

FLUID POWER NETWORKS

Digitization in pneumatics for increasing automation efficiency

Technology trends in automation systems

Trends

Customer specific production

Individualised products
Mass production, but individual design
Small lot sizes, one piece flow

Sustainability

High efficiency
Reusability of equipment
Avoid waste and emission

Digitization and networking

Digital & virtual factory
Business models in value chains
Connectivity and data analytics

productivity
modular flexible adaptive

Future production systems

sustainability
lean clean green

Enabler

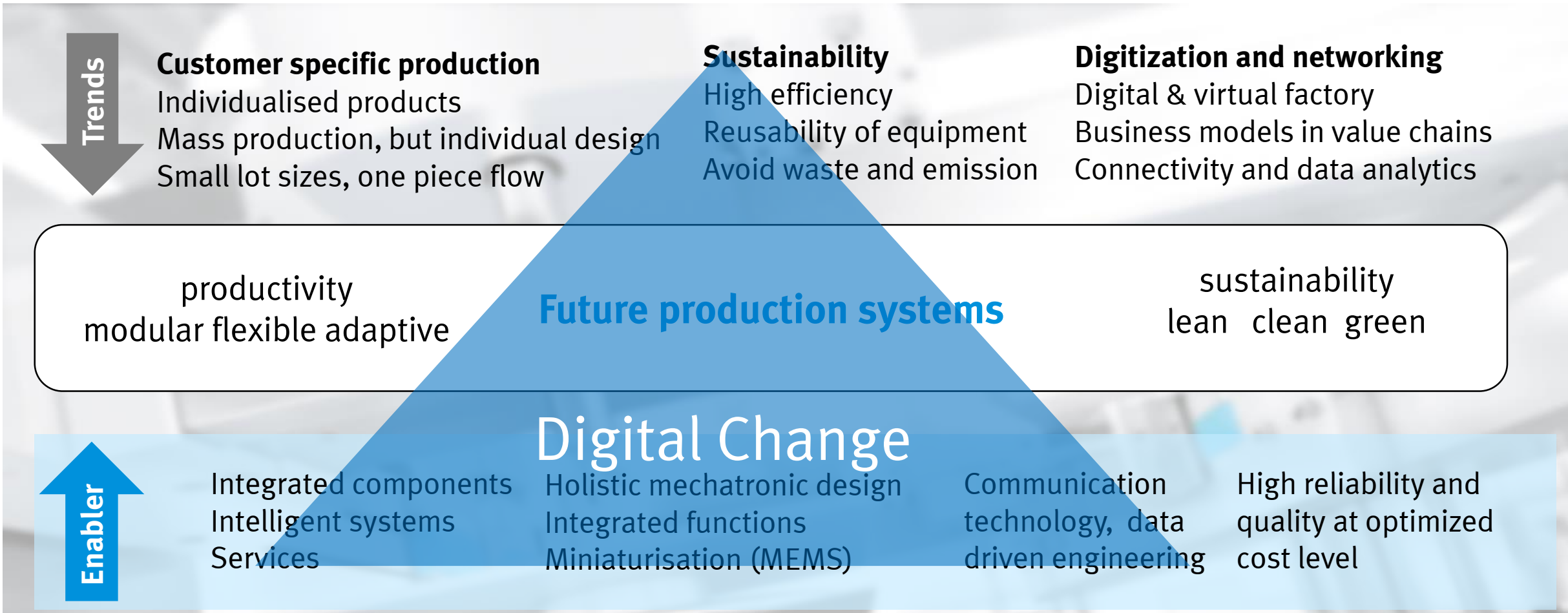
Integrated components
Intelligent systems
Services

Holistic mechatronic design
Integrated functions
Miniaturisation (MEMS)

Communication
technology, data
driven engineering

High reliability and
quality at optimized
cost level

Technology trends in automation systems



Industrie 4.0 - the german platform of all stakeholders

Experten Community aus den Bereichen Industrie und Akademia



Referenzarchitekturen, Normung
Forschung und Innovation
IT-Plattformen und Datenökonomie



Sicherheit vernetzter Systeme
Rechtliche Rahmenbedingungen
Arbeit, Aus- und Weiterbildung



Digitaler Wandel

LNI4.0

Mittelstand-Digital de:hub
digital ecosystems

IHK



STANDARDIZATION COUNCIL INDUSTRIE 4.0

The 4 commonly agreed dimensions of Industrie 4.0



Horizontal integration



Value chain • Life cycle costs • Customized products

Vertical integration



Reconfiguration • Lot size 1 • Apps • Constant change

Integrated Engineering



Systems Eng. • along supply chain • Dig. factory

Human centricity



Orchestration • Skills • Knowledge • Training

1. Horizontal Integration along the value chain



Opportunities with Data

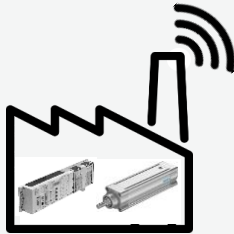
- new business models
- new service models
- process optimization
- predictive maintenance

Horizontal Integration: New business models

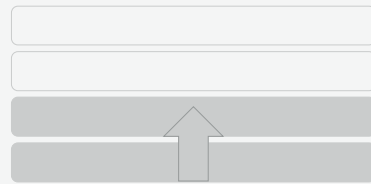


What is our role model in the world of Industrie 4.0

1) Platform Enabler



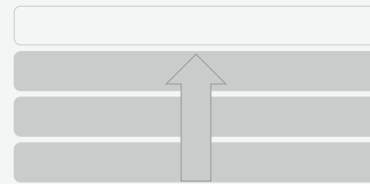
2) Data-Provider



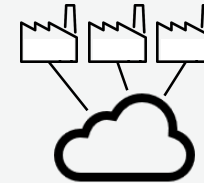
3) Service Provider



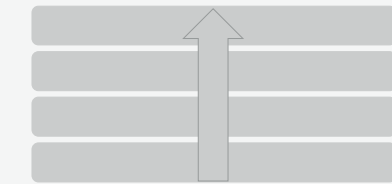
Variants:
 a) Individuel solution
 b) via closed platform
 c) via open platform
 d) ...



4) Platform Provider



Variants:
 a) via closed platform
 b) via open platform
 c) ...

