Digitalization in Process Industries
Questions to be answered in the Process Industries

How can I use the new recipe of my newly designed yoghurt in the factory which has free production capacity?

How can I ensure the all the engineering faculties working on my new plant are working in parallel without problems at the interfaces?

How can I use all the data created at my shopfloor for optimizing the production processes?

How can I interconnect all my production facilities without loosing the high security standards at my plants?
Five Megatrends shaping our world of tomorrow – changes in the markets are accelerating

### Demographic change

<table>
<thead>
<tr>
<th>Year</th>
<th>Developing countries</th>
<th>Industrial countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>6.10</td>
<td>1.25</td>
</tr>
<tr>
<td>2020</td>
<td>9.00</td>
<td>1.36</td>
</tr>
</tbody>
</table>

- **World population**
- **Age distribution**
  - 0-14
  - 15-65
  - 65+

### Urbanization

- Contribution to global GDP growth, 2007-2025:
  - Cities >10mn
  - 38%
  - 5mn – 10mn
  - 150k – 2mn
  - 2mn – 5mn
  - Other cities and rural areas

### Growing and ageing population

### Global warming and weather extremes

- **Annual mean temperature variations 1950-2014**

### Climate change

- **Foreign direct investment vs. global GDP**

### Globalization

### Digital transformation

- **Connected devices**
  - 2012: 9 billion
  - 2016: 23 billion
  - 2020: 50 billion

- **Exponential growth of connected devices**
- **and digital data**

- **ZB = Zettabytes = 10^9 Terabytes**

- **Other cities and rural areas**
  - 38%

- **Cities as main driver of GDP growth**

- **Trend to increase investment abroad**

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1. UN World Population Prospects (2015)
2. Met Office Hadley Centre observations (2014)
4. UNCTAD (2013)
5. Cisco: The Internet of Everything (2013)
Digitalization changes everything and causes new business models

From Bookstore to e-book
From Record Store to Streaming
From Yellow Pages to service portals
From Taxi to ride-sharing

Source: Digitalization Day 2015, Prof. Russwurm
Digitalization will speed up changing the entire industry!

The *megatrend* Digitalization …

- covers all areas of consumer life and
- will continue to change the entire industry sector (products, business models) in a disruptive and sustainable manner!

Current drivers of the Information and Communication Technology

- Computing power
- New sensors
- Virtualization
- Cloud computing
- Ubiquitous networking
- Simulation
- Augmented reality
Easy to digitize industries have already started to change …
…more complex industries will follow

We're seeing an increasing digitization of industries

1 Technical Drivers
- Digitization, Sensors, Connectivity, Bandwidth, Data Capturing and Storage, Clouds, Analytics …

2 Business Drivers
- New Business Models, Ecosystem concept and Paradigm shift: From product-focused to user-centric mindset …

Degree of maturity of digital business models

- Media
- Trade
- Mobility
- Health
- Discrete & Process Industries
- Energy

Less complex industry
More complex industry

Based on "Smart Service Welt" report/Accenture visualization
Digitalization is the next level to yield productivity within Process Industry

Process Industries → Electrification, Automation and Digitalization as levers to increase productivity

Technological driver
- Computing power
- Communication
- New sensors
- Virtualization
- Cloud computing
- Simulation
- …

Different initiatives, e.g.
- Industrie 4.0
- Industrial Internet Consortium (IIC)
- Made in China 2025
- …

Digital Plant
Integrated Engineering and Integrated Operations

Digitalization

Electrification
- Electrical power wherever and whenever

Automation
- Electrical power wherever and whenever

Integrated Drive System (IDS)
Optimum integration of entire drive train, automation and life cycle engineering

TIA@Process Industry
Perfect interaction of all components along the life cycle

TIP@Process Industry
Integrated Engineering and Integrated Operations

Time

Next level of productivity

Experienced partner for automation and electrification

Pioneer for Digitalization in Industry
From Industrie 1.0 to Industrie 4.0, an initiative of the German industry sponsored by the German Government

