Dr. Wolfgang Heuring, Head of Research and Technology Center

Industrie 4.0 –
The path from research to practice
Siemens is the driver of innovation in Automation for decades

1st Industrial Revolution
Siemens founded in 1847. Werner von Siemens inspired by innovations to discover the dynamo-electric principle in 1866.

End of 18th century

End of 19th century

2nd Industrial Revolution
The world’s first reversible electric drive from Siemens at the Georgsmarien steelworks with 6,800 kW.

3rd Industrial Revolution
SIMATIC and SINUMERIK boost industrial productivity

2020 - 2030
4th Industrial Revolution
Modular cyber-physical Systems

Path to Industry 4.0
The path to Industry 4.0: evolution – no revolution
Next step is the integration of product and production lifecycles

Yesterday

Electronics for Automation

Today

Modular, IT-supported Automation

Tomorrow

Integration and optimization of the entire product and production lifecycles with innovative software

Future

Self-optimizing cyber-physical systems based on analysis of virtual models expressing options for action

Industrie 4.0
Research to realize the vision of Industrie 4.0 for leveraging customer benefits covers 3 levels: strategy, processes, system.

**Level strategy**
*Horizontal integration across value networks*
- New business models
- Eco-systems

**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

**Level system**
*Vertical integration and networked production systems*
- Flexible reconfigurable and adaptable production systems based on cyber-physical systems

Source: Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0
Standard PLC can be used as cyber-physical system (CPS) platform

Siemens research project:
Cyber-physical PLC

Results:
- Demonstrator for integration of demand response in production and facility control
- Realized as CPS interacting with Web services

Used platform: Standard PLC HW & SW
- Seamless integration of Web services with PLC apps in the IEC 61131 programming paradigm
- Application easy to implement
Siemens is consortium leader for IoT@Work to develop self-organizing automation networks for modular cyber-physical production

Cyber-physical systems
Self-organizing modular production

EU FP 7 research project

Today: Pre-configured automation networks
CPS: Demand for flexible communication services

Duration: 06 / 2010 – 5 / 2013
Partners, e.g.:

Expected results
- **Self-organizing automation networks** combining network virtualization, resource mgt. and policy control
- **Communication services** can be set-up and modified at run-time w/o interruption of system operation
- **Pilot system** (automotive industry) available in Turin (FIAT)
- Input to **IEEE 802.1 standardization** delivered

Source: [www.iot-at-work.eu](http://www.iot-at-work.eu)

For details visit the Forum “Industrial IT” at the Hannover Messe, 04/12/2013
End-to-end solutions are already available
Example: Personalized Healthcare Manufacturing (shown at HMI 2012)

Integrated digital process chain, from imaging to finished implant, means cost efficiency, safety, and reliability

1 OR = Operating room  2 OP = Surgical operation
The new BMBF project mecPro\textsuperscript{2} addresses model based engineering of product and production system

**New BMBF research project:** mecPro\textsuperscript{2}

**Duration:** 9 / 2013 – 9 / 2016

**Partners, e.g.:**

![SIEMENS]

**Expected results:**

- **Integrated engineering process and data models** for product and production systems based on existing description languages
- **Simulation on system level** for verification of concepts in early stages of the engineering process (frontloading)

mecPro = Modellbasierter Entwicklungsprozess cybertronischer Produkte (CTP) und Produktionssysteme (CTPS)
Integration needed across different domains (mechanics, electrics, software) and along complete value chain (suppliers, partners, customers)

Siemens’ holistic view into OEMs’ and End Customers’ PLM Processes

Domains

Mechanical

Electrical

Software

OEM

Production

Product

CAx Software

CNC Controller

OEM Variables

Level:

Strategy

Timeframe:

Yesterday

Today

Tomorrow

Future

Siemens AG, CT RTC

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Future research needed on Eco-Systems, joint approach with suppliers, partners and customers

Eco-System

A network of market participants whose know-how, IP, products or services a company (OEM) relies on for its product innovation.

Focus of research to create Eco-Systems jointly with suppliers, partners and customers:

- Designing business models and value-networks
- Strategy for standardization
- Creation and protection of own knowledge
- Sustainability, e.g. resource efficiency
- Skills and people development across organizational borders
- Optimal bundling of goods with services across organizational borders
It`s a long way to Industrie 4.0 …
… we continue to proceed hand in hand with our customers and partners

- The path to Industrie 4.0: it’s an evolution - no revolution

- Important milestones on the path to Industrie 4.0 have already been reached by Siemens – certain aspects of the vision are already reality

- Siemens has initiated research activities together with partners to drive towards Industrie 4.0 and to deliver further proof points
Industrie 4.0 – The path from research to practice

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