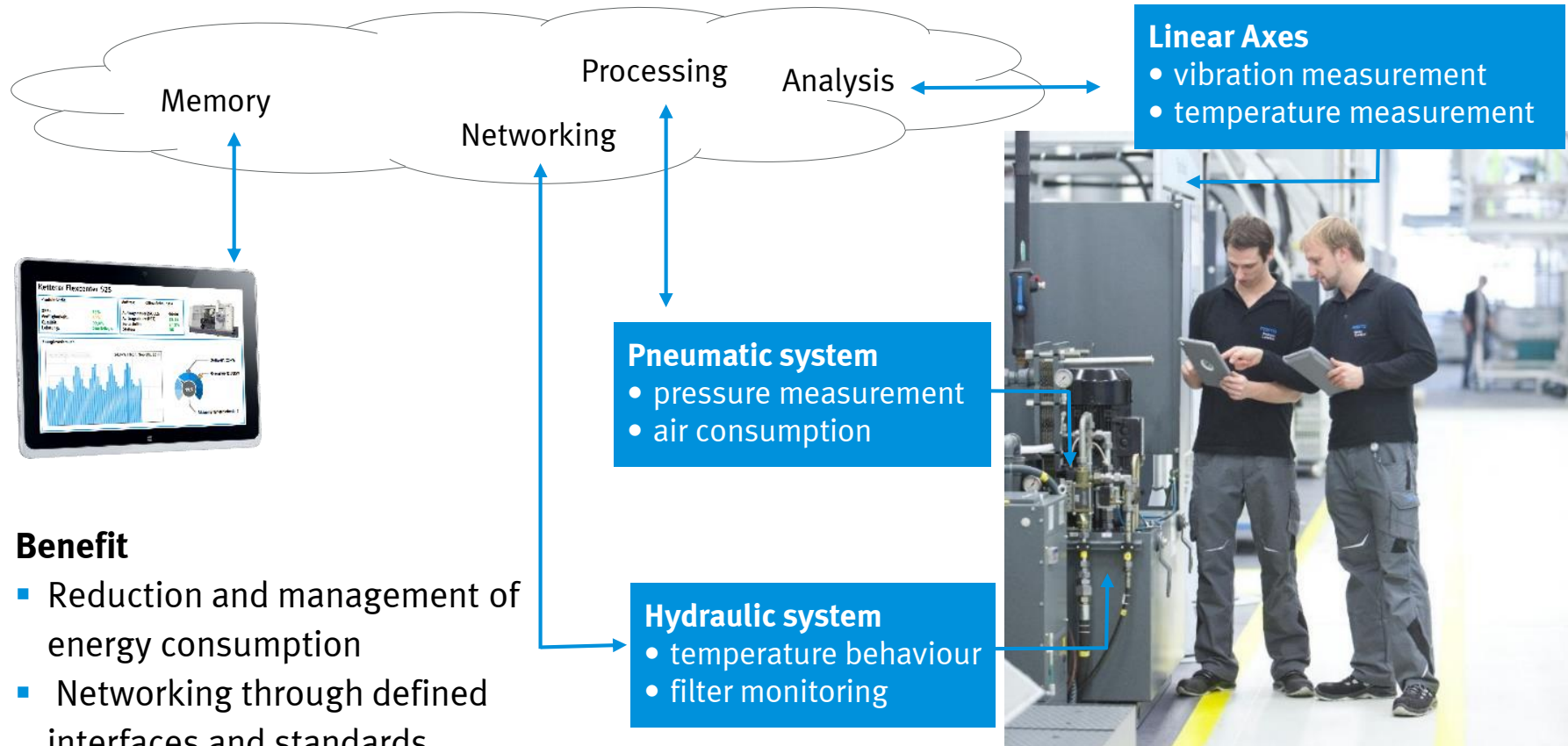


Business models can be successful only with a deep understanding of our own role in the ecosystem

See: Krüger, M., : Innovative Services als Grundlage für neue Industrie 4.0 Geschäftsmodelle. VDI Wissensforum Automation

Fast balance of effectiveness and efficiency in production plants

Example: Predictive maintenance is possible by exchanging and analyzing data



Benefit

- Reduction and management of energy consumption
- Networking through defined interfaces and standards

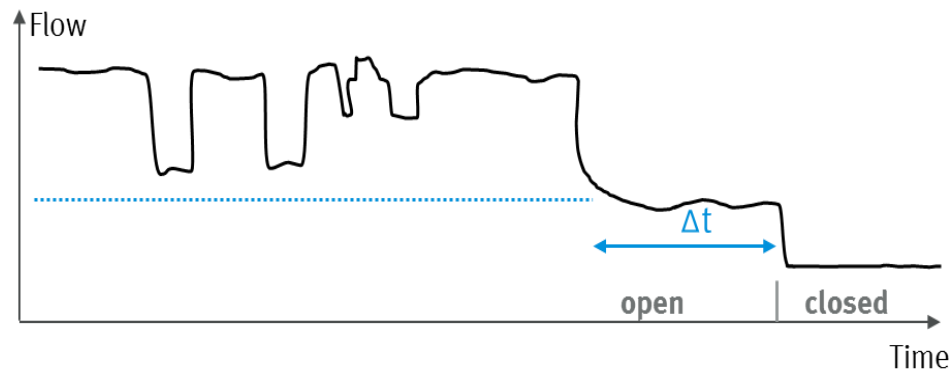
Energy monitoring as basis for sustainability


Energy management from component level up to factory level





E²M-Unit

- Analysis of consumption profile
- Automatic shut-off at standby
- Leakage detection



3 Manage Self-management for consumers
Active energy management
Smart Grid compatible 

2 Control Detailed data analysis
Benchmark and comparison 

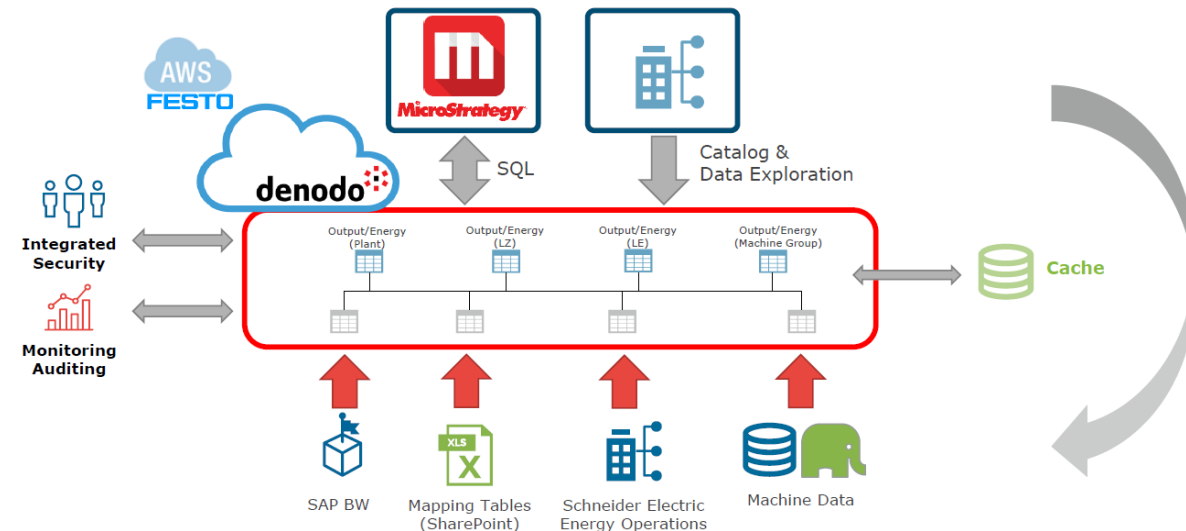
1 Measure Real-time visualization
• of all energy consumers 
• in all different applications

Digital networked energy management

Vertical system integration

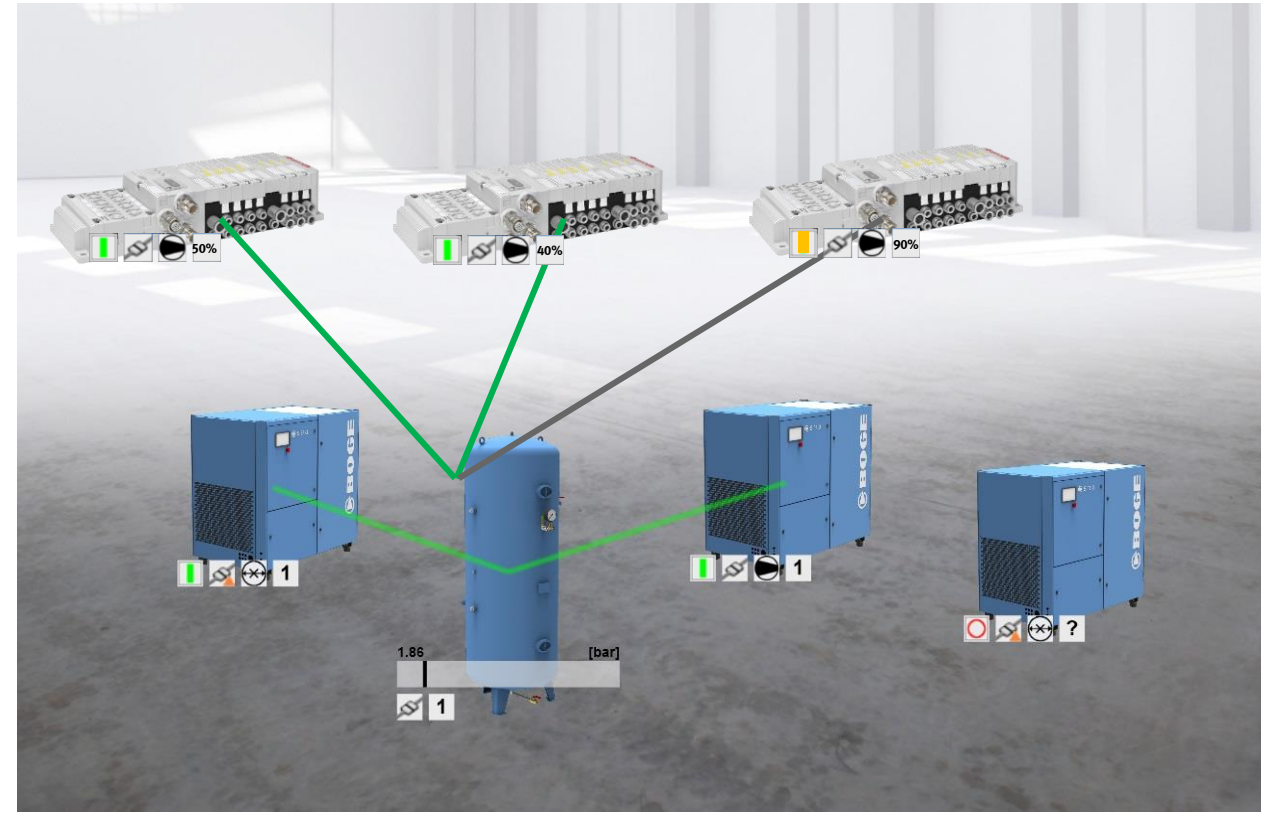
- Holistic Integration of energy and production data in the ERP system
- E²M Unit: Measurement of air consumption, local evaluation and pre-processing, communication to upper control level
- Access to control data from all standard OPC UA clients of
- Continuous monitoring of machine data shows optimization potentials during operation
- Adaptable green cockpit for visualization of energy KPI on several management levels

Implementation of the Festo energy transparency system is demonstrated in the own factory



Showcase “Smart Pneumatic Grid” with AVENTICS and BOGE

- Communication between compressed air supplying and consuming devices creates a “Smart Pneumatic Grid”
- Communication based on OPC-UA standard
- Advantages for TCO, OEE
 - Energy monitoring down to application level
 - Self optimization of compressor utilization based on current and future consumption and pressure level changed infrastructure (hot plugging of suppliers and consumers)
 - Predictive maintenance through anomaly detection (abnormal demand → leakage)
 - Safe shut down of pneumatic application before pressure loss



Predictive Maintenance: Industrial examples

Condition Monitoring – Datenanalysen für Vorhersagen nutzen TRUMPF

Überwachung der Zustandsdaten durch Algorithmen & TRUMPF Experten

- Früherkennung von Fehlern
- Überprüfung der Wirksamkeit von Serviceeinsätzen
- Erkennung / Behebung ansteigender Meldungshäufigkeiten

PREDICTIVE MAINTENANCE IM UMFELD VON IOT, Dr. Volker Nestle

Predictive Maintenance versus Wartungsarme Maschinen KOCH

22.02.2018 VDMA Predictive Maintenance Vortrag Jürgen Welker

Condition Monitoring - Neue Möglichkeiten bei Industrie 4.0
Ausblick – Lease and Buy back

Vernetzte Maschinen und Anlagen

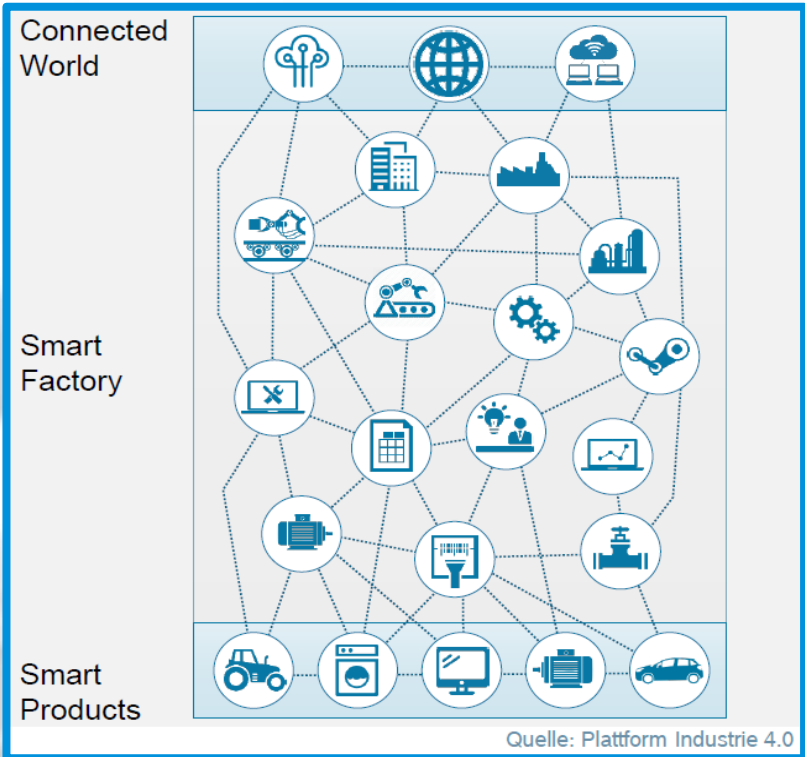
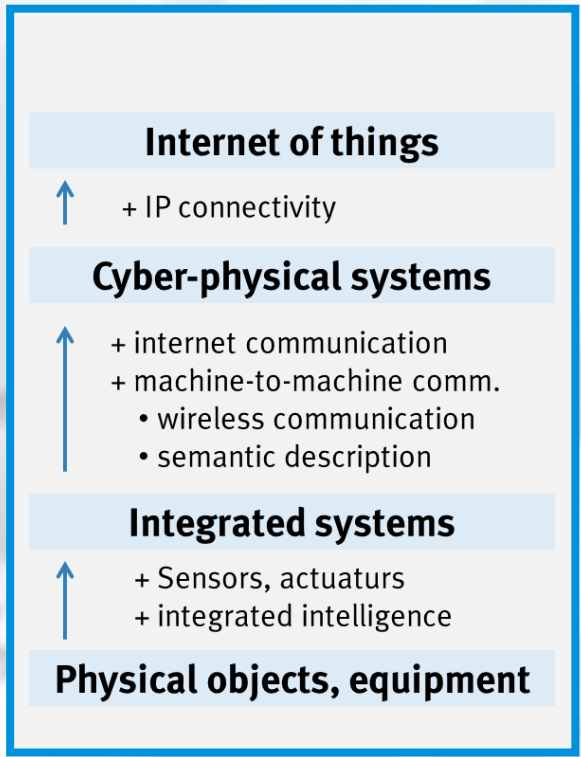
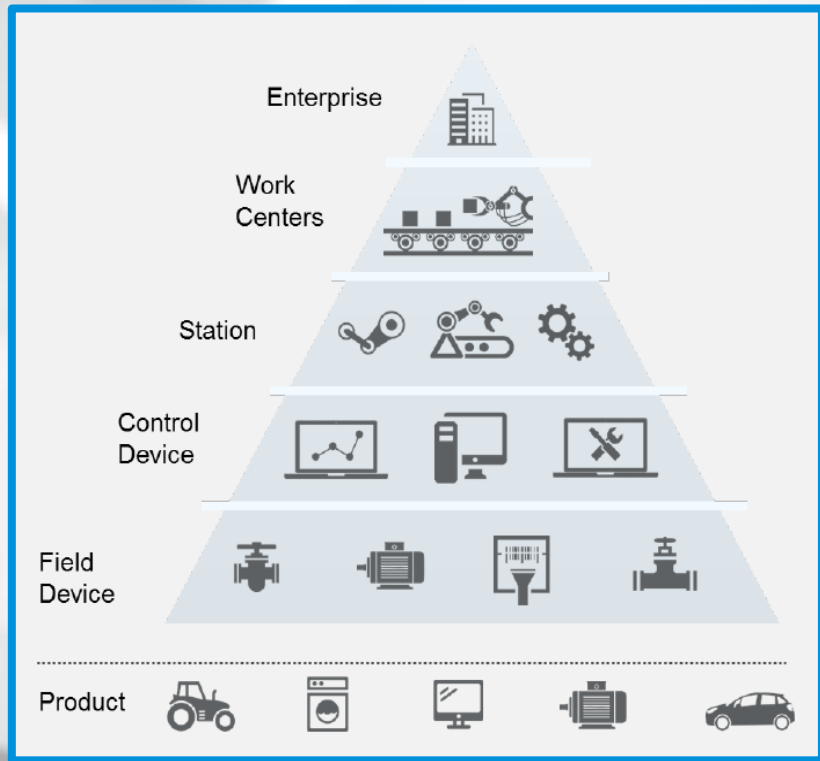
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            graph TD
            subgraph "Leasing"
            L[Leasinggeber]
            K[Kunde Leasingnehmer]
            L -- "Reservierung / Leasing" --> K
            K -- "Bezahlung" --> L
            end
            subgraph "Service"
            H[Hersteller, Serviceanbieter]
            K -- "Service" --> H
            end
            L -- "Maschinennutzung, -zustand" --> H
            
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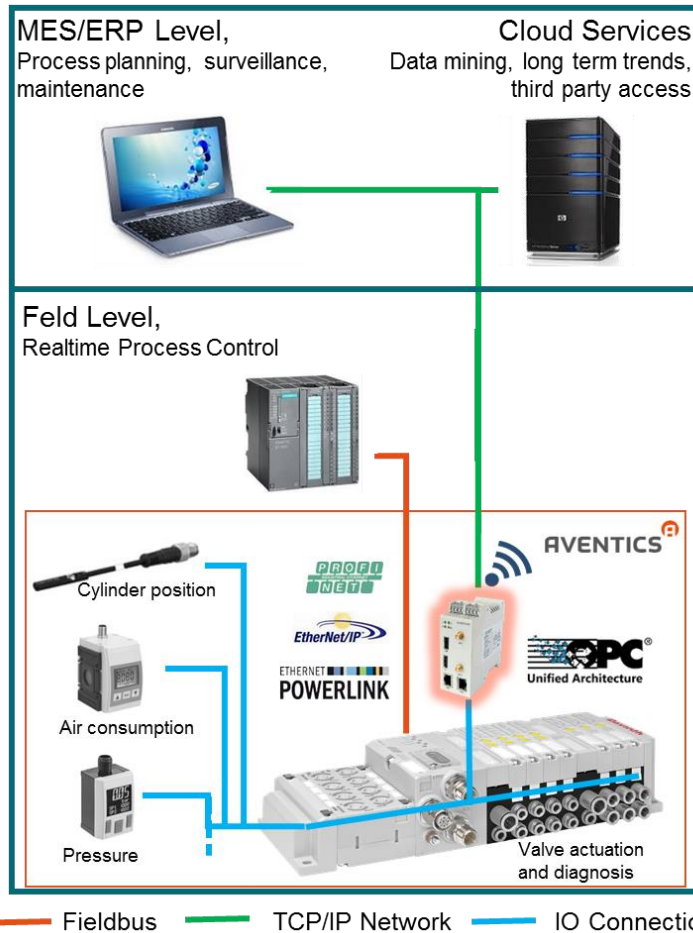
27 Martin Hinkel | 22.02.2018
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Rexroth
Bosch Group