**First Industrial Revolution**
Based on the introduction of mechanical production equipment driven by water and steam power

- 1784: First mechanical loom

**Second Industrial Revolution**
Based on mass production achieved by division of labor concept and the use of electrical energy (electrification)

- 1870: First conveyor belt, Cincinnati slaughterhouse
- 1908: Ford T-Model

**Third Industrial Revolution**
Based on the use of electronics and IT to further automate production (automation)

- 1969: First programmable logic controller (PLC) Modicon 084

**Fourth Industrial (R)Evolution**
... driven by Digitalization, Integration and enhanced Flexibility

**Characteristics**
- Humans, devices and systems are connected along the entire value chain
- All relevant information is available in real-time – across suppliers, manufacturers and customers
- Parts of the value chain can constantly be optimized with respect to different criteria, e.g. cost, resources, customer needs
Future challenges in industry

- Shorter **time to market**
- Increased flexibility in volatile, heterogeneous, global markets
- Optimized **productivity**
- Energy and resource **efficiency**
- Mitigation of **demographic change**
- Continuous, **safe and reliable operations**

Industrie 4.0: Research areas

- Cyber Physical Systems (CPS)
- Horizontal integration of the value-add networks
- Vertical integration and networked production systems
- Seamless integration of the engineering along the entire life-cycle
- Reference architecture model
- Integration of human creativity and innovativeness

Digitalization is key to provide answers to future challenges in industry
Digital transformation also addresses challenges in process industries

Digital transformation is originally driven by discrete industries but also valid for process industries with a specific interpretation

**Horizontal integration through value-add networks***
- Remote operations, Operation excellence center
- Production related logistics (e.g. supply & demand management, track & trace)
- Data analytics/services (e.g. predictive maintenance)
- Enterprise Asset Management (e.g. fleet optimization)

**Vertical integration and networked production systems***
- Condition monitoring
- Plug&Produce (e.g. FDI, modular automation)
- Ethernet based communication down to the field
- Semantic communication (e.g. eCl@ss, OPC UA)
- New automation principals (e.g. control in the field, decentralized automation, automation in the cloud)

**Seamless integration of the engineering along the entire life-cycle***
- Integrated Engineering & Integrated Operations
- Simulation-based Acceptance Tests
- Operator training simulation
- Decision support / assistance systems
- Plant Asset Management
- Performance contracting

**Optimization of resources in value-add networks from raw materials to product**
- Increased flexibility and optimization of production in volatile and global markets
- Time savings in engineering by consistent data storage along plant life-cycle

**Modeling and Simulation**
- Seamless interoperability and communication based on standards

**Cyber Security / Industrial Security**

*) Source: acatech, April 2013 “Umsetzungsempfehlung für das Zukunftsprojekt Industrie 4.0”
Siemens realizes Digital Enterprise for Process Industries through Integrated Engineering and Integrated Operations

Digital Enterprise for Process Industries → Focus of Siemens

Integrated Engineering optimizes engineering and life cycle management …

- Integrated engineering tools
- Simulation
- Common data model

… Integrated Operations improves productivity and flexibility

- Cloud-enabled services and analytics
- Next generation of Control
- Digitalization of field level
- Reliable connectivity

Product design  Process & plant design  Engineering & commissioning  Operation  Service
A common data model is enriched along the life cycle and ensures consistency during all workflows.
Integrated data from all levels to provide decision support, optimize productivity and enable new control concepts

Integrated Operations with Siemens → Today and future vision

**Integrated Operations**

**Today**

- Increased **productivity** and **decision support** through increased **transparency**, **analytics** and **services**
- **Advanced control** with scalability, remote access, interoperability with COMOS and proven IT security
- **Simple integration** of field level (libraries, connectivity) and **increasing intelligence**
- **Reliable connectivity** as backbone for integration as well as **remote operations** and **services**

