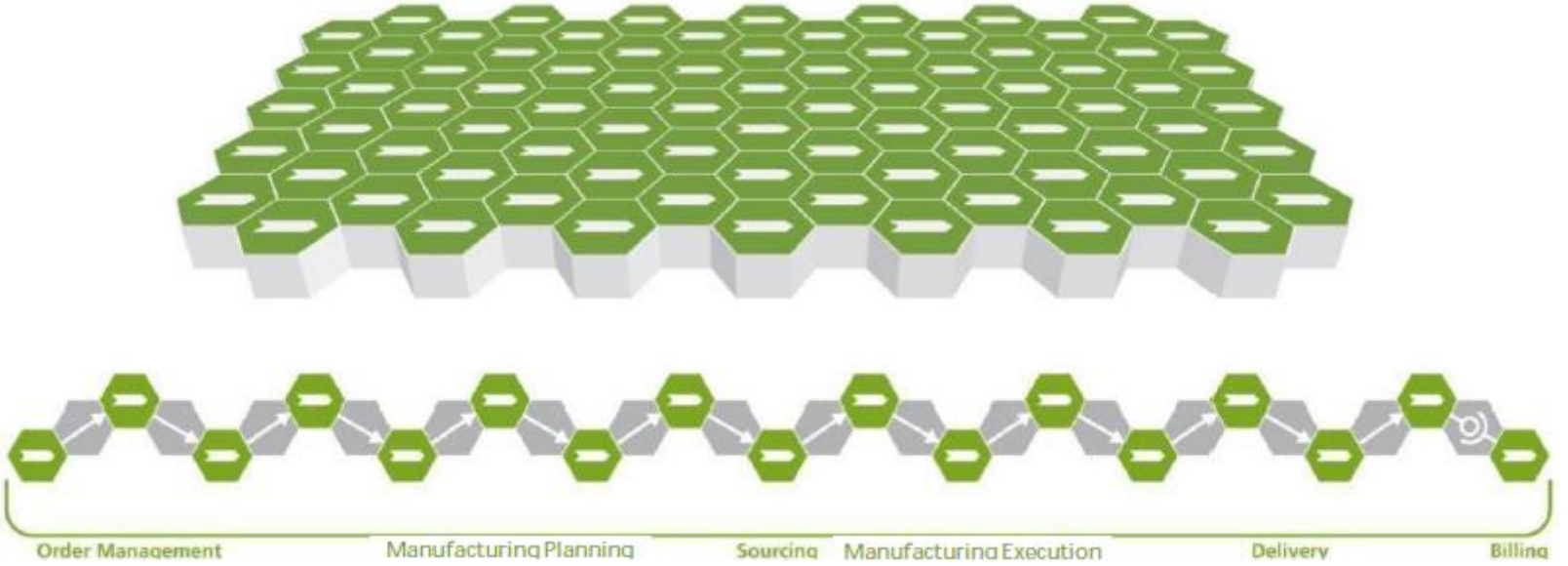
Technology behind I 4.0

Cloud
PaaS
SaaS



Technology behind I 4.0

Cloud
PaaS
SaaS

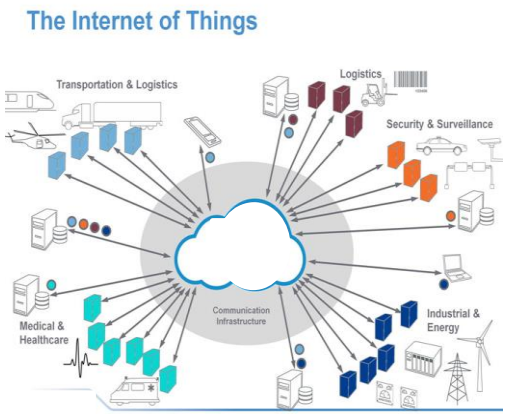


Technology behind I 4.0

Mobile
Service
Diagnostics
HMI
Logistics

Technology behind I 4.0

Functional Integration
Plug&Produce
IoT



Internet of Things

↑ + IP - capabilities

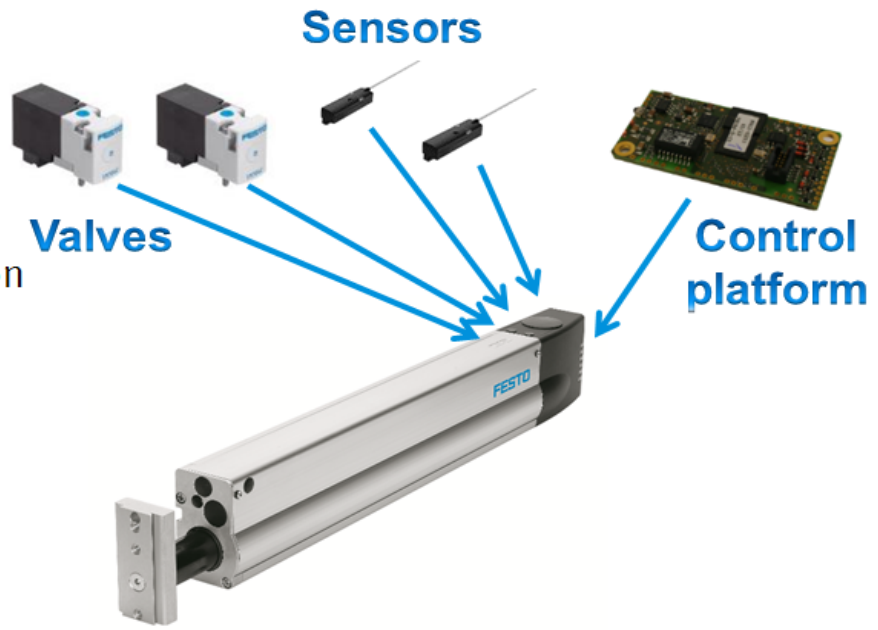
Cyber Physical Systems

↑ + internet communication
+ machine to machine Communication
•wireless communication
•semantic description

Embedded Systems

↑ + sensors, actuators
+ integrated intelligence

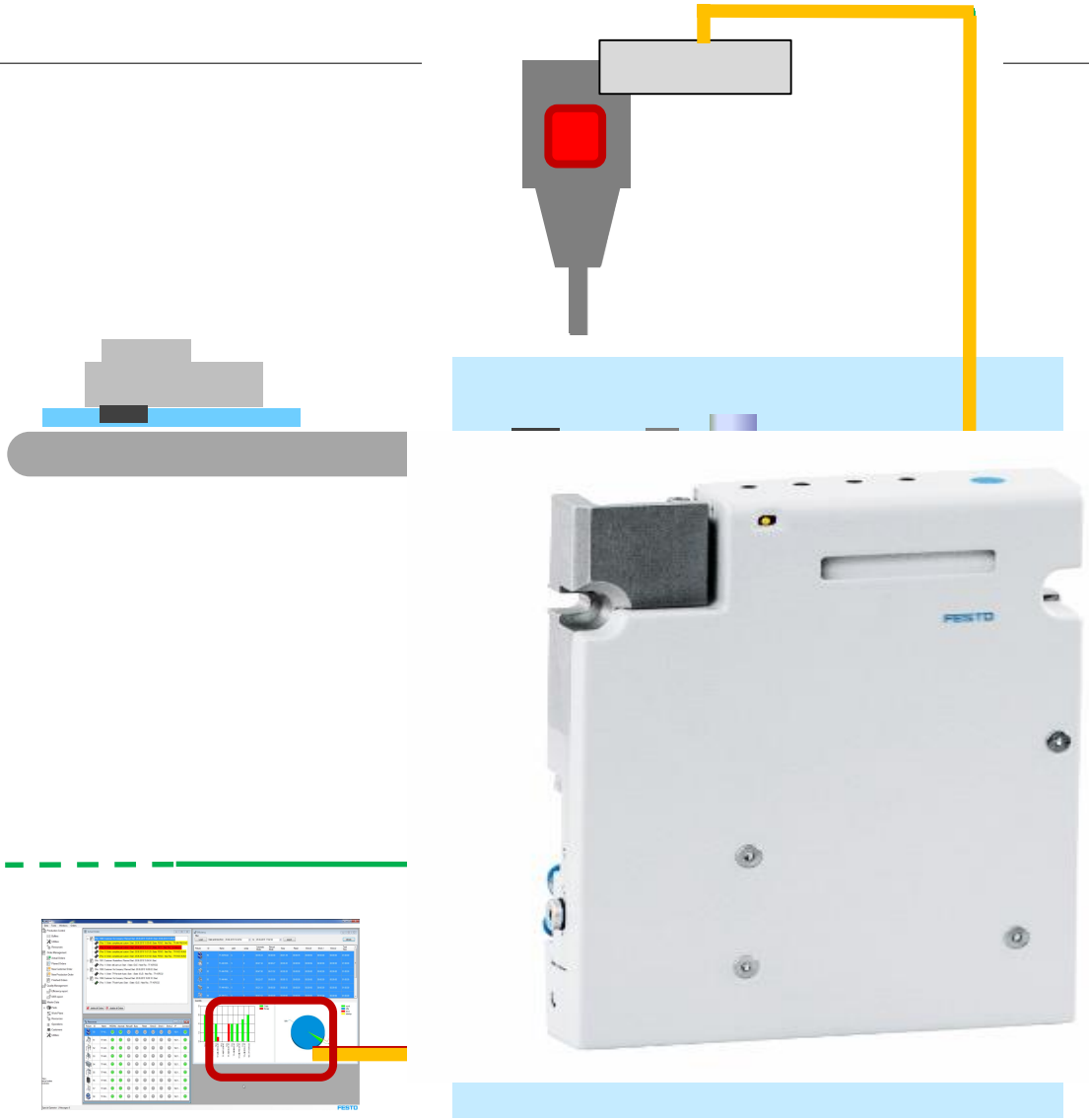
Physical Objects, Devices



Technology behind I 4.0

Functional Integration
Plug&Produce
IoT

- Pallet Conveyor
- Stopper
- Valves , Sensors
- Identification (RFID, QR, ..)
- Fieldbus Nodes
- PLC
- Process Module
- Production Data (MES, …)



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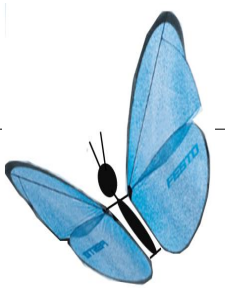


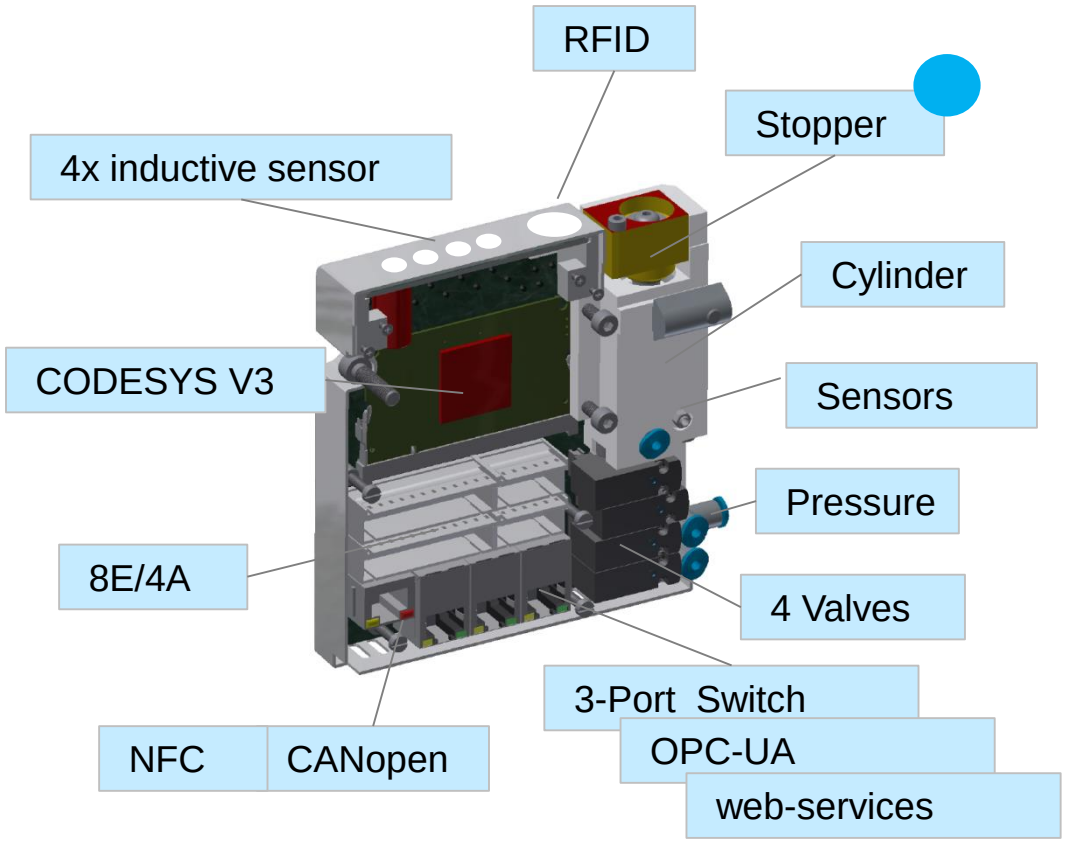
Functional Integration
Plug&Produce
IoT

> **Highly Integrated CPS Stop Gate**

- Conveyor
- CPS-Stop Gate
- **Mech. Stopper**
- **Valves / Sensors**
- **Shunt Control**
- **Identification RFID**
- **Parametrizing NFC**
- **IEC 61131 Controller**
- Line Controller
- Data Server (MES, …)

Technology behind I 4.0

Functional Integration
Plug&Produce
IoT

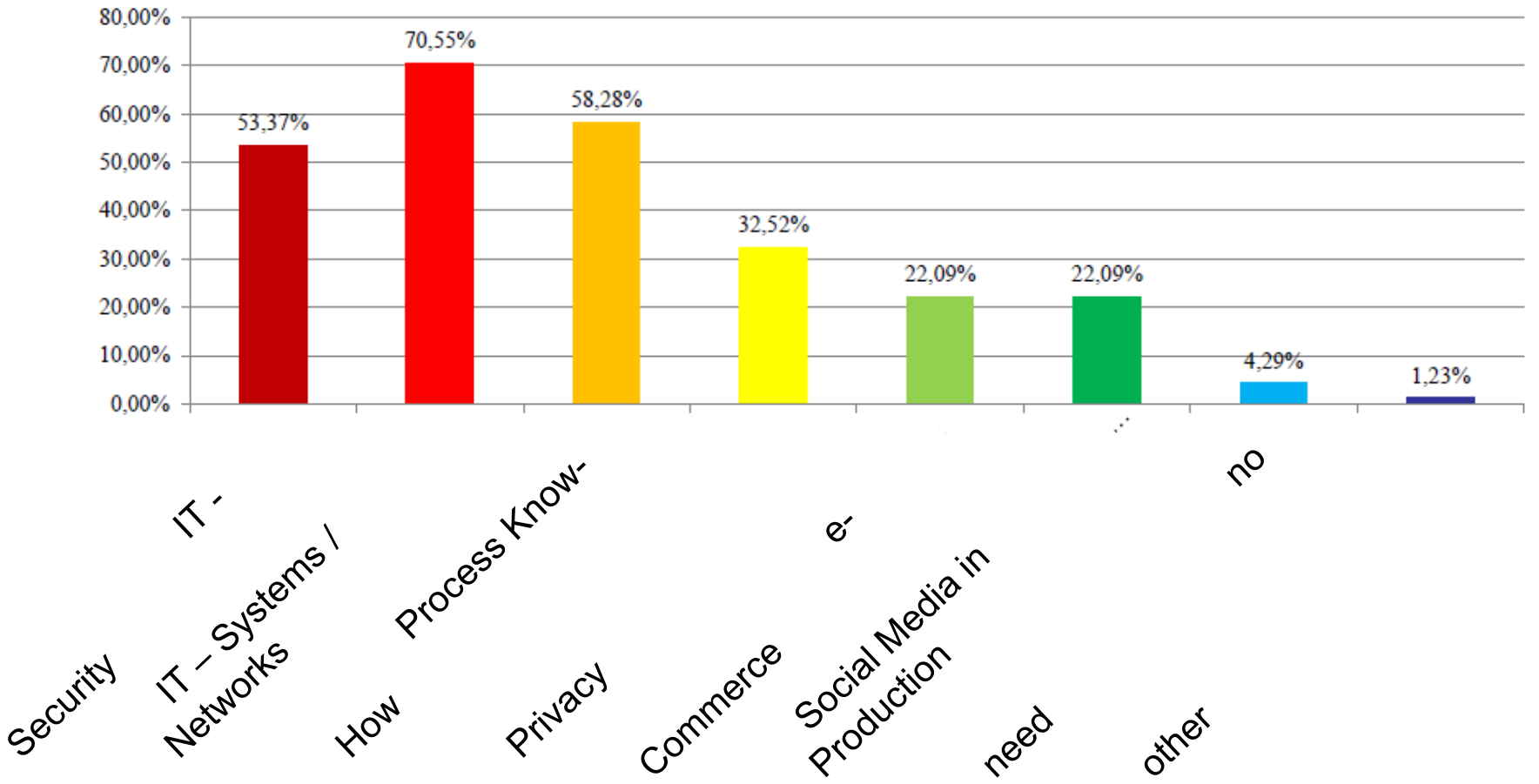


Qualification for I4.0

Qualification for I4.0

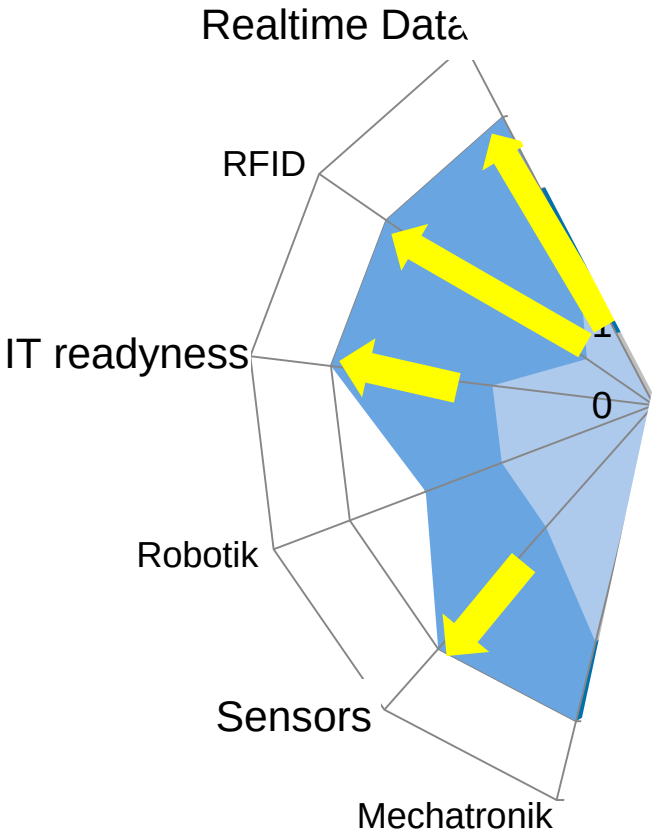
Qualification Demand
for I4.0

In which areas do you see need for quaification for your employees ?



Qualification for I4.0

Qualification Profile
Maintenance Staff
FESTO



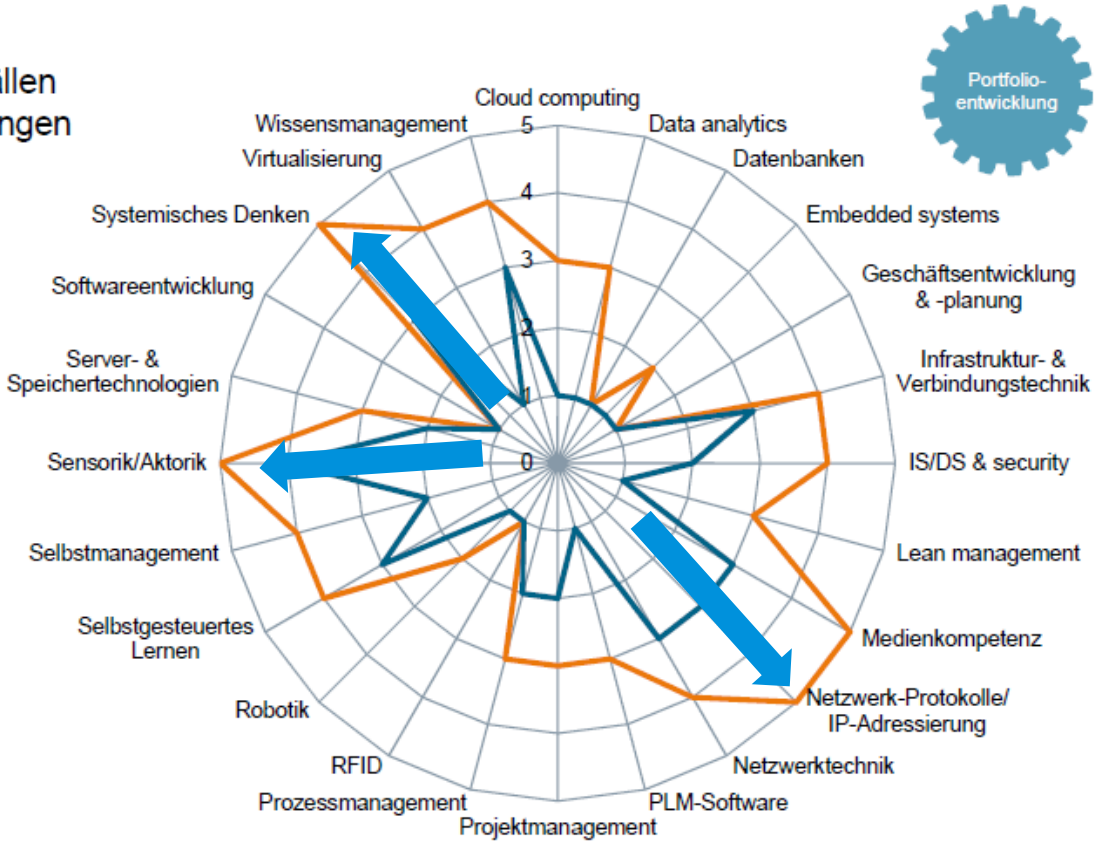
Qualification for I4.0

Qualification Profile
Maintenance Staff
SIEMENS

Basierend auf 25 Anwendungsfällen können sich je Rolle Verschiebungen von Industrie 4.0 relevanten Kompetenzfeldern ergeben

Diese Vorgehensweise stellt folgendes sicher:

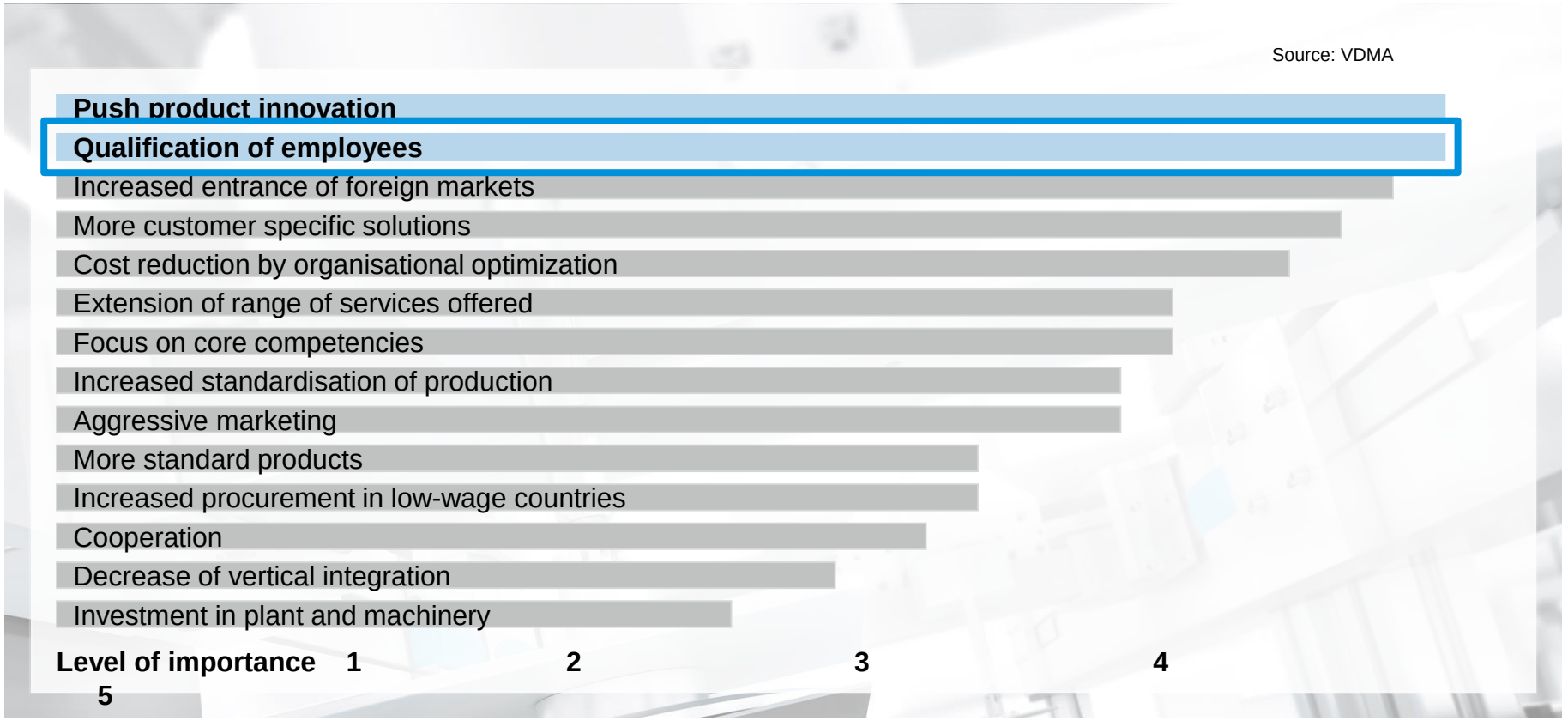
- ✓ Keine Annahmen
- ✓ Hoher Realitätsbezug
- ✓ Hoher Praxisbezug
- ✓ Repräsentative Erhebung



Beispiel: **Service-Techniker**

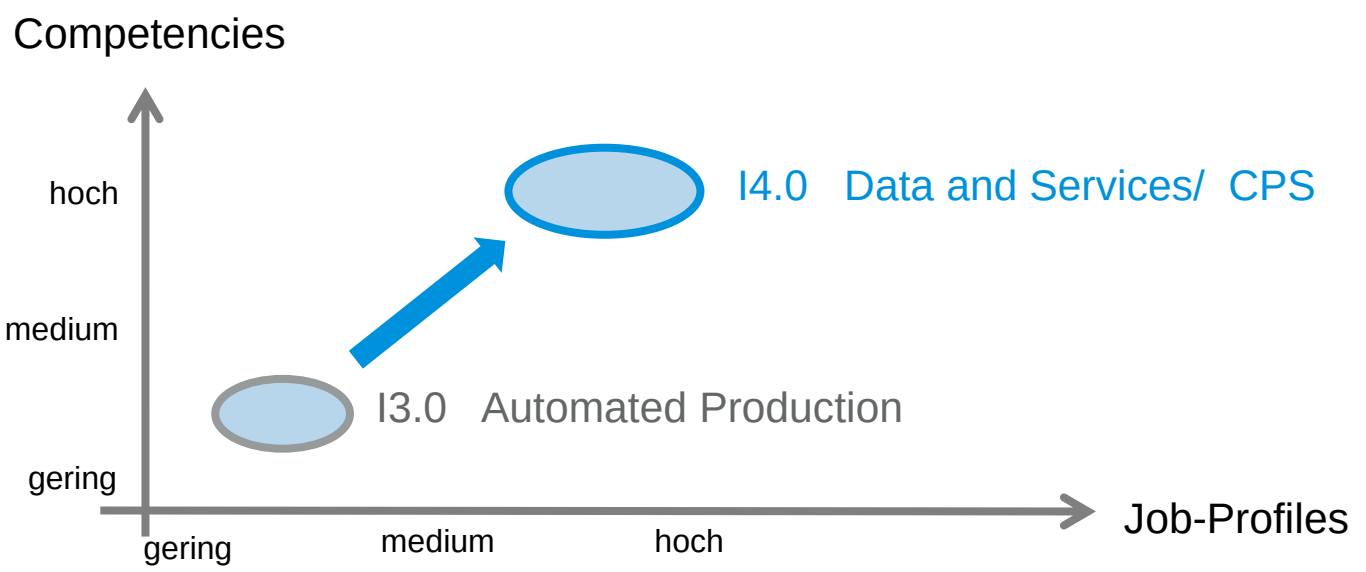
Qualification for I4.0

German manufacturers invest in the “Circle of Innovation and Qualification”



Qualification for I4.0

Changed Job Profiles for Employes in I4.0 Environment



Qualification for I4.0

Productivity and qualification

Economic development

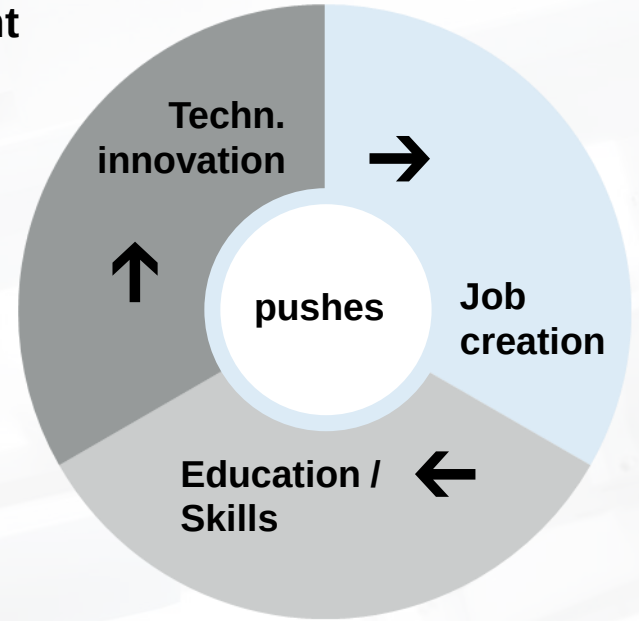
→ Productivity

Knowledge

Innovation

Independence

Growth



Economic demand

→ Education

Skilled workforce

Creativity

Problem solving ability

High Technologies

Investments

Qualification for I4.0

3 Pillars

- Spezialisierte Vorlesungen
- Adaptierte Curricula
- Neue Forschungsfelder
- Fachübergreifende Kooperation
- Master of I4.0 ?

Academic

Vocational

Further Training

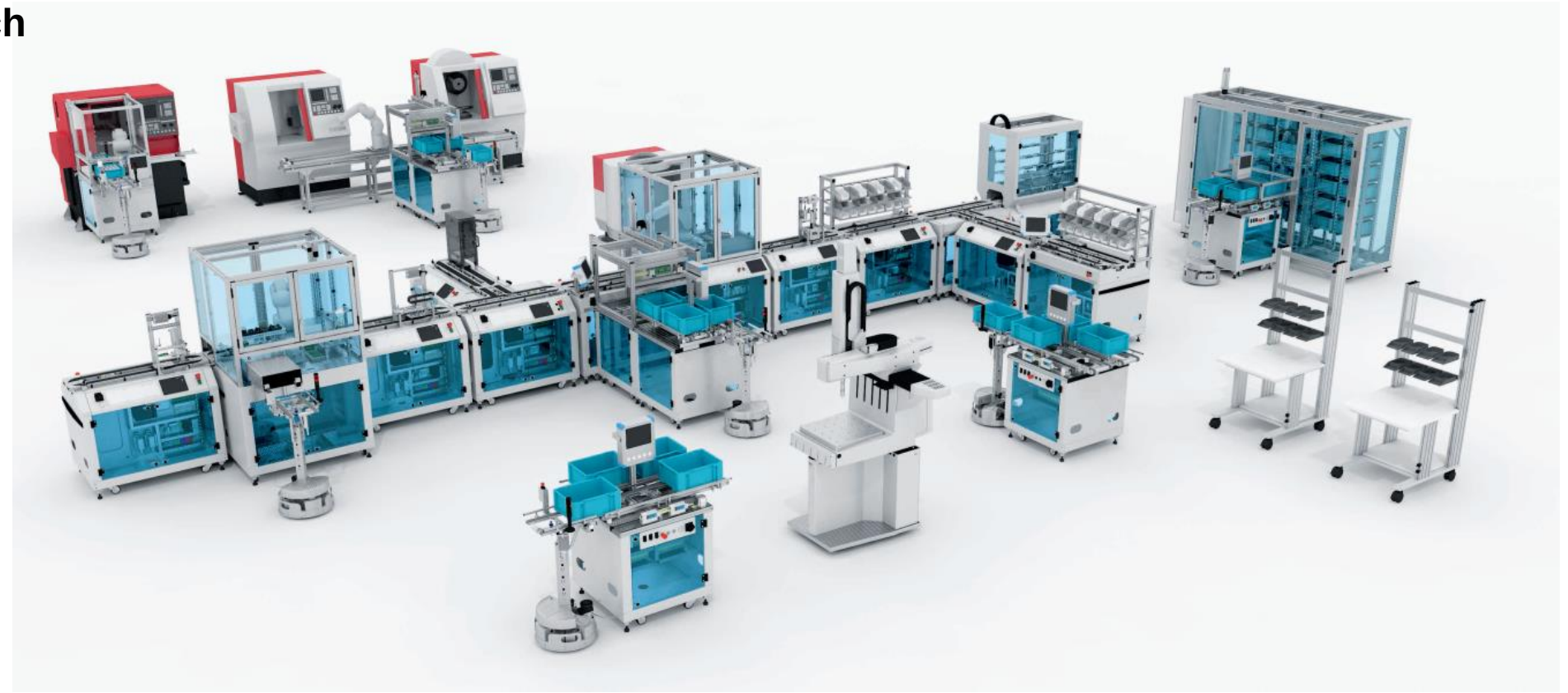
- Integration in berufliche Guidelines
- I4.0 praktische Erfahrungen
- Adaptierte Skill-Sets
- ..

- I 4.0 Wissens- und Anwendungszentren
- Konferenzen und Events
- E-Learning
- neue Kurse für Trainer

Qualification for I4.0

Training and Research Platform

CP Factory



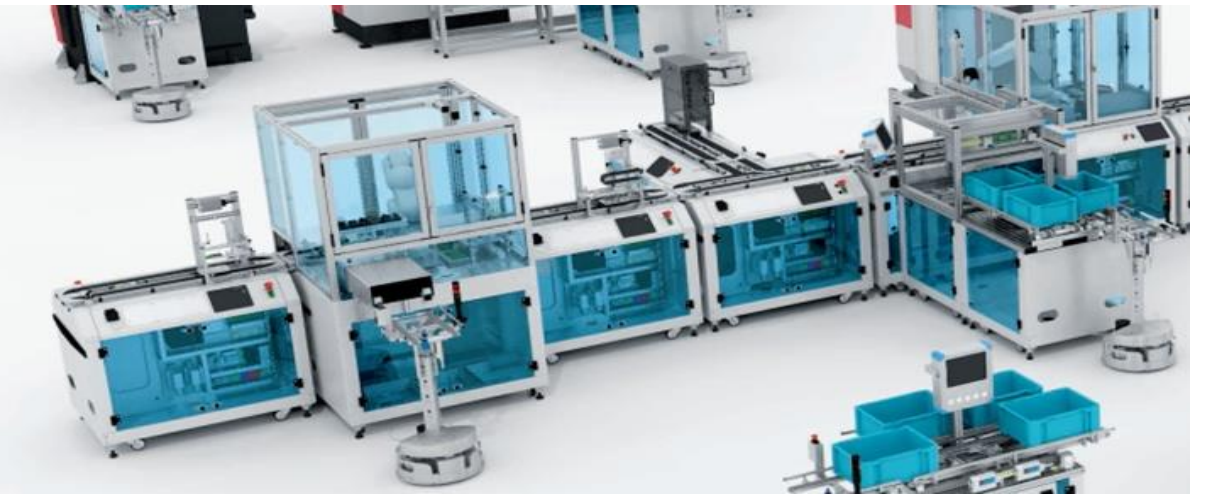
Qualification for I4.0

Training and Research Platform

CP Factory

Real plant

Training Factory



Qualification for I4.0

Training and Research Platform

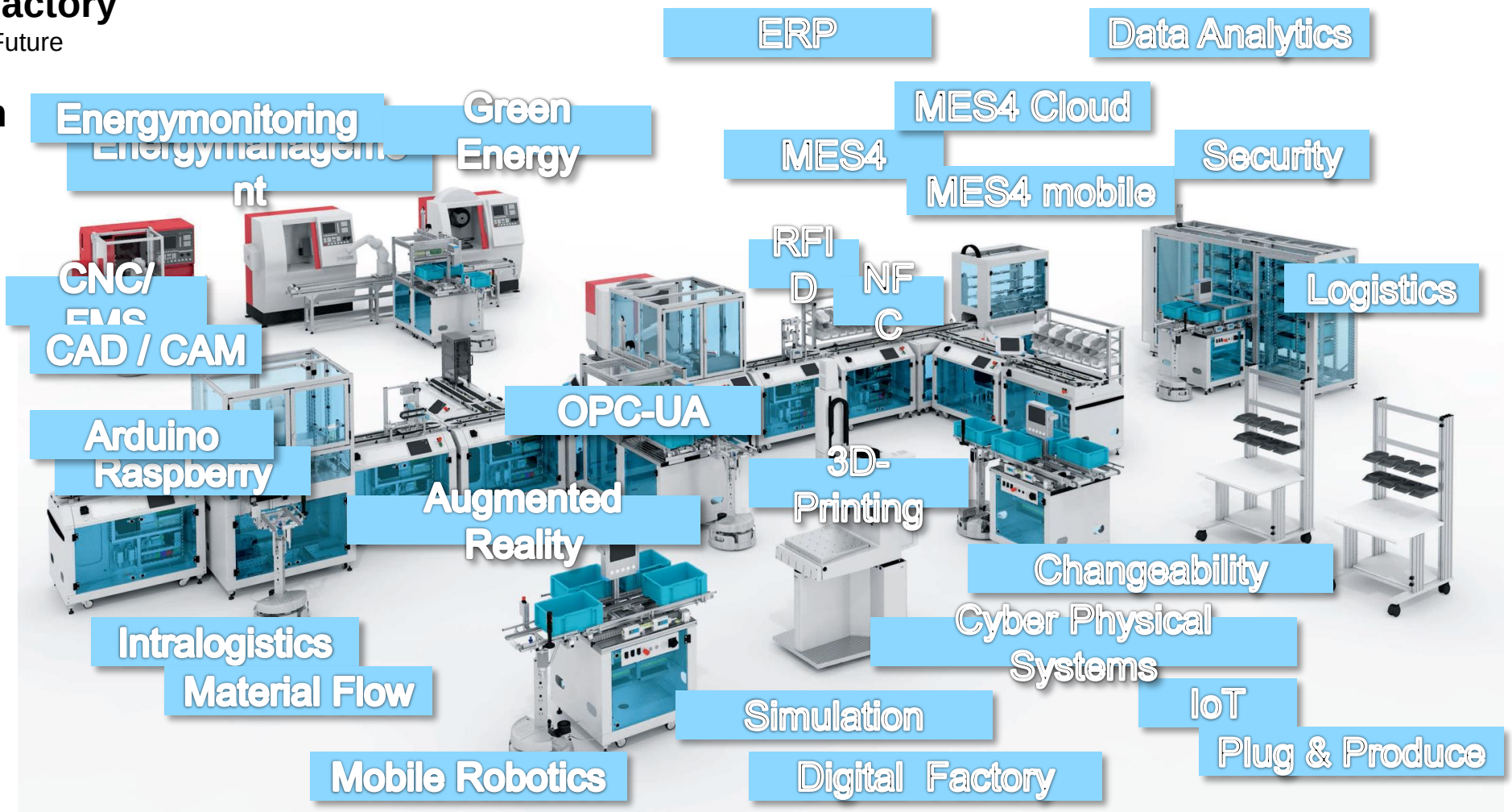
CP Factory

- Modularity
- Flexibility
- Changeability
- Plug & Produce

Industrie 4.0 @ CP Factory

Qualification for the Factory of the Future

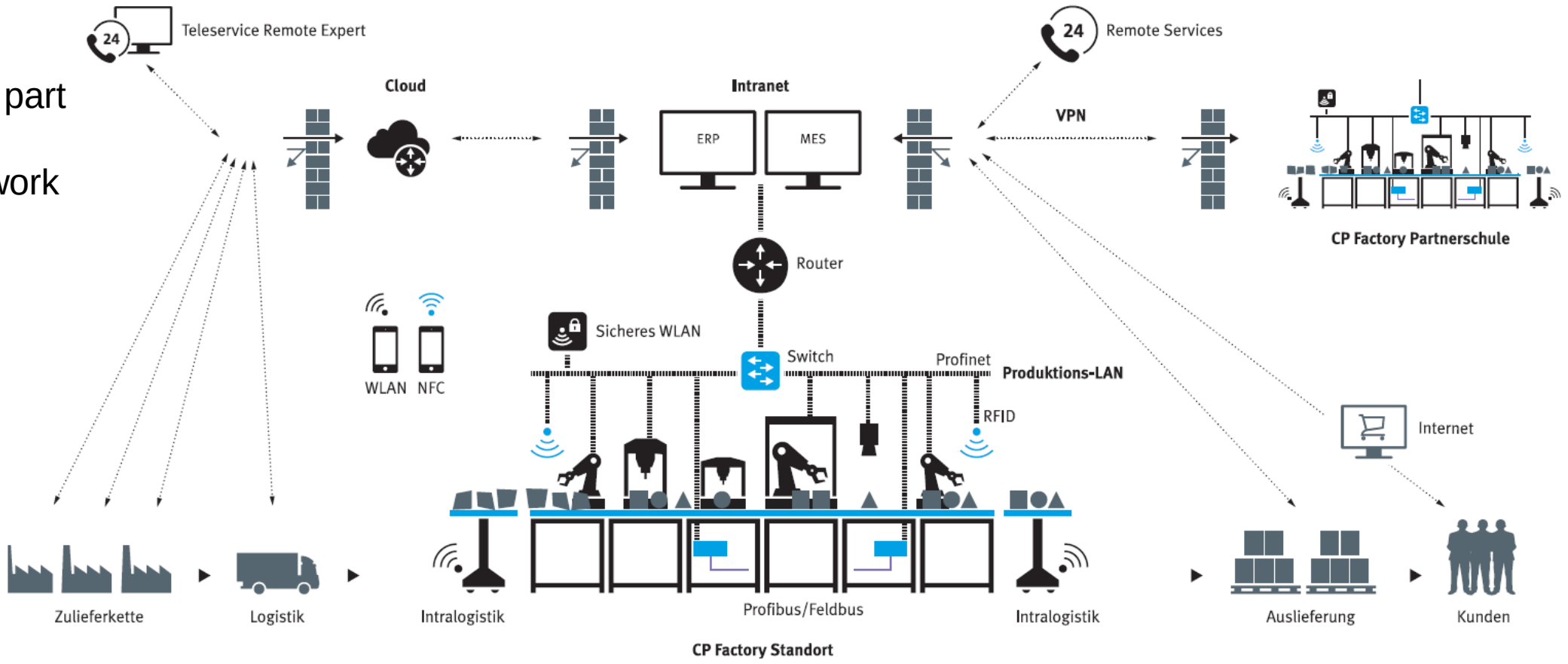
Training and Research Platform



Qualification for I4.0

CP Factory

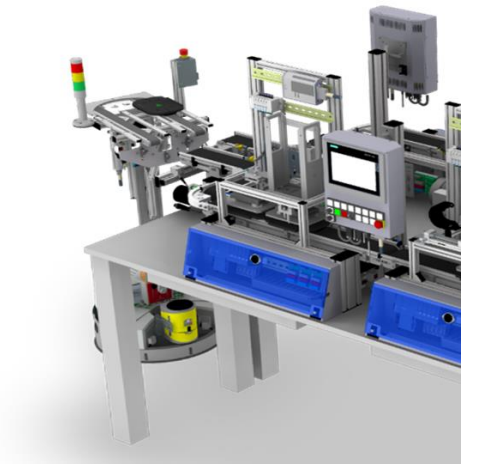
The factory as a part of a worldwide Production Network



Qualification for I4.0

Changeability

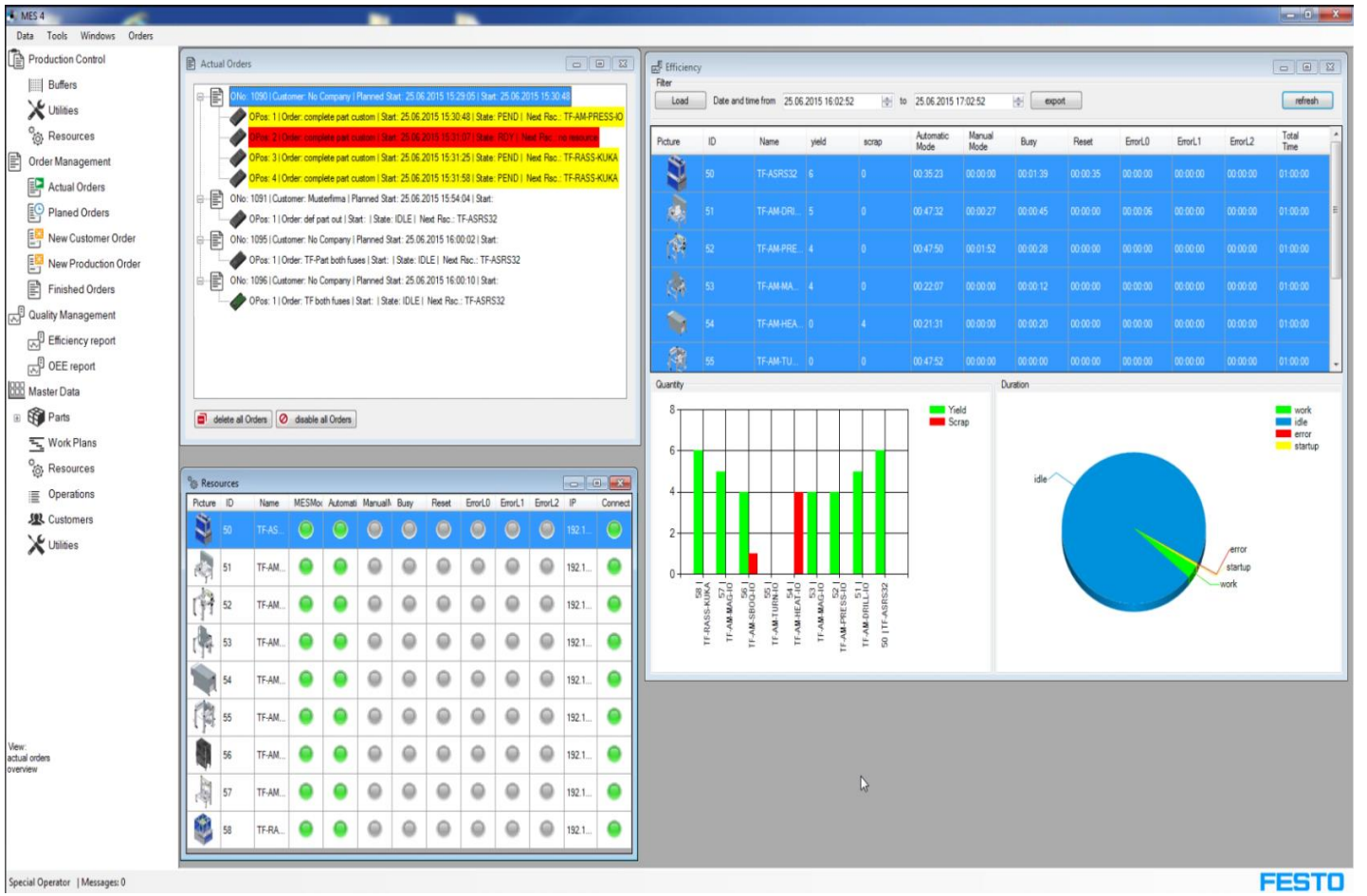
Mobile robotics as an enabler for
Changeability and
Flexibility.



Qualification for I4.0

Production Data

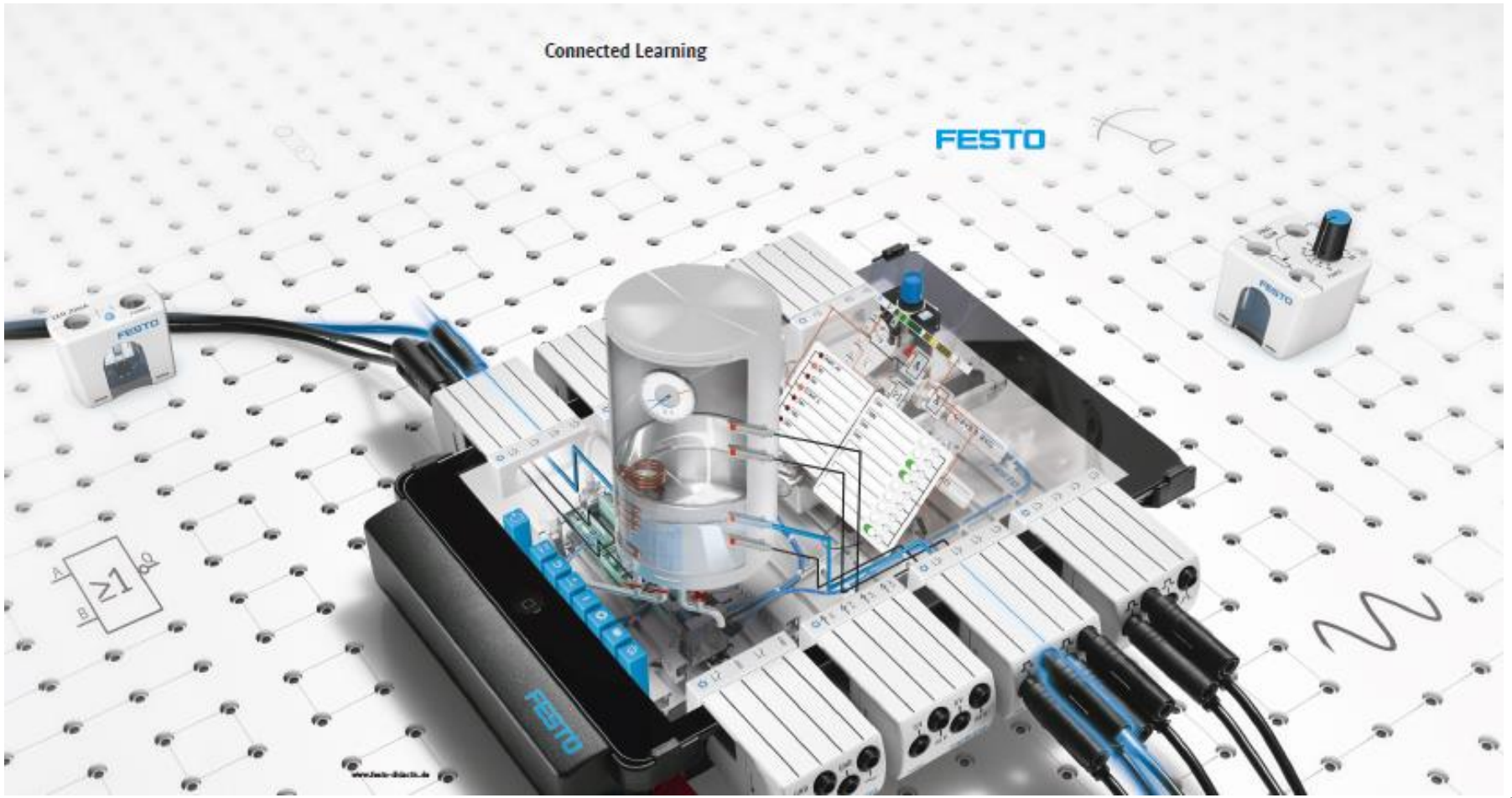
MES as a Data Server for Production Data



Qualification for I4.0

QI4.0

New Training Methods



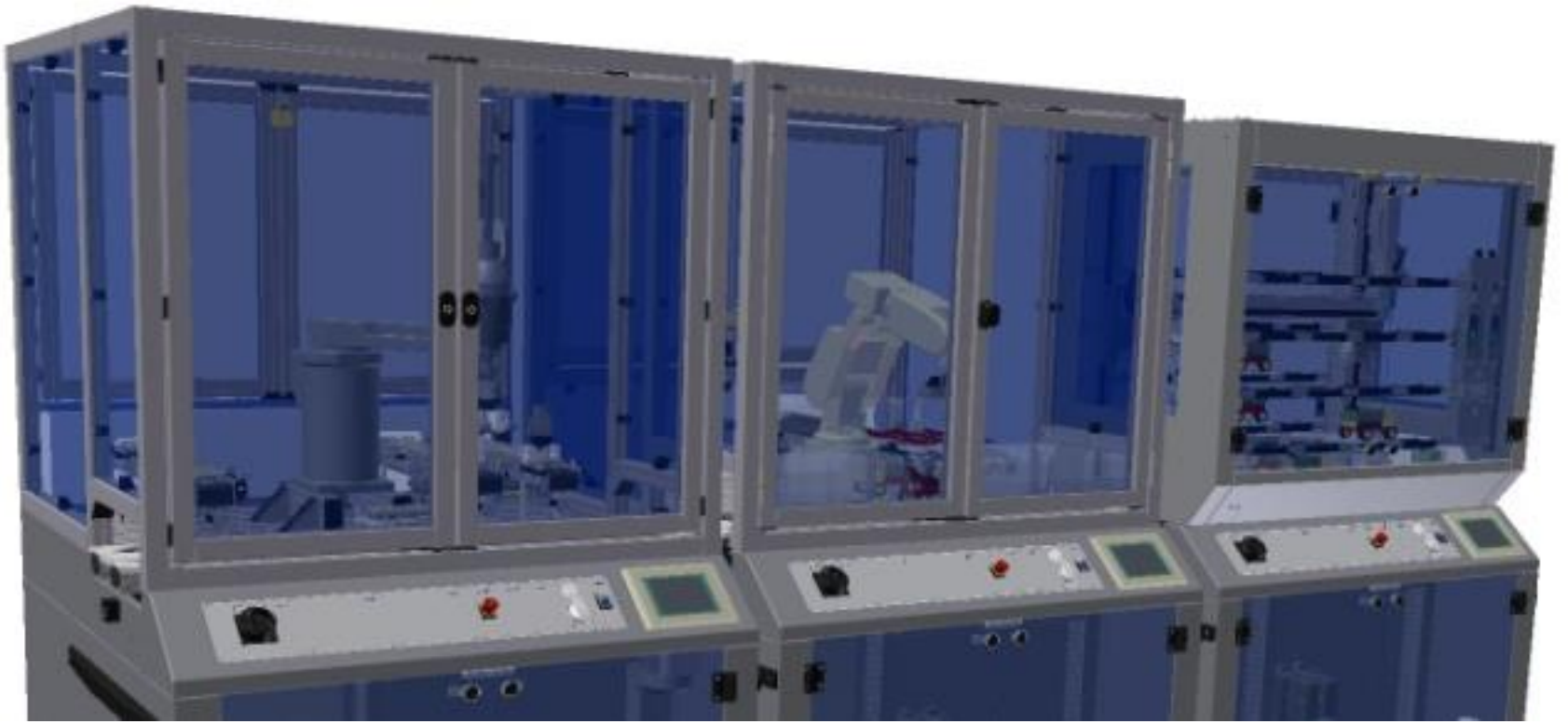
The Spirit of Industrie 4.0

Thank You

Festo Didactic - Research Platform for flexible Robot Assembly Systems

Reference DHBW Mannheim

- MPS TransferFactory Robotic Lab
- Including Robot assembly cell with RV-3SDB robot, SCARA robot cell, Cartesian robot AS/RS
- Training topics: Lean management and lean production, value stream analysis, TPM, …



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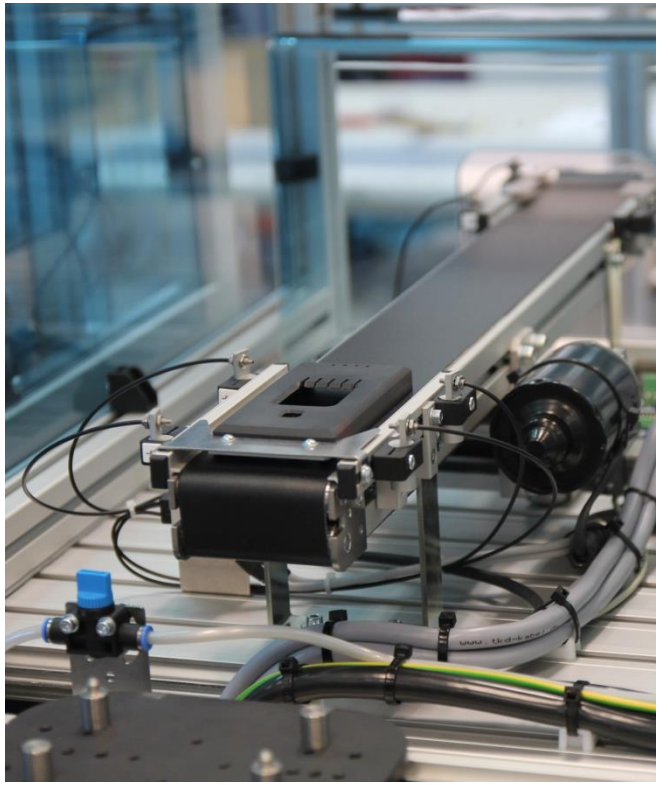
  1x Robot assembly cell with RV-3SDB robot,
  1x SCARA robot cell,
  1x AS/RS (Cartesian robot)
- Training topics:
  Robotics,
  workpiece tracking
  Handling



Festo Didactic - Training and Research Platform for Hybrid Automation

Reference Guilford Technical Community College USA, AFB Factory

- Hybrid training factory AFB
- including:
  Process automation and factory automation
  Handling technology, Robotics,
  RFID technology, camera inspection and Datamatrix coding

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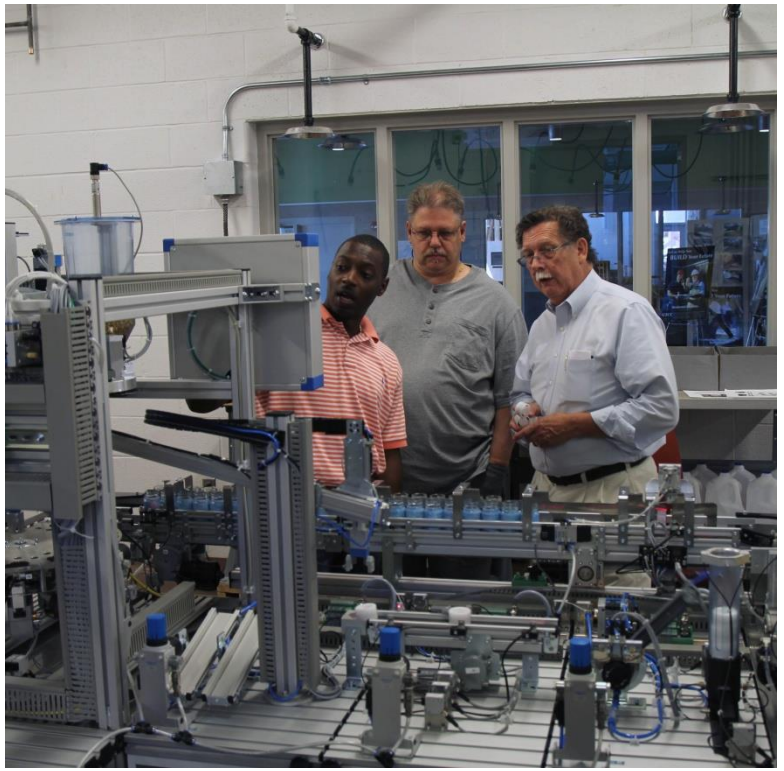