2. Vertical Integration with cyber physical systems



Smart pneumatics – connecting pneumatics to the cloud

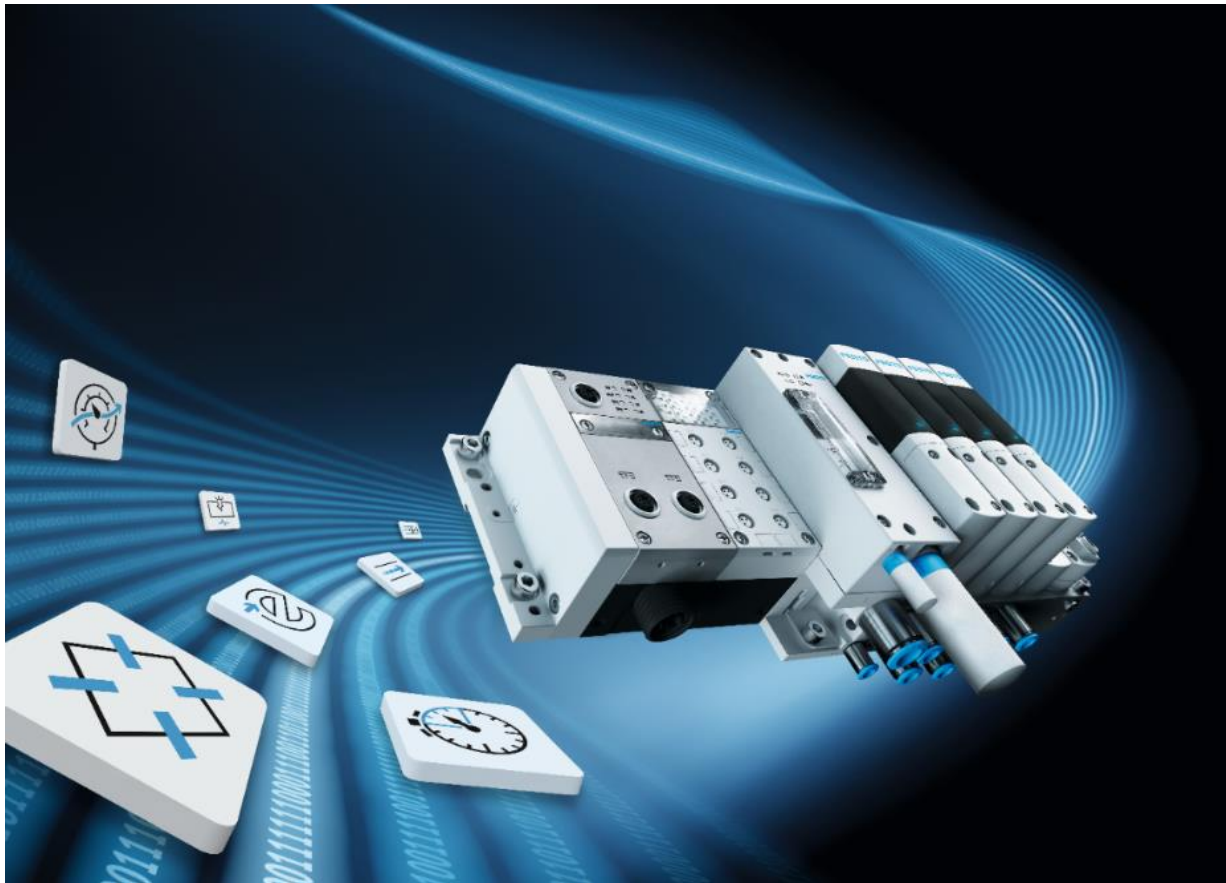


AVENTICS *Smart Pneumatics Monitor*

- By utilizing the raw data from a modern valve system with integrated IOs *Smart Pneumatic Monitor* adds IoT functionality to existing and future applications
- Communication and internal software based on open standards
- Enrichment and preprocessing of local *data* to create added value *information*
 - Lifetime data of valves and cylinders
 - Monitoring and optimization of energy efficiency
 - Event timing and correlation
 - Threshold monitoring
 - Anomaly detection

AVENTICS 

Digital Simplicity - Festo Motion Terminal VTEM



Digitalisation for reduced complexity

Wide range of functions via motion apps

Just one valve technology: maximum adaptability, reduced system complexity

Adaptability for greater productivity

Maximum process stability with motion apps

Self-regulating, independent adaptation

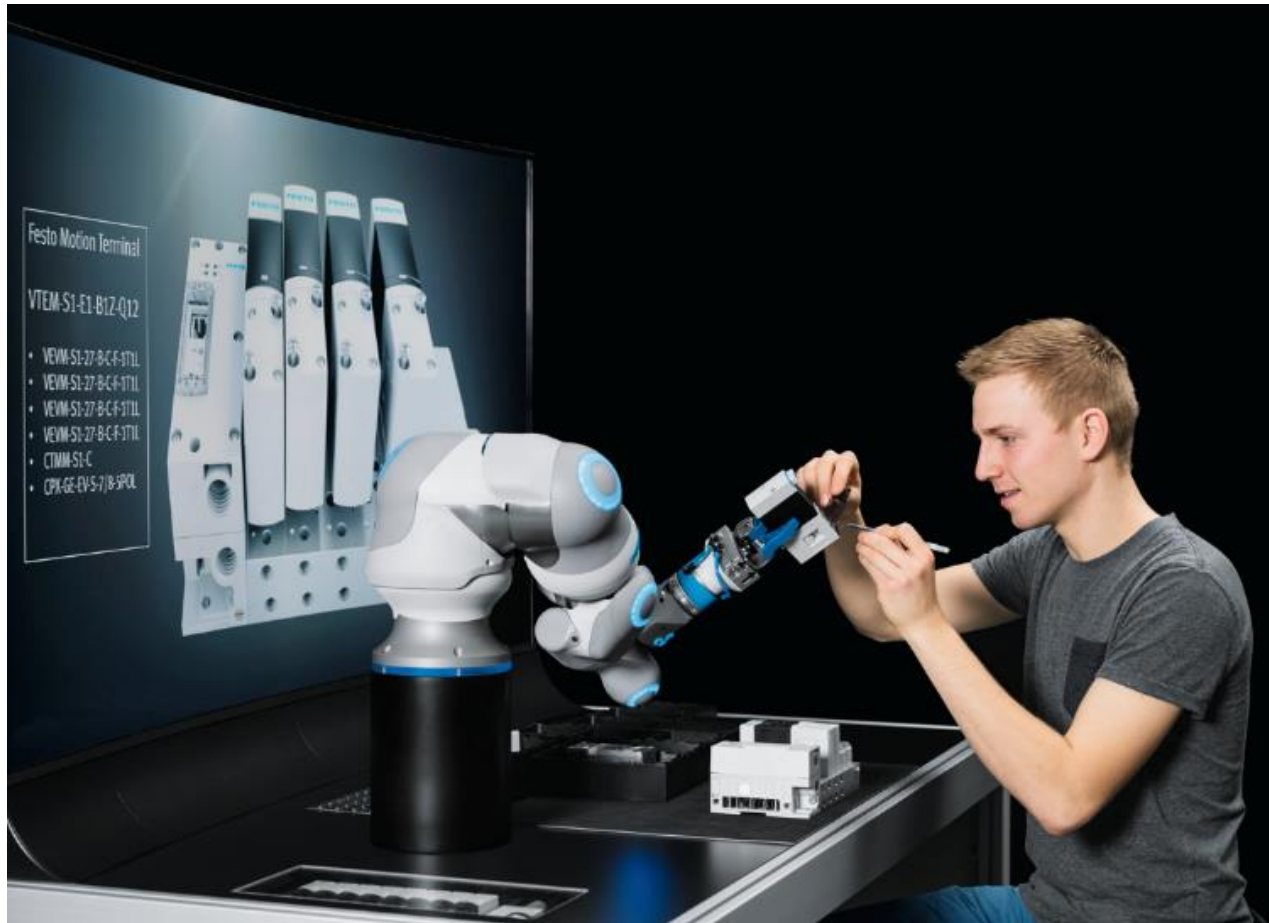
Standardised networking, data-based decisions

Integrated web server and controller

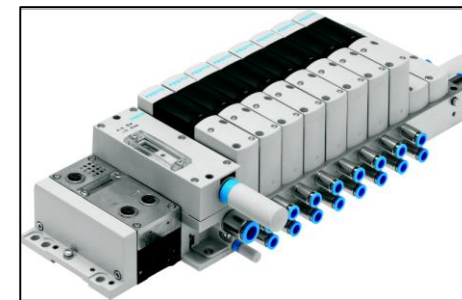
OPC UA using the automation platform CPX

