THE INTELLIGENT FACTORY OF THE FUTURE:
INDUSTRIE 4.0 AND THE SMARTFACTORYKL PROJECT

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German Research Center for Artificial Intelligence (DFKI)

Since 07/1988
- Augmented Reality
- Embedded Intelligence
- Knowledge Management
- Innovative Factory Systems

Saarbrücken
Since 07/1988

Bremen
Since 11/2005

Berlin
Since 05/2007

Lab Osnabrück

SmartFactoryKL – from research to practice

Since 07/1988
Innovation Drivers

Yesterday
- long delivery time
- increasing salaries
- cost driven

Today
- shorter product lifecycles
- shorter engineering time
- product individualization
- customer driven

Faster, better, cheaper

Advances in IT
Digitalization of the Industry

Automation structure

Digitalization

Enterprise level

Control level

Field level

2.5th Revolution

3rd Revolution

4th Revolution

1 Bytes

100+x MegaBytes

100 000+x TeraBytes

EtherNet/IP

Messages
From Pyramid to Network

Cloud

Remote Maintenance

3.0

Complexity

Object orientation
Modularization
Standardization
Lean Thinking

IND 4.0 World - dynamic
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?)

Electrical signals

Controller

Field Bus

Field Device

µWeb server

Network Services

IP-Adress
The Rocky Road to Industrie 4.0

- Development
- First Demonstrators
- First Industrial Systems
- Industrial Use
- To Reality
- New Business Models
- Training
- New Rules
- Safety and Security
- Worldwide Standards
- From Vision

- Today
- 2 years
- 10 years

Worldwide Standards
FDA, Emergency Stop, ANSI

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Industrie 4.0 in the Lifecycle

Design

Engineering

Start-Up

Operation

Recycling

Information Backbone

PLM (Design)

Maintenance (Repair)

ERP (Planning)

MES (Control)

Resource Control (Optimization)

Change-Management (Rebuild)

Customer (Information)

Logistics (Delivery)

OPC UA

Cloud
Launch: June 2005
Legal form: registered non-profit association
Members: institutions only
Governance: general assembly, executive board
Fees: 12,000 / 3,000 € annual fee
Financing: fees, donations, projects
Employees: currently 16
Revenue: 1 Mio €

The SmartFactoryKL is the worldwide biggest and most popular manufacturer independent research and demonstration center for INDUSTRIE 4.0 technologies.
Development of SmartFactoryKL

- **Idea**
  - Initial talks
- **Study**
- **Launch**
- **Build up phase**

**Timeline**:
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2015
- 2016

**Phases**:
- Demonstration systems
- Research and development projects

- **7 Members**
- **10 Members**
- **40 Members**

**Key Points**:
- SRC KL
- I4.0 Ctr.
The Members of SmartFactoryKL

ODVA members

Industry

Science

Industrie 4.0 Demonstrator Line © 2015
Industrie 4.0 Demonstrator Structure 2015

- Infrastructure Box
- Infrastructire Supply
- Manual Workstation
- Weighing Module
- Quality Control
- Laser Marking
- Force Fitting
- Production
- Engraving
- Storage Module
- Infrastructure Server

- System Coordination
- ERP
- Data Analysis & Evaluation
- OPC UA .NET Client
- Network Infrastructure
- Engineering
- Certification
Structure of Demo Line

- Modules are connected via transport system
- Modules recognize neighbor modules
- Infrastructure Boxes supply power, compressed air, network connection and safety (emergency stop)
- Data connection to supervisory systems via OPC UA
Bosch Rexroth wants to evaluate the ODVA machine data model in the SmartFactory demo line at Hannover Fair 2016.

The MES / ERP system providers are very interested.

Next steps:
- Publication of data model, 10/14/2015
- Application to demo line
The Industrie 4.0 Demonstrator – in Detail

Infrastructure Box
- Energy Control
- Firewall
- Power Distribution

Product Memory

Module Localization

Connector
- 3x400V
- Emergency Stop
- Air
- Network

SoA-PLC

Flexible Conveyor Lock
Standards Used

**Interoperability**

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<th>ISO-OSI</th>
<th>SEMANTIC SERVICE DESCRIPTION</th>
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<td>Ethernet</td>
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**Communication**

- Ethernet
- RJ45, WiFi
- TCP/IP
- OPC-UA
- SoA

**Electromechanical**

- Modular connector
- 3x400V
- 24V
- RJ45 Network
- Emergency Stop
- Compressed Air

Industrie 4.0 worldwide

- **IT-driven**
- **Low production**
- **Few skilled workers**

- **Production driven**
- **High production**
- **Many skilled workers**
- **SME-structures**

- **Government driven**
- **High production**
- **No skilled workers**

- **Industry driven**
- **High production**
- **Many skilled workers**

- **320 Mio$/5 yrs DMDII**
- **160 Mio$/5 yrs UI Labs**

- **470 Mio € / 5 J.**
- **BKZ 28 Mio € / 3 J.**

- **DMDII**

- **USA**

- **Germany**

- **China**

- **USA**

- **Germany**

- **China**
THANK YOU

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