**Vision**

- **Optimization** through real-time (cloud-enabled) data analysis and **advanced tools / services and simulation**
- **Modularization** and **virtualization** through highly scalable controls, optimized interoperability and open interfaces
- **Digitalization of field level** with full and easy ("plug’n’produce") integration and embedded intelligence
- **Full interoperability** and **advanced remote operations** and **services** through seamless connectivity
Connectivity will be key to enable Digitalization of Process Industries

Integrated Operations with Siemens → Reliable connectivity

**Future challenges in industry**

- Vertical integration and remote operations enabled by industrial identification and high performance, reliable communication
  - IP based communication
  - Profinet / OPC UA with various diagnostic functions
  - Ubiquitous connectivity (WAN, WLAN, LAN, wireless fieldbuses, RFID)

- Domain specific data transfer (realtime, security, safety)

- Comprehensive security enabled by embedded security and solutions for network and plant security

**Our Vision**

- Increased usage of plug’n’play components and on-demand networks
- Easier and automated (self-)configuration
- Real-time communication with higher robustness, bandwidth and reliability
Integrated data from all levels to provide decision support, optimize productivity and enable new control concepts.

**Today and tomorrow**

**SIMATIC PCS 7**
- **Scalable DCS system** with integrated IT security and simulation
- **Common plant model and integration** through bi-directional interfaces to COMOS, SIMIT and SIMATIC IT and connectivity to enterprise analytic systems (e.g., XHQ) and cloud
- **Operators support** with technology driven workflow, multiuser engineering, easy visualization (web-based, KPI-driven) and mobile devices
- **Process optimization** with Advanced Process Control

**MES System**
- **SIMATIC IT** as interface between enterprise and plant operations (detailed planning, scheduling, quality control, reporting)
- **XFP** for electronic batch recording for paperless manufacturing

**One historian** for DCS, SCADA and MES

**Vision**

- **Common plant model**
- **Modularization**
- **Virtualization**
- **Remote operations**
- **Interoperability**

**High scalability**

**Technology:**
- Hardware
- Software
Siemens Digitalization –
Leveraging digital technology trends for concrete customer benefits

Combining the virtual & physical world …
… across entire customer value chains

Design & engineering

Improved productivity & time-to-market

Automation & operation

Higher flexibility & resilience

Maintenance & services

Increased availability & efficiency

Collaboration and mobile

Smart data and analytics

Cloud technologies

Connectivity and Web-of-systems

Cyber-Security
Siemens terms its way to Industrie 4.0 the Digital Enterprise. Comprehensive offering for the Digital Enterprise in process and discrete industries.
Siemens Digital Services powered by Sinalytics – Combining technology with domain and context know-how for customer value

Context of data from installed basis

- Installed products, systems, processes and sensors
- Domain know-how
- Context know-how
- Analytics know-how

= Digital Services powered by Sinalytics
- Improved performance
- Energy savings
- Cost reductions
- Risk minimization
- Quality improvement

Data → Data analysis → Information → Options for action → Customer value
Siemens PD offerings provide solutions for customers from process industries on their way to Industrie 4.0

Characteristics of Industrie 4.0 (I4.0) in process industries and Siemens PD offerings

I4.0 in process industries:
- Digital Plant
- Flexibilization of production
- Optimization of production
- Remote services
- Preventive/predictive maintenance
- Modularization
- …

Siemens PD offerings:
- **Industrial Security**: Products and systems with integrated security and Plant Security Services
- **Integrated Engineering**: Efficiency in engineering and commissioning; Seamless workflow along plant entire life-cycle with COMOS/SIMATIC PCS 7
- **Integrated Operations**: Efficiency in operation and maintenance
- **Smart Products**: Intelligent and Internet-interconnected sensors and actuators
- **Data Services offerings**: Plant Cloud services, Plant Analytics Services, Plant Security Services
- **Digitalization of Verticals**: e.g. Digital Oil-field, Digital Mining, …