Preventive maintenance using condition monitoring apps

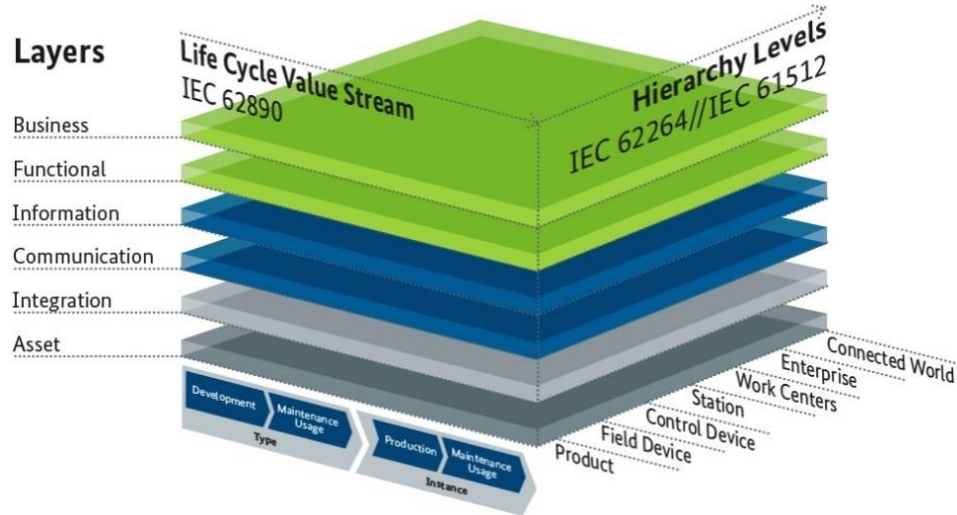
Pneumatic technology with new opportunities for human machine cooperation



- Cobot: Collaborative robot for save human machine interaction
- Free robotic motion with 7 degrees of freedom
- Totally controlled by the pneumatic motion terminal of Festo



Reference Architectural Model Industrie 4.0 (RAMI 4.0) and “Verwaltungsschale”

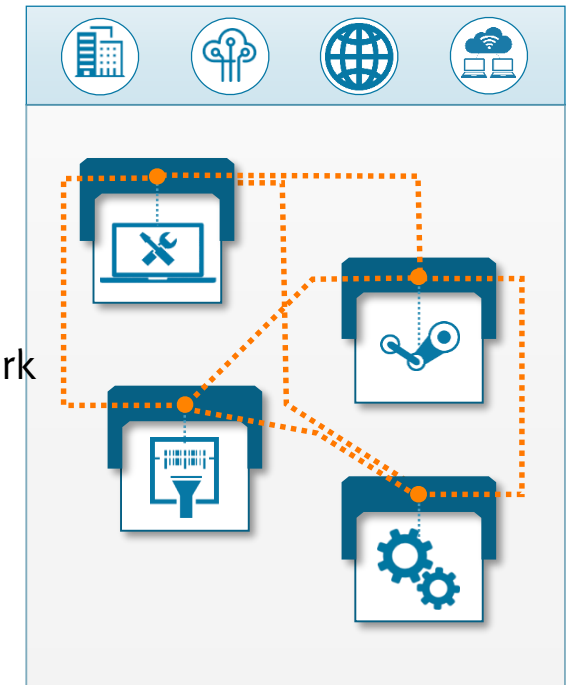


- defined functional layers
- OPC UA as communication standard

„Verwaltungsschale“ makes any object an I4.0 component

- interface between communication and physical object
- provides all information of the objects
- is standard communication interface
- can include passive assets
- can be explicitly addressed in the network and uniquely identifies the object

basic building block for cross-company solutions



The Solution Space with a Coordinate System for Industrie 4.0

Open engineering platform for autonomous mechatronic components in functionbased architecture



- Intuitive and efficient engineering-process
- Behavioural description of each component based on standards
- Standard architectural model
- Testbed approval – engineering, implementation, production

ASYS GROUP



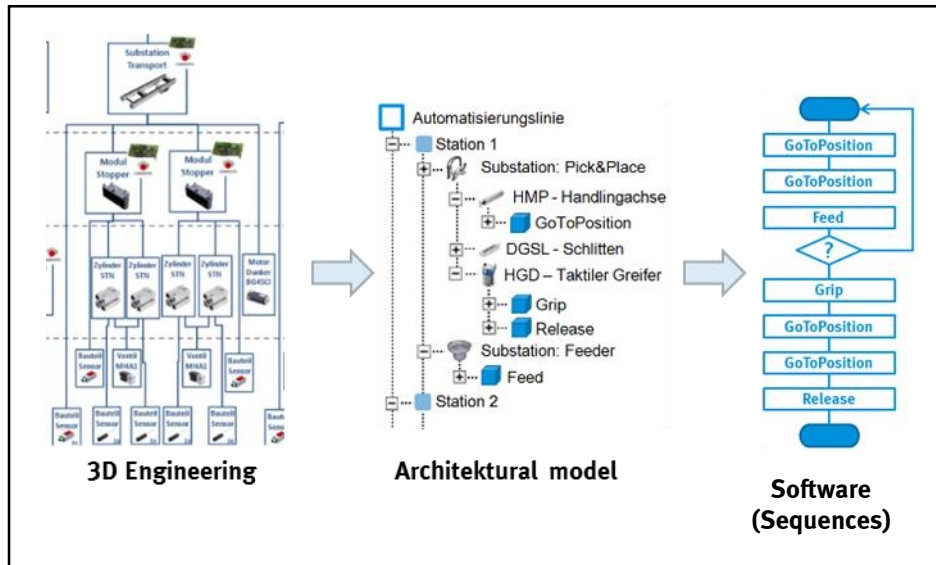
elrest

FESTO

fortiss



Gefördert durch:



3. Integrated Engineering along the whole product life cycle



Customer-specific handling systems with the Handling-Guide-Online

Selection and dimensioning of handling systems

Based on customer input

- CAD model, data sheets
- Documentation, offers and more

Standardized system solutions (kinematics, control and software)

- 3D axis systems
- 2D Gantry systems
- 2D Linear portals

Generation of the necessary software

Commissioning directly prepared

- Virtual commissioning / application programs

Reduced engineering time (at least 50%) and time-to-market (20% to 50%)



And Now...Introducing The IMI Norgren Express App



A unique app for engineers to buy aftermarket product

- ▶ A new app that makes it easier for maintenance engineers to find and buy the products they need to keep their machines moving
- ▶ Uses the capabilities of smart phone – location, camera, messaging

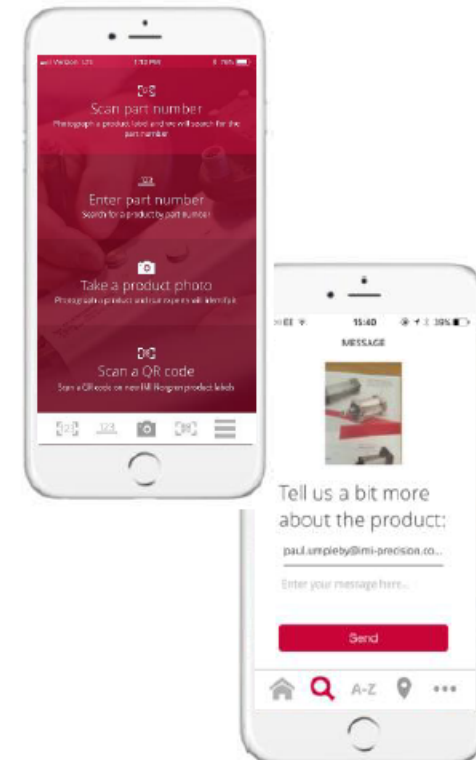


What Does It Do?