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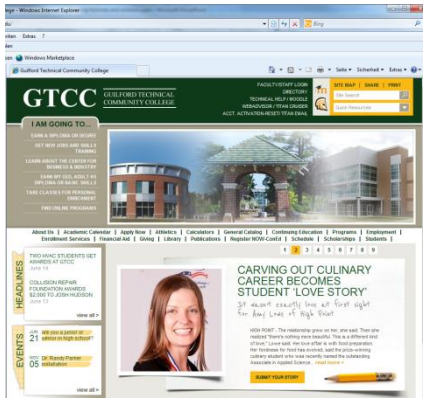
More infos:



http://www.gtcc.edu/

Festo Didactic - Training and Research Platform for Flexible Manufacturing

Reference Anhui University of Science and Technology, China

- MultiFMS
- including:
  EMCO Mill250,
  EMCO Turn 250
  Complete MPS500 system
- Training content:
  CNC Technology,
  Robotics,
  Mechatronics,
  PLC Technology

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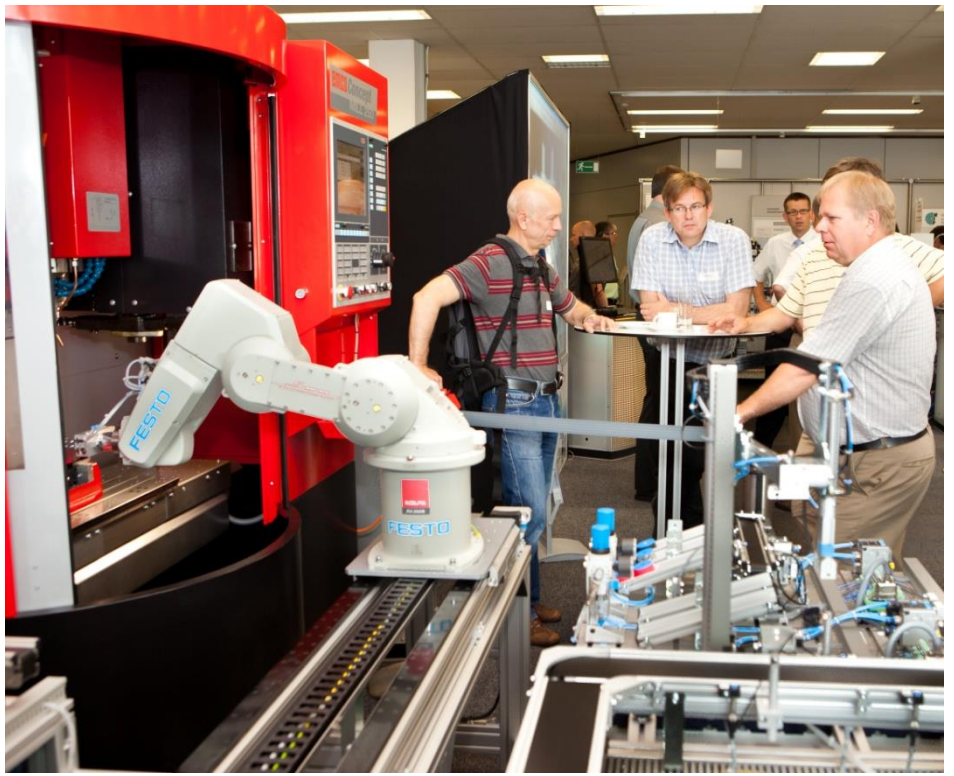

Festo Didactic - Training and Research Platform for Mobile Robotics and Logistics

Reference Universidad Autonoma de Campeche, Mexico

- Prolog Factory
- including:
  Production line
  MPS
  Picking station wit
  robot RV-2SDB
  Logistic field with
- Training content:
  Logistics,
  Robotics,
  Mobile robotics,
  Mechatronics,
  RFID technology,
  Communication

ProLog factory

More information

→ Video ProLog factory

A Global Partner of worldskills international

- Kanban
- Just in sequence
- Order scheduling ...

The exciting new training platform for logistics, communication technology, mechatronics and industrial engineering.

http://www.festo-didactic.com/de-de/service/videos/7354.htm?fbid=ZGUuZGUuNTQ0LjEzLjMyLjg5Ny43MzU0

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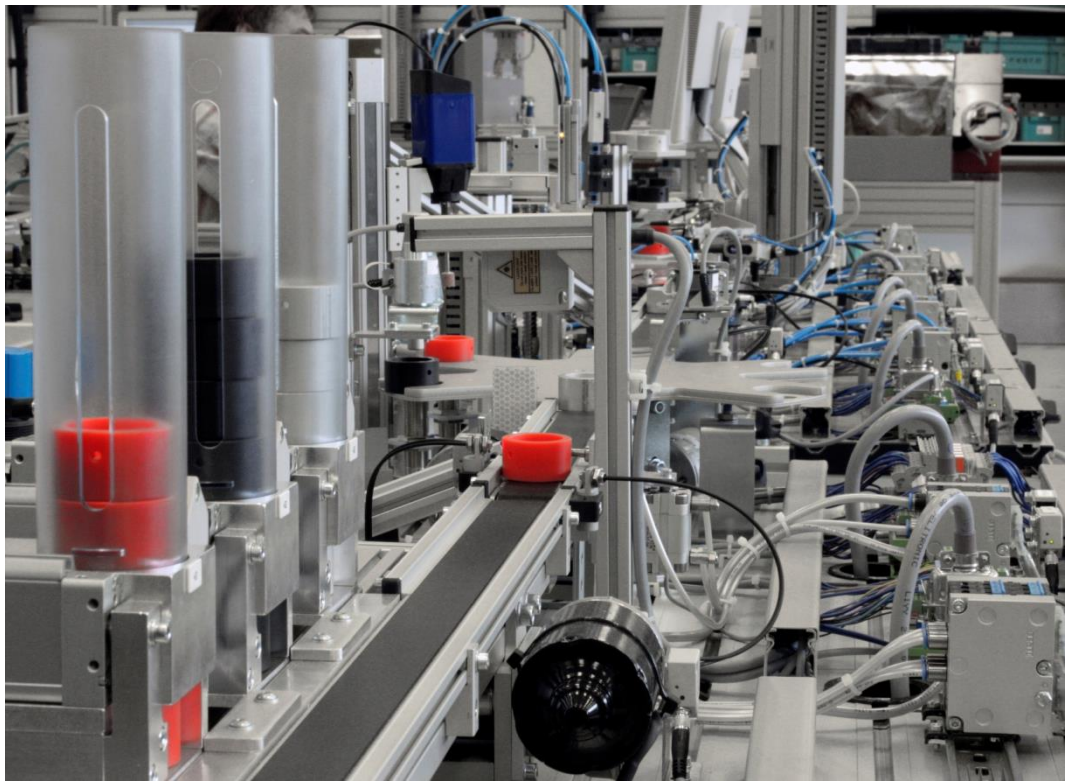

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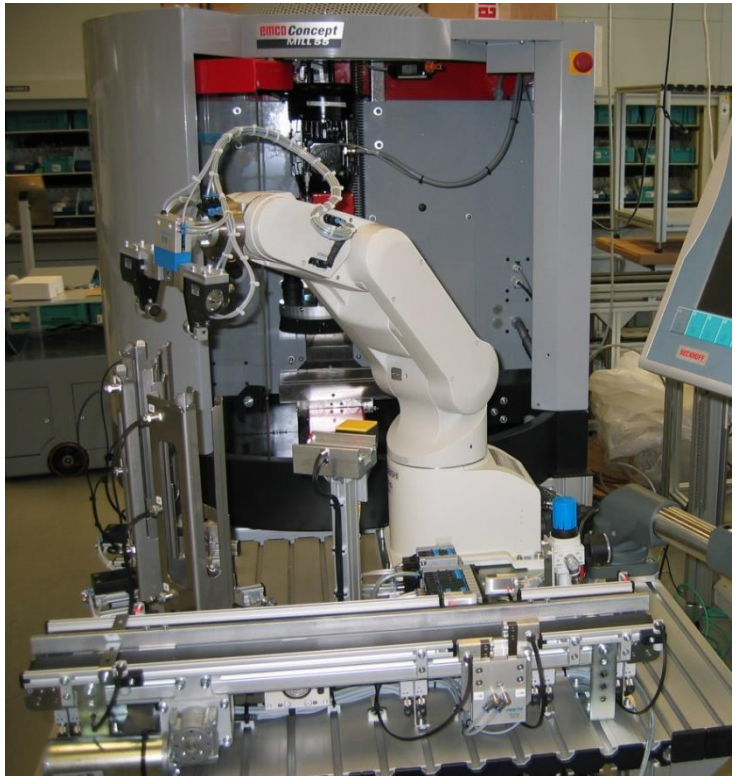
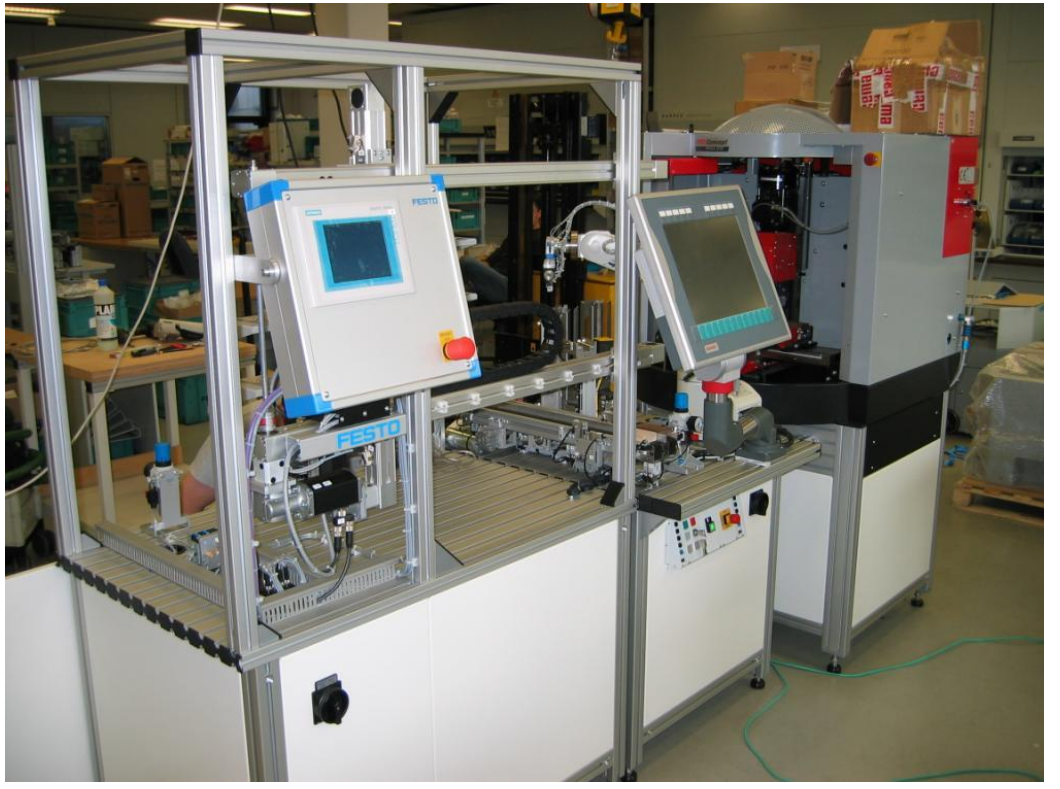
  Communication

Festo Didactic - Research Platform for Industrie 4.0

Reference Future Factory SAP Research Dresden, MicroFMS

- Gaining full trans-parency and insight into all manufact-uring processes
- SAP addresses the challenges around data acquisition, system integration, and visualization
- Supporting sustain-able energy efficient production is focus of current research and development





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SAP RESEARCH LIVING LABS

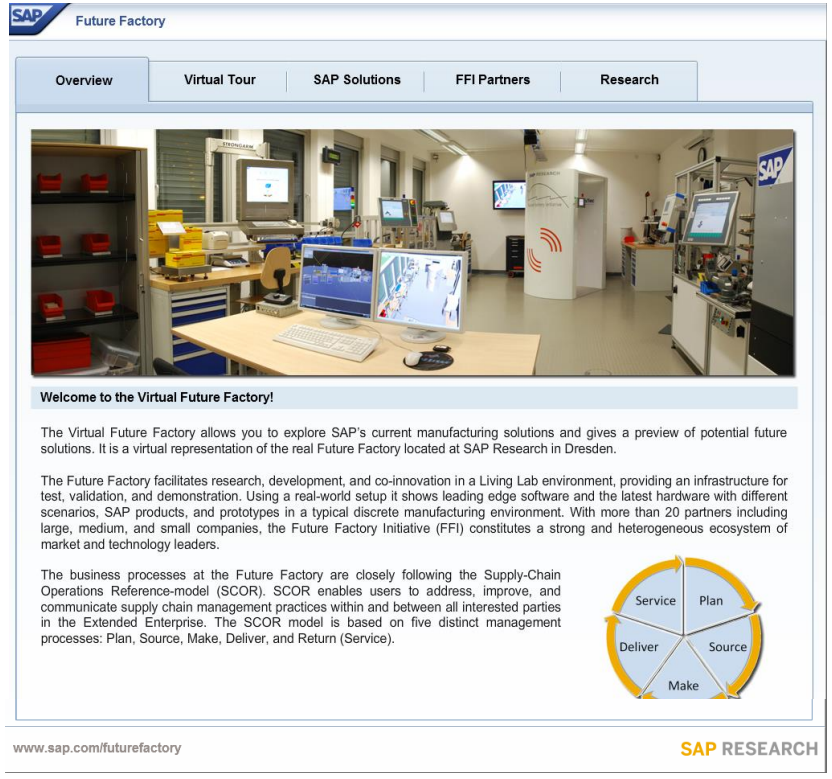
FUTURE FACTORY INITIATIVE

Managed by SAP Research in Dresden, the Future Factory Initiative is a joint effort between SAP Research and industrial partners to foster co-innovation, research, and development for the manufacturing industry.

Using a real-world setting, the Future Factory Initiative presents leading edge software and the latest hardware with different scenarios, SAP products, and prototypes in a typical discrete manufacturing environment. With more than 20 partners, including large, midsize, and small companies, the Future Factory Initiative constitutes a heterogeneous and strong ecosystem of market and technology leaders.

Following the SAP corporate strategy to develop the world's best business applications for on-premise, on-demand, on-device, and orchestration, the Future Factory Initiative is active in three areas:

http://www.sap.com/corporate-en/our-company/innovation/research/livinglabs/futurefactory/index.epx



Festo Didactic - Research Platform for Industrie 4.0

Reference iFF Stuttgart transformable production, iFactory

At the learning factory for Advanced Industrial Engineering, principles of the transformable assembly and production facilities that are fundamentally important in terms of planning, physical and control technology aspects are being implemented.

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Reference iFF Stuttgart transformable production, iFactory

The connection between the cells is done via one standardized connector, including:

- power supply 400V
- air-supply
- Ethernet
- Grounding
- 24V Emergency Stop

This allows a fast and save connection of the different cells of the iFactory.

Intelligent network:

Festo Didactic - Research Platform for Industrie 4.0

Reference iFF Stuttgart transformable production, iFactory

"In order to secure the existence and ensure com-petitiveness of companies, it is absolutely necessary that production planners and those responsible for factory organisation learn how they can compensate for market turbulences without interfering with running production",
says Prof. Engelbert Westkämper,
Director of the IFF at the University of Stuttgart
and
of the Fraunhofer Institute for Production Technology
and Automation (IPA – In-

Reference IFF Stuttgart:
http://www.lernfabrik-aie.de/aktuelles/

Universität Stuttgart IFF
Institut für Industrielle Fertigung und Fabrikbetrieb

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Reference Cognitive Factory iwb TU Munich, iCIM

Research area
Cognitive factories
Computer Integrated Manufacturing (CIM)
Green machining

Excellence University TU Munich, Germany

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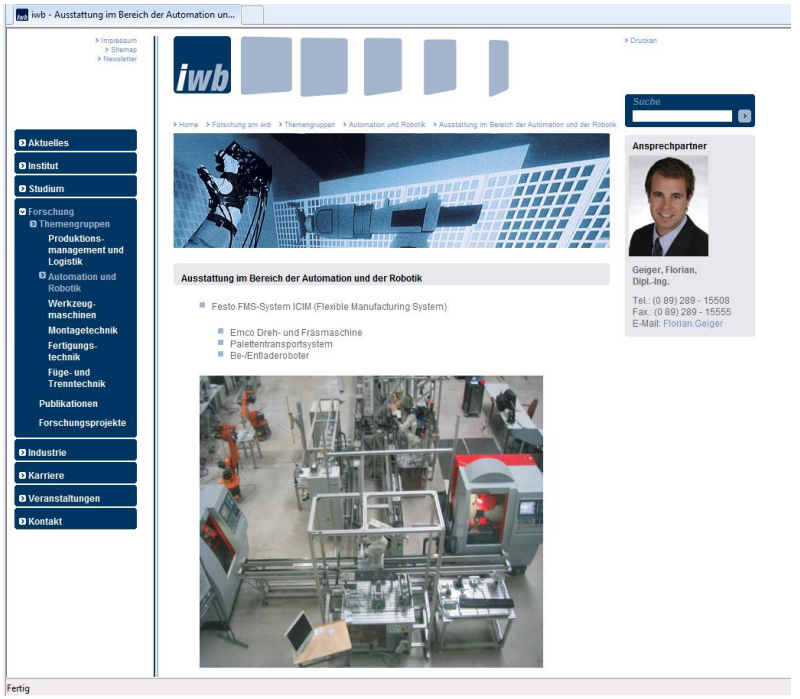

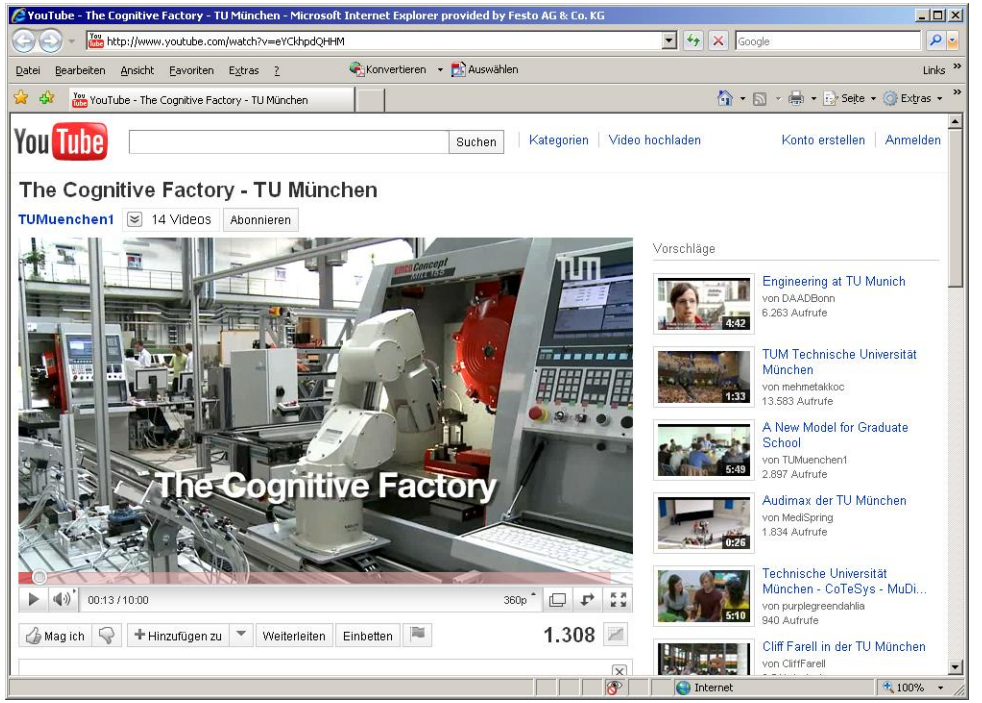

http://www.youtube.com/watch?v=eYCkhpdQHHM