Industry 4.0
Technologies for the factory of the future

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German Research Center for Artificial Intelligence (DFKI)

780 employees
18 Professors
>40 Mio € Turnover
• the basics

• the changes

• the smartfactory

• conclusion
Our smart world

Information will be available anywhere, anytime, with any content, for any user using any device and any access always „ON“

All locations

All ages

Have fun

Apps all over

All applications

Worldwide network

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Internet of Things

- Mobile Devices
- Control Systems
- Consumer Devices
- Field Devices
- Products
- Traffic

Industry 4.0
Smart manufacturing

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The Industry 4.0 / SmartFactoryKL History

- **2004**: SmartFactoryKL – from research to practice
- **2005**: SmartFactoryKL – 7 members
- **2010**: INDUSTRIE 4.0
- **2011**: -- Research --
- **2016**: -- SME --

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What is Industry 4.0?

Digitization and networking of all processes, products and resources

- Pervasive Engineering
- Internet of Things
- Big Data
- Smart products
- Virtual <-> real world
- Human and work
- Standardized Interfaces

It’s not a standard

INDUSTRIE 4.0

It’s not clearly defined
Game changing technologies

- CPS edge computing
- Cloud computing
- AI technologies e.g. Deep learning
- 5G wireless network
- UX-Design
- Big Data Analytics
- Ethernet TSN/SDN
- OPC UA

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Digital Transformation of the Industry
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Customer’s changing paradigms

Paradigm of the past

Cheap, cheaper, cheapest!

Paradigm of the future

Order by a mouse click get YOUR product tomorrow!
Personalized products are coming
Reshoring production

- Mass production and low wages
- Long delivery times

Advances in IT
Shorter product lifecycle

- Mass customization
- Local production

Leading to a new world economic structure?
The network is the future
Production in networks

Order → Digital marketplace

Order → Local Cloud

Order → Digital Marketplace

Supplier → Local Cloud

Supplier → Digital Marketplace

Order → Delivery

Digital marketplace → External Cloud

Local Cloud → Producer

Supplier → Producer

Supplier → Delivery
Digitization | from Pyramid to Network Structures based on worldwide standards

Business level

Controller level

Field level

Rigid structures today

Dynamic structures tomorrow

Ethernet

Profinet, Ethercat...

SERCOS, Ethernet/IP

ASI, IOlink

Ethernet-TSN/SDN

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Towards smart modules

Cyber-Physical System

Fundamental Principles

- Self Identification
  (who am I?)
- Services Exploration
  (what do I offer?)
- Autonomous Networking
  (who are my partners?)
The modular agile factory kit

...needs a stack of standards

Interoperability Standards

<table>
<thead>
<tr>
<th>ISO-OSI</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
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<tbody>
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Communication Standards

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Interoperability Standards

- OWL
- OWL-S
- SAWSDL
- WSDL
- EDDL
- Device Class Profiles

Communication Standards

- TCP/IP
- ISO-OSI
- Ethernet
- WiFi
- 5G

Electromechanical Standards

- Han-Modular®
Standardization in progress

Reference architecture model RAMI 4.0
The open AAS model

Asset administration shell

Source: DIN SPEC 91345:2016-04
Separation of Hard- & Software

App-Store

- App Meas
- App Filter
- ...
- ...
- App History

Supplier

Firmware

Electronics

Mechanics

Technical device

Third Party

Customer

Sales

Operation

Software

Sales
The human in the Industry 4.0 age...

will be supported by smart technologies

will have more information available

will have higher mobility

must have more interdisciplinary knowledge

needs additional education and training

will have more responsibility and freedom
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From vision to reality – the **SmartFactory**KL

**Launch:** June 2005  
**Legal form:** registered non-profit association  
**Members:** 50 (institutions only)  
**Governance:** general assembly, executive board  
**Financing:** fees, donations, projects  
**Employees:** currently 32  
**Turnover:** 2.5 Mio €

The **SmartFactory**KL is the worldwide biggest and most popular manufacturer independent research and demonstration center for **INDUSTRIE 4.0** technologies.
SmartFactoryKL Lab

Learn together
Work together
Present together
Build together

Industrie 4.0 vision
in multivendor cooperation
Industrie 4.0 products

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SmartFactoryKL members
Industry 4.0 vision

we Learn Work Build Present together

organized as a registered non-profit association

Component manufacturers
Certification organizations
Security providers
Software providers

Network providers
Research organizations
Users
Marketing organizations

Industry 4.0 products
• the basics

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Hurdles to cross

- the social acceptance hurdle
- the human hurdle
- the political hurdle
- the cyber security hurdle
- the legal hurdle
- the technological hurdle

Information
Education
Funding
Liability
Products Standards

001101 101110
Path to Industry 4.0

1st -> Analyze your situation

Level 1
- Keep informed
- Use standards
- Track assets
- Train staff
- Care about data
- Use smart devices

Level 2
- Participate in networks

Level 3
- INDUSTRIE 4.0
- Smart machines
- Smart products
- Smart processes
Industrie 4.0 worldwide competition

EU – DIH Program

China

Korea

EU

USA

640 Mio$/5 yrs Gov+Ind
320 Mio$/5 yrs states

Market share

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Thanks for listening and remember

Everything should be made as simple as possible, but no simpler!

Albert Einstein

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