Die Zellstoff- und Papierindustrie als Vorreiter der Digitalisierung in der Prozessindustrie

Jahrestagung der Vereinigung der Gernsbacher Papiermacher e.V. Gernsbach am 4. und 5. Mai 2018
Agenda

1. Digitalization
2. Advanced Process Control, *on-site solution*
3. Control Performance Analytics, *off-site solution*
4. Mindsphere, *cloud based open platform*
5. Outlook
Siemens since October 2017/18
Flat and market driven organization along the value chain

Divisions (Global P&L)
- Power and Gas (PG)
- Energy Management (EM)
- Building Technologies (BT)
- Mobility (MO)
- Digital Factory (DF)
- Process Industries and Drives (PD)
- Siemens Healthineers
- Siemens Gamesa Renewable Energy
- Financial Services (SFS)

Go-to-market
- Americas
- Middle East, CIS
- Europe, Africa
- Asia, Australia

Managing Board

1) Commonwealth of Independent States
## Siemens offers the most comprehensive portfolio for Process Industry and Drive

### Process Industry and Drive

<table>
<thead>
<tr>
<th>Process Automation</th>
<th>Large Drives</th>
<th>Mechanical Drives (Separate)</th>
<th>Process Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed control system (hardware and software) and plant engineering software</td>
<td>Low voltage motors and low voltage converters</td>
<td>Helical gear units</td>
<td>Closed ring power system (drilling)</td>
</tr>
<tr>
<td>Process instrumentation for flow, level, pressure, temperature, weighing and positioners</td>
<td>High voltage motors and medium voltage converters</td>
<td>Bevel-helical gear unit</td>
<td>BlueDrivePlusC™ diesel electric propulsion system (drilling and marine)</td>
</tr>
<tr>
<td>Process analytics and analytical solutions</td>
<td>Motors, converters, control units and gears for traction, including rail, hybrid drives and mobile mining</td>
<td>Planetary gear units</td>
<td>Pipeline solutions</td>
</tr>
<tr>
<td>Wired and wireless industrial communication, rugged communication</td>
<td>Wind generators</td>
<td>Application specific gear units for industries</td>
<td>Tankfarm &amp; refinery solutions</td>
</tr>
<tr>
<td>Industrial identification</td>
<td>Products, solutions and systems for cranes</td>
<td>Couplings</td>
<td>Fiber-, mining- and cement industry Systems and solutions</td>
</tr>
<tr>
<td>Industrial power supplies</td>
<td>Hydrogen solutions</td>
<td>Gear units and couplings services, spare parts</td>
<td>Off shore &amp; on shore production solutions</td>
</tr>
</tbody>
</table>

### Integrated drive systems

- Life cycle services

Portfolio for cement, chemicals, cranes, fiber industry, food & beverage, glass & solar, marine, mining, oil & gas, pharmaceuticals, water
Fiber Industry – a Process Industry demanding integrated solutions and a complete product portfolio
Driving the Digital Enterprise in the Fiber Industry – with SIPAPER!

The SIPAPER Portfolio

<table>
<thead>
<tr>
<th>World-class products</th>
<th>+</th>
<th>perfectly matching, industry-specific modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Technology</td>
<td>SIPAPER Drive Systems</td>
<td>SIPAPER Drives APL</td>
</tr>
<tr>
<td>SINAMICS, SIMOTICS, FLENDER, ...</td>
<td>SIPAPER Process Automation</td>
<td>SIPAPER DCS APL</td>
</tr>
<tr>
<td>Industrial Automation</td>
<td>SIPAPER Winder APL</td>
<td>SIPAPER QCS APL</td>
</tr>
<tr>
<td>SIMATIC, SIPLUS, ...</td>
<td>FLENDER Gear Units for SIPAPER</td>
<td>SIPAPER DPO</td>
</tr>
<tr>
<td>Energy Management</td>
<td>SIPAPER Power</td>
<td>SIPAPER Power</td>
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<tr>
<td>SIMOCODE, SIVACON, SIPROTEC, ...</td>
<td>SIPAPER PPA</td>
<td>SIPAPER Services</td>
</tr>
<tr>
<td>Industry Services</td>
<td>Life Cycle Services, Plant Data Services, ...</td>
<td></td>
</tr>
</tbody>
</table>

Integrated SIPAPER Solutions

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Digitalization is the next level to yield productivity in the process industry

Technology is ready
- Data Analytics
- Computing Power
- Connectivity
- Sensors

Digitalization
- Next level of productivity

Automation
- Siemens as experienced partner for Automation and Electrification

Electrification
- Pioneer for Electrification in industry
## Agenda

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Digitalization will speed up changing the entire industry!

The megatrend Digitalization …

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

Current drivers of Information and Communication Technology

- Computing power
- New sensors
- Virtualization
- Cloud computing
- Ubiquitous networking
- Simulation
- Augmented reality
End User behavior is radically changing based on new business models

- From **Bookstore** to **eBook**
- From **Record Store** to **Streaming**
- From **Yellow Pages** to **Marketplaces**
- From **Taxi** to **Ride Sharing**
Value creation processes are radically changing based on new distribution.
Products are augmented digitally for different stakeholder along their entire lifecycle.
Massive pervasion of technologies driven by exponential growth of computational power
Digitalization is key to provide answers to future challenges in industry

**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*

**Research areas**

- **Horizontal integration** of the value-add networks
- **Vertical integration** and networked production systems
- Seamless integration of the *engineering* along the entire life cycle
- Cyber Physical Systems (CPS)
- Reference architecture model
- Integration of human *creativity and innovativeness*
The Cornerstones of Industrie 4.0 also address challenges in process industries

Industrie 4.0 is originally driven by discrete industries but also valid for process industries with a specific interpretation

### Horizontal integration through value-add networks*
- Remote operations via Internet
- Cloud computing
- Data driven services, e. g. predictive maintenance

### Vertical integration and networked production systems*
- Integrated Operations
- Plant Asset Management
- Seamless interoperability (Plug & Produce)
- Decision support / assistance systems

### Seamless integration of the engineering along the entire life cycle*
- Integrated Engineering
- Augmented Reality
- Digital Twin of the "as-is"-plant status
- On-site training simulation

---

*) Source: acatech, April 2013 "Umsetzungsempfehlung für das Zukunftsprojekt Industrie 4.0"
Digitalization → Different forms in industries

Digital Enterprise

Process Industries
- Product design
- Process & plant design
- Engineering & commissioning
- Operation

Hybrid Industries
- Product design
- Production planning
- Production engineering
- Production
- Services

Discrete Industries
- Product design
- Production planning
- Production engineering
- Production
- Services
Digital Enterprise

Digitalization → Different forms in industries

Process Industries
- Product design
- Process & plant design
- Engineering & commissioning
- Operation
- Services

Hybrid Industries
- Product design
- Production planning
- Production engineering
- Production
- Services

Discrete Industries
- Teamcenter
- NX
- Tecnomatix
- MCD
- Data Driven Services
- SIMATIC IT
- SINUMERIK Integrate
- Automation / Drives Portfolio

Manufacturing Execution Systems
- COMOS
- COMOS
- Data Driven Services
- NX
- Tecnomatix
- MCD
- NX
- Tecnomatix
- MCD
- COMOS
- COMOS
- Data Driven Services

PIA Selector
- Automation / Instrumentation and Drives Portfolio
- TIA Portal
- Automation / Drives Portfolio
- TIA Portal
- Automation / Drives Portfolio
- TIA Portal
- Automation / Drives Portfolio

Communication / Security
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- Communication / Security

TIA: Totally Integrated Automation
Siemens realizes Digital Enterprise for Process industries through Integrated engineering to 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 systems**
- **Digitalization at field level**
- **Reliable connectivity**

Product design  Process & plant design  Engineering & commissioning  Operation  Service
SIPAPER Process Automation – COMOS, SIPAPER DCS APL CMTs, SIMIT and CPAS – a real example

Seamless integration of engineering disciplines, steps and tools
## Agenda

<p>| | |</p>
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Automation Hierarchy
ISA 95 Level Definitions

**Level 4**
Business Planning & Logistics
- Plant Production Scheduling, Operational Management, etc.
- Establishing the basic plant schedule - production, material use, delivery, and shipping. Determining inventory levels.
- Time Frame: Months, weeks, days, shifts

**Level 3**
Manufacturing
Operations Management
- Dispatching Production, Detailed Production Scheduling, Reliability Assurance, ...
- Work flow / recipe control, stepping the process through states to produce the desired end products. Maintaining records and optimizing the production process.
- Time Frame: Shifts, hours, minutes, seconds

**Level 2**
Discrete Control
Continuous Control
Batch Control
- Monitoring, supervisory control and automated control of the production process

**Level 1**
DCS/QCS
- Sensing the production process, manipulating the production process

**MES**
Manufacturing Execution System

**Level-2-System**
Model-based online simulation and optimization

**DCS/QCS**
Distributed Control System
- Raw materials

**ERP**
Enterprise Resource Planning
- Orders

**MES**
Manufacturing Execution System
- Invoices

**DCS/QCS**
Distributed Control System
- Raw materials

**Level-2-System**
Model-based online simulation and optimization

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Enterprise Resource Planning
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**MES**
Manufacturing Execution System
- Invoices

**DCS/QCS**
Distributed Control System
- Raw materials
SIPAPER APC DrySec – Functioning of level 2 system

**Optimization of energy consumption**
- At steady-state production conditions

**Process monitoring**
- Detection of saving potential
- Value consistency Measurement

**Level 2 system**

**Operator input (e.g. limits)**

**Process model**

**Physical model**

**Model coefficients (plant specific)**

**Model adaptation**

**Measurement value preprocessing**

**DCS/QCS**

**Sensors**
SIPAPER APC Bleach – The level 2 system

- Brightness after Bleach Tower
- Brightness
- Flow
- …
- Specific Energy
- Level
- Brightness
- Dosage
- Peroxide
- NaOH
- Press
- Disperger
- Bleach Tower
- Dead Time 1 (2-3 Min.)
- Dead Time 2 (50-70 Min.)
SIPAPER APC Bleach – Reliable quality with optimized chemical consumption

Model Predictive Controller

Dead Time Model

Brightness

Bleaching Model

$\text{NaOH}$

$\text{H}_2\text{O}_2$

Optimizing Function

$\text{NaOH/H}_2\text{O}_2$

9 Weeks

8 Brightness Points [ISO]
SIPAPER APC Bleach – Coordination of two bleaching stages

I. Pre-flotation  
   Ink removal 1

II. Disperser-bleaching 1  
Peroxide bleaching

III. Post-flotation  
   Ink removal 2

IV. Coordination

V. Disperser-bleaching 2  
Dithionite bleaching

Set point brightness (calculated)

Set point for peroxide dosage

Process values

Set point brightness (from operator)

Set point for dithionite dosage

Process values

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SIPAPER APC – Integration into DCS system

Level-2 PC
- Operation & monitoring
- Engineering Station

Communication to any DCS:
- OPC
- Profibus
- TCP/IP
- Modbus
- ...

Sensors / Actuators

AS 1

AS 2

... 

AS x

Operator Station 1 ... n

DCS Server 1 .. x (redundant)

Mill bus (fast) Industrial Ethernet

Terminal bus (office Ethernet)

PROFIBUS-DP
APC is more and more becoming commodity

![Graph showing the evolution of technology over time.](image)
The right tool for the right job: Improved Process Control through embedded APC

Industrie 4.0 use case – Optimizing operation: Embedded APC with SIMATIC PCS 7

Initial situation

Value Proposition

- Realize economic plant potential
- Reduced variability
- Reduced energy and raw material
- Increased quality and throughput
- Increasing trend

Challenges

- Low barrier for small applications
- Sophisticated functionality for large applications
- Standardized across the company with central support
- High availability and same look and feel in operation
- Reduced cost of technology (design, implementation)
- Low lifecycle cost (e.g. Migration, transfer to other units)
- Low training expense

Variations

<table>
<thead>
<tr>
<th></th>
<th>Separate PC (External)</th>
<th>DCS integrated (Embedded)</th>
</tr>
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<tbody>
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<td>✓</td>
<td>✓</td>
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</tbody>
</table>

Value-add

- Powerful controllers allow more embedded functionality and capabilities
- Set of functionalities available depending on application:
  - PID Tuner
  - Gain scheduling, override control, disturbance compensation, Smith Predictor
  - Model Predictive Control (MPC (4x4) or MPC10x10)
  - APC interface blocks with watch dog, central switch-over, etc.
- Control- and equipment modules (CM, EM), unit templates with APC

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Agenda

1. Status
2. Advanced Process Control (APC), *on-site solution*
3. Control Performance Analytics, *off-site solution*
4. Mindsphere, *cloud based open platform*
5. Outlook
Cost Efficiency through a Managed Service Approach

Process Data Analytics

Customer

Visualization and recommendations

Secure connection

Data analytics and simulation

Consulting and implementation support

Siemens

Secure connection

Data combination and secure storage

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### Optimized process based on transparent control performance

**Process Data Analytics**

#### Performance Reporting
- Long-term plant overview on control performance of all control loops
- Visualization of important indicators for prioritized optimization actions
- Stiction* recognition KPI
- Analytics of historic data from 3rd party DCS

#### Characteristics Reporting
- Detailed information on control performance of each single loop
- Detailed KPIs for varying time frames
- Visualizes process data and characteristic diagrams like scatterplot, FFT spectrum, cross correlation for stiction recognition etc.

#### Optimization Reporting
- Optimized control parameter for increased control loop performance

#### Consultants Report
Provides expert statements about the performance of individually analyzed control loops on request

*static friction*
Continuous Process Improvement with Siemens
Process Data Analytics

Customer

Process Plant with PCS 7 DCS

Realization

User Transmission Mode

System Transmission Mode*

PDA Data Collector

Consultants Reports & Expert Consulting

Reports & Recommendations

Siemens

Process Industry Experts

Siemens Cloud for Industry

Raw Data

Analytics

* Development

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…. only **50 %** control loops are **optimized**\(^1\)

**Percentage of not optimized control loops at...**

- Pulp Mill in Sweden: **61 %**
- Pulp Mill in Finland: **77 %**
- Paper Mill in Sweden: **83 %**
- Paper Mill in Germany: **86 %**

\(^1\) Source: Control Engineering
Siemens Value Services
Plant Data Services

Maintain Mill Operability
- Industrial Network Analytics
- Drive Train Analytics
- Machine Tool Analytics

Process Efficiency
- Control Performance Analytics
- Process Event Analytics
- Dynamic Process Optimization

Industry Security
- Assess Security
- Implement Security
- Manage Security

Energy efficiency
- Energy Analytics

Mind your digital future
- MindSphere – Siemens Cloud for Industry

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**Funktionsprinzip DPO**

**Optimierungsablauf**

1. Aufnahme von Messdaten
2. Modellierung des stationären Zustands
3. Optimierung eines gewählten Optimierungsziels unter Einhaltung von Prozess-Nebenbedingungen
4. Ausgabe eines Sollwertvorschlags
5. Übernahme oder Änderung des Vorschlags

**Diagramