Production of the Future
Festo and Industry 4.0 – Next Level of Automation
Quo Vadis Industry 4.0?
- Where we are now?
- What are the important technologies to be there?
- Results?

Beyond Industry 4.0?
Festo and Industry 4.0 – Next Level of Automation

Introduction Festo

The Industry 4.0 platform
- Overview
- Working results

Festo activities
- Interpretation of key features of Industry 4.0
- Research projects

Summary
Festo facts

- Turnover (Group): EUR 2.6 billion (2014)
- 17,700 employees in 176 countries
- Over 30,000 catalogue products
- Factory and process automation
- 3,000 patents world-wide
- R&D budget: more than 7% of sales
Innovation excellence

• Sustainable innovation management
• Over 20 Technology Engineering Centres world-wide
• More than 100 new products every year

Skilled enhancement of electromagnetic compatibility
Innovation down to the last detail
Pure innovation: virtual reality
## Products for key industries

<table>
<thead>
<tr>
<th>Sector</th>
<th>Image</th>
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<tbody>
<tr>
<td>Automotive</td>
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<tr>
<td>Food &amp; Beverage</td>
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<td>Electronic &amp; Light Assembly</td>
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- **Automotive**
- **Food & Beverage**
- **Electronic & Light Assembly**
- **Bio & Pharma**
- **Water & Waste Water**
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Summary
Industry 1.0 - 4.0

1.0
Mechanical Production

Water-/steam power
End of 18th century

2.0
Mass production by divisioning of labour

Electric power
Beginning 20th century

3.0
More and more digitalised automation

Electronics / IT
Nineteen-seventies

4.0
Integrated automation

Cyber-physical systems
21st century (2030~)

Source:
The vision of Industry 4.0 as part of a networked, intelligent world

- Industry 4.0 focuses on the production of **intelligent products, methods and processes**
- Cyber-physical systems enable the **intelligent factory**
- **Intelligent products** actively support the production process
- At its interfaces, the factory becomes part of an **intelligent infrastructure**
- Production is adapted to the **human rhythm**
Changing production over to Industry 4.0 will involve a long-term transition.

Yesterday

Local automation technology

Industry 3.0

Today

Communication-supported automation

Industry 3.x

Tomorrow

Optimisation of entire product development and production processes using innovative software systems

Industry 4.0

The day after

Self-optimisation of “Cyber Physical Systems” based on virtual models

Benefits remain to be proved

Benefit achievable in certain cases only at high costs in money and know-how

Source: Siemens Industry, Detlef Pauly
Structure of Industry 4.0 Platform

- **Steering Committee (SC)**
  - Member companies
  - Representatives of the 3 professional associations
  - SAC spokesperson
  - Guests: working group leaders

- **Governing Board (GB)**
  - Board members from Steering Committee’s member companies

- **Secretariat (Sec.)**
  - Run jointly by BITKOM, VDMA and ZVEI

- **Community of experts**
  - Informing, communicating
  - Sends representatives

- **Steering Committee (SC)**
  - Manages the platform in coordination with WG leaders

- **Scientific Advisory Committee (SAC)**
  - Professors from the relevant technical disciplines

- **WG 1, WG 2, ..., WG n**
  - Supports
  - Sends one spokesperson
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SOA as seen by an Industry 4.0 Component

- Protected core, service offerings at the SOA interface based on standards

SOA (Service Oriented Architecture) Interface
- Issues and accepts defined own service offerings
Service oriented architecture – example for the internal structure

Application A

Internet

Machine B

– Service C

– SOA interface
  – Offers and accepts own defined ranges of services

RFID, QR ..

Workpieces

SPS + Remote IOs

Remote IOs with int. PLC

Integrated components/modules, (CPS)
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Summary
The challenges of the “Production of the future” have led to Industry 4.0

- Fast pace of technological change
- Customised solutions
- Innovative technologies
- Wide diversity of customers and markets
- Permanent pressure on costs
- Globalisation
- Increasing importance of product availability and prompt delivery
- Rising energy costs and environmental awareness
- Networking, flexibility and adaptability in production
→ Autonomous, self-learning and knowledge-based systems
The factory of the future: a learning and adaptive production system

Understanding of the environment and requirements of a factory as a whole

Understanding of processes in the various sectors

Understanding of suitable automation systems, functions and solutions
**Future production trends**

**Product trends**
- Individualization
  - Individual products
  - Personalization
- Short product cycles
- ECO-Friendly
  - Natural materials
  - Customer demand for low environmental impact
- New materials and technologies
- Social Media

