Future of Manufacturing
View on enabling technologies
Thomas Hahn
Agenda

1. Siemens – Our innovation agenda
2. Manufacturing challenges and “Industrie 4.0”
3. Technical point of view on Cyber-Physical Systems
4. OPC UA and what’s next
Innovations keep us strong – Milestones across three centuries
Electrification, Automation and Digitalization are the key drivers of our innovation agenda

Selected research topics

**Electrification**
- Smart Grid
- Storage technologies
- Power-to-value

**Automation**
- Autonomous systems
- Robotics
- Industrie 4.0

**Digitalization**
- Data analytics
- Cloud
- Mobile computing
Smart data to business example: Optimization of gas turbine operation

Energy system
- Market drivers
- Customer needs
- Product cycles

Gas turbines
- Mechanical Engineering
- Thermodynamics
- Combustion chemistry

Autonomous Learning
- Neural Networks
- Smart Data Architecture processes data

Results
- Reduced NOx Emissions
- Extension of service intervals

Domain know-how + Device know-how + Analytics know-how = Smart Data
**Smart data to business example:**
Health check for CERN’s Large Hadron Collider

**Automation infrastructure:**
- Market leader in industry automation
- Strong presence in all business areas

**Autom. components:**
- Complex: hundreds of SCADA systems and SIMATIC control systems

**Rule and pattern mining:**
- >1 terabyte of operational data generated per day
- Detect fault patterns

**Results**
- Early warnings to increase Operating Hours

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**Domain know-how** + **Device know-how** + **Analytics know-how** = **Smart Data**
Smart data to business example: Smart City Research Aspern, Vienna

**Objective**

“My clear goal now is to become the greenest city in the world.”

Michael Häupl, Mayor of Vienna

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**City infrastructure**
- Market drivers
- Customer needs
- Power networks
- Building technology

**Smart Grid/Smart building**
- Electrical engineering
- Power storage
- Smart meters

**Smart City Cockpit**
- Integration of smart grid, smart buildings, water and mobility
- Analytics dashboard

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**Domain know-how**
**Device know-how**
**Analytics know-how**

= **Smart Data**
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Challenges: Manufacturing is changing faster than ever before

Increasing competitiveness

1. Increase efficiency
   - Energy and resource efficiency are decisive competitive factors

2. Shorten time-to-market
   - Shorter innovation cycles
   - More complex products
   - Larger data volumes

3. Enhance flexibility
   - Individualized mass production
   - Volatile markets
   - High productivity

Industrie 4.0 should help to solve manufacturing challenges
Recommendations for Industrie 4.0: 5 central research themes

- Horizontal integration through value networks
- End-to-end engineering across the entire value chain
- Vertical integration and networked manufacturing systems
- New social infrastructures in the workplace
- Cyber-Physical Systems technology
The research for realization of Industrie 4.0 covers 3 levels: Strategy, processes, system

**Level strategy**

**Horizontal integration through value networks**
- New business models
- Eco-systems

How can the *business strategy* of a company and new types of value networks are supported by CPS?

**Level processes**

**End-to-end engineering across entire value chain**
- Integration of product and production lifecycle: From design to production to service and loop-back

How can the *business processes* including engineering workflows are designed throughout with CPS?

**Level system**

**Vertical integration and networked production systems**
- Flexible production based on modular, autonomous production units

How can the *production system* using CPS be flexible reconfigurable and adaptable?
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Vision Industrie 4.0: Optimization by Cyber-Physical Systems (CPS)

Vision for Industrie 4.0

- The **product** to be manufactured **contains all necessary information** on its production requirements
- **Self-organization of integrated production installations** considering the entire value chain
- **Flexible decision on production process** on the basis of the current situation
- **Human beings remain essential as creative planners, controllers and decision-makers**
Industrie 4.0
Production based on Cyber-Physical Systems

“Smart” products

- The product to be manufactured has all the necessary information for every step of its production

Modular production units

- Optimized organization of networked production facilities taking into account the entire value chain
- Production steps are configured flexibly in response to changing situations

Reduction of complexity due to “smarter” structures
Cyber-Physical Systems
have all the information as a digital model

Cyber-Physical System (CPS) + Digital model

Contains all the information on ...
- Software / Informatics
- Mechanics
- Electrics, Electronics
- Automation, HMI
- Safety, security
- Maintenance
- Location, identity…
- Status
- SW version
- Interfaces
- …

The digital model is always up-to-date and is extended over the entire lifecycle

Product design > Production planning > Production engineering > Production execution > Services
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Siemens
A long and successful history with OPC foundation

Founding member OPC Foundation

OPC XML products

Important contribution to OPC UA Standardization


1st product with OPC interface

>50 products with OPC interface

1st certified product OPC UA

1st product OPC

1st product with OPC UA interface

>10 products with OPC UA interface
OPC UA and relation to Industrie 4.0

Before OPC UA

Features with OPC UA
- Multi Vendor Interoperability
- Secure, Cross Platform Protocols and Generic Services
- Semantic Interoperability – More than a protocol
- Enabler for Industrie 4.0 and Internet of Things

Call for actions
- Define information models for various industrial domains
- Synchronize with standardization committee
- Facilitate Industrie 4.0!
Industrie 4.0: Faster time-to-market, increased flexibility and reduced complexity

Product and Production Design
- Common digital enterprise platform

Cyber-Physical Systems
- Integrated autonomous functionalities
- Plug & produce capability

Production Network
- Dynamic supply chain
- Self optimization
Thank you for your attention.
Questions and remarks are welcome!