Easy part identification for your customers within one mobile app

IMI
Precision Engineering

- ▶ Scans labels
 - ▶ *Scan the label of the product*
 - ▶ *The app then checks the IMI Norgren database and presents the exact part*
- ▶ Scan QR codes
 - ▶ *For newer products, scan the QR code and go straight to technical content for that range or part number*
- ▶ Identify products using a photo
 - ▶ *Take a photo of the cylinder, valve, product*
 - ▶ *Send it to IMI Norgren for rapid identification and response within 30 minutes*
- ▶ Then find **local stock** where available, either distributor stock or IMI Norgren stock.



Online platform for 3D-printed gripper fingers



Upload data of the parts (step or stl data)



Choose type of gripper and adjust gripper fingers



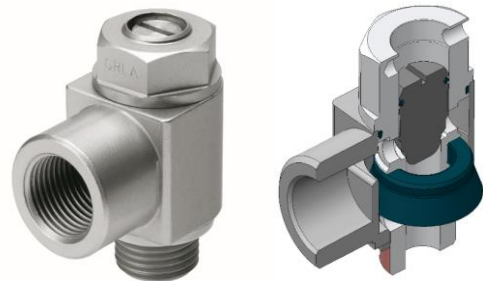
Order online
(or via standard process)



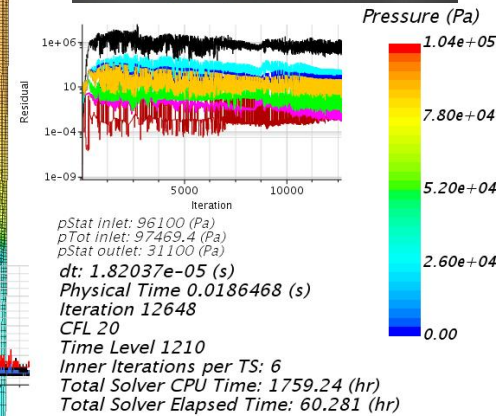
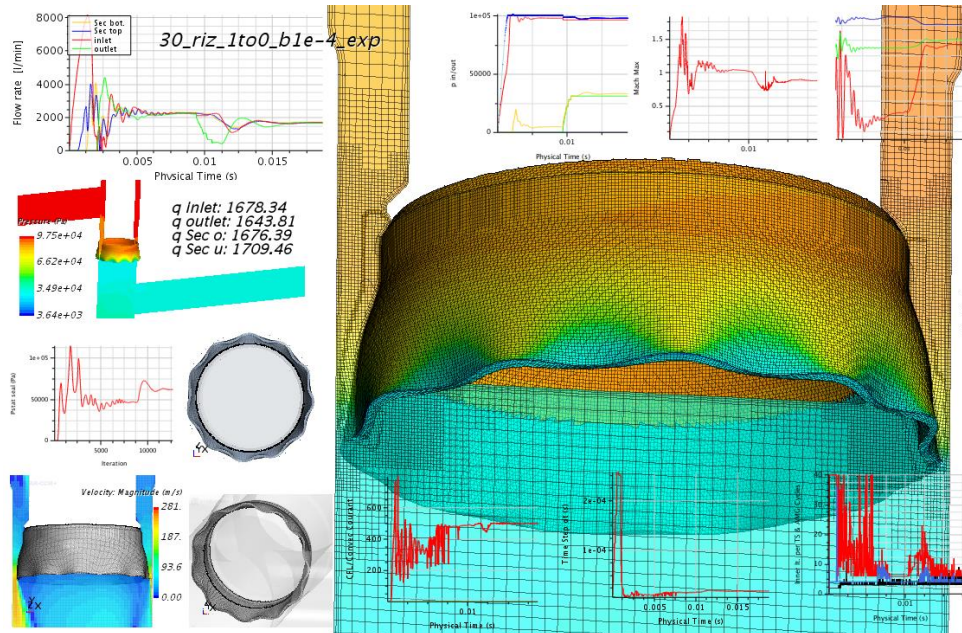
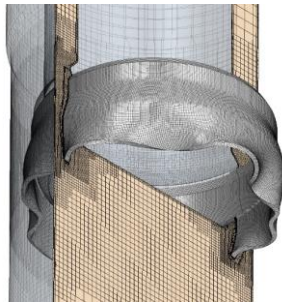
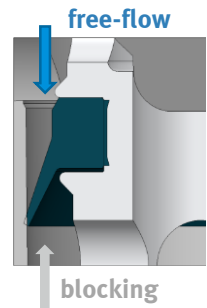
Download the whole new
CAD-model

Fluid Structure Interaction in Flow Control Valve

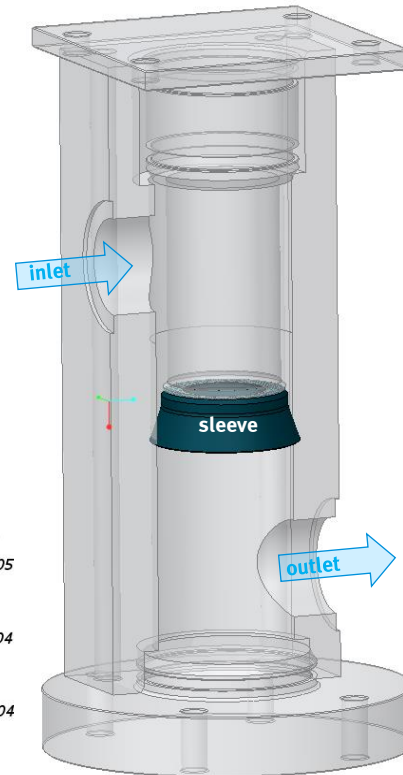
- highly deformable Elastomer sleeve in flow control valve
- flow rate in free-flow direction? transonic, compressible, 8 against 0 bar
- realistic prediction with FSI Co-Simulation (STAR-CCM+ & Abaqus)