**Production trends**
- Customization
- Sustainability
- Digitalization & Networks
- Social Aspects

**Future production**

*Result of: MindCloud-Trends.pptx; Expertenansichten.pptx*
Smart Components for the Internet of Things

Integration of local “intelligence” and communication capabilities

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

Source: Forschungsunion Wirtschaft – Wissenschaft
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Summary
Smart Pneumatics in Industrial Applications

Learning Factory (Modular Production System)

- Modular, flexible manufacturing system
- Demonstration product: High-variant pick & place/assembly line
- High adaptivity
- Each module has its own controller “distributed intelligence”
- Superior “digital factory” system
- Complete realisation possible with in-house control technology!
AutoPnP – plug and play for automation systems

Within the project, software architectures are developed which
• allow scalability
• and modularity

This in turn allows adaptive production lines

Demonstrator “Convertible factory”
OPAK – open engineering platform for mechatronic components

- Functional planning by process planner
- Automatic translation into architecture and controller code
- Data processing and controller code on autonomous component
- Convergence to form complete control system
- Plug and Produce
Bionics can teach production technologies of the future

Festo is doing research to identify future production trends

→ for example:
  Projects of **Bionic Learning Network** and **Future Concepts**
The Bionic Learning Network is a cooperation between Festo and renowned universities, institutes and development companies with the goal to transfer nature’s strategy of efficiency to automation technology.

- Interdisciplinary core team
- Specialists from internal departments
- External development partners
- Universities and institutes
- Students and trainees
- Private inventors

Inspired by nature – The Bionic Learning Network
Bionic Learning Network – Open Innovation

• **Creating networks** and discerning trends in research and development

• **Motivating people** to develop their ideas together with Festo

• Initiating **dialogue with customers** and partners

• Analysing customer **feedback** on innovative topics at trade fairs

• **Expediting product pre-development**

We want to provide impetus and initiate innovations.
Production of the future – self-adapting and efficient

Self-adapting components

Factory of the future

- Individualised products
- Small batch quantities
  → Adaptability

Self-organization

Reduced complexity

Communication

Learning

→ Survival of the fittest
- Adapt to changing environment
- Be resource-efficient

Energy efficiency

Nature

Nature
Tomorrow’s production inspired by nature

Nature has perfectly adapted to its surroundings throughout millions of years of evolution.

- Energy efficiency
- Lightweight design
- Functional integration
- Communication and learning
Lightweight design

A bird can only fly since it is very lightweight.

If the moved mass is reduced, this directly decreases the energy consumption.

This is shown impressively by the SmartBird.

Lightweight design in automation applications will reduce materials and energy consumption.
**Function integration**

The dragonfly flies like a plane, helicopter or glider due to the fact that each wing is moved separately. It can alter the angle of attack, the amplitude and the frequency of each wing separately.

**New approaches in automation:**

- More and more functions will get integrated into the smallest space
- Components will become smarter and more flexible
- Very high level of complexity under control by intuitive user interfaces
Human-machine interaction

Inspired by the elephant trunk, the **Bionic Handling Assistant** directly interacts with humans.

**ExoHand demonstrates** human-machine interaction by using haptic **force feedback**.

Human-machine interaction of the future will be safe.
Self-organization

Collective behavior and swarm intelligence are surviving strategies in nature.

With WaveHandling, intelligent components are self-organizing as soon as they are put together.

Intelligent components and self-organization will directly decrease setup times in the production of tomorrow.
Industry 4.0 - the Festo view

Real world and virtual reality continue to merge

A holistic, interdisciplinary approach

### Technology
- Intelligent components
- Modularity
- Networked systems
- Innovative solutions for functional integration and microsystems

### People
- Human-machine interaction
- Adaptive and intelligent technology
- Simple, intuitive operation

### Qualification
- Training the new generation of workers
- Employee qualification
- Learning systems by Festo Didactic
Summary: Opportunities presented by Industry 4.0 discussions

Industry 4.0 approaches are being implemented in practice in all cases where networking will lead to better control, organisation, efficiency etc. and a clear customer benefit can be identified.

Action area
- Production
- Engineering Process
- Energy management
- Logistical processes
- Quality management
- Predictive Maintenance
- ...

Customer benefit
- Economic, flexible, convertible production
- Fast commissioning of machines/installations
- Increasing resource efficiency
- More efficient control of procedures
- Analyses of causes of faults
- Increasing machine availability
- ...

The implementation of the vision of Industry 4.0 is an evolutionary process which will progress at different speeds in factories and certain segments of industry.
Thank You for Your attention!