flow control valve



test case

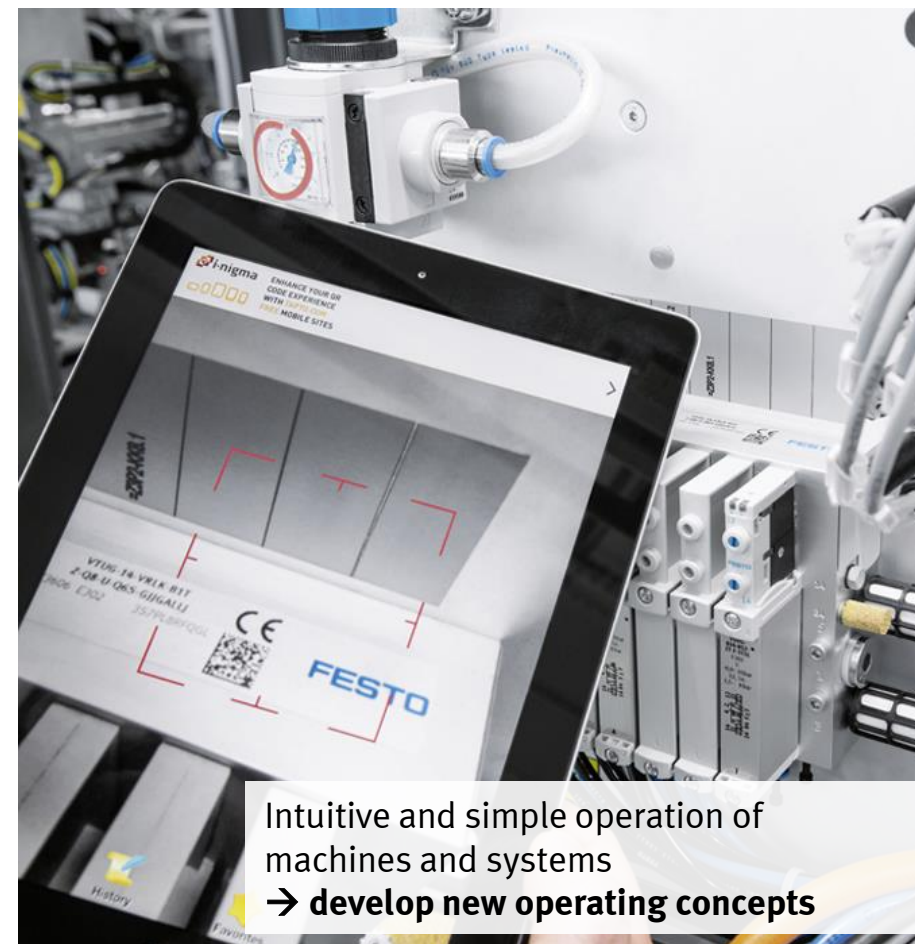


4. Human Centricity “It’s all about people”



- Focus on People: skills – knowledge – training**
- Adaptation to changing working environments
 - Human-machine interaction
 - Simple and intuitive operation
 - Innovative assistance systems

Work organisation in the digital industrial era: **new level of human-machine cooperation**



Transfer of research knowledge to reality

smartFactory^{KL}



Integrated learning factory



Research factory / testbed



real production lines



Digitization and New Work

- continuous development of competence- qualification is an integrated part of our life
- „How can I continuously extend my knowledge“ and „Where do I find appropriate material/know how“
- interdisciplinary knowledge – overcoming barriers of misunderstanding
- Implementing leadership and agility culture



Technical education at general schools



Communities of Practice and knowledge networks



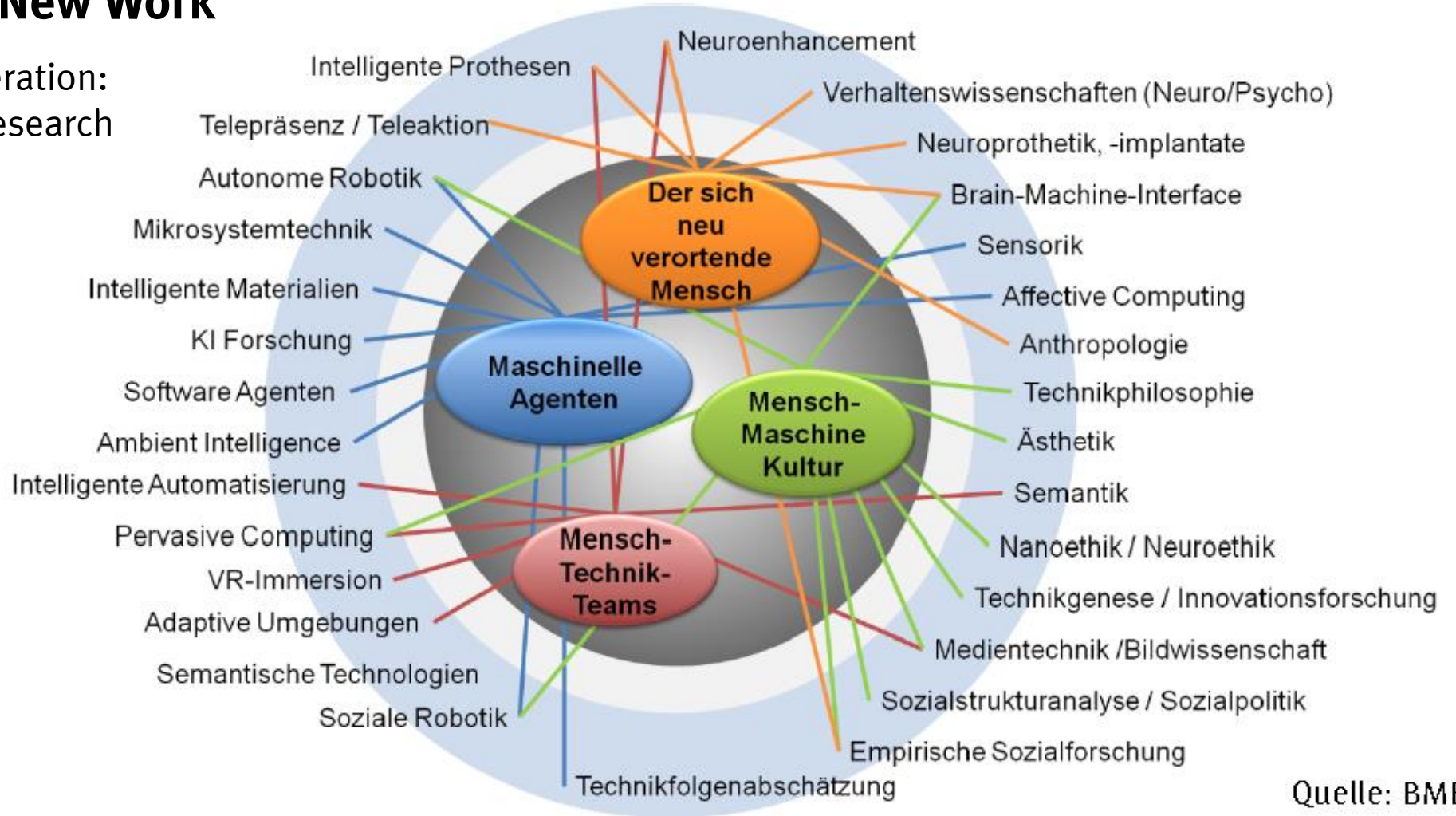
Tablet supported learning with Tec2Screen®



Blended learning
Mobile learning
Learning on demand

Digitization and New Work

Human machine cooperation:
Aspects and fields of research



Quelle: BMBF

Recognizing trends – implementing innovation - opening future potential

Trends

Customer specific production

Individualised products
 Mass production, but individual design
 Small lot sizes, one piece flow

Sustainability

High efficiency
 Reusability of equipment
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 Connectivity and data analytics

smart integration and communication
 technical performance parameters

Future pneumatic systems

material properties / functional materials
 tribology / noise
 energy efficiency / carbon footprint

Enabler

Integrated components
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 Services

Holistic mechatronic design
 Integrated functions
 Miniaturisation (MEMS)

Communication
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 quality at optimized
 cost level

Digitization in pneumatics for increasing automation efficiency

Thank you!



Prof. Dr. Peter Post
Applied Research
Festo AG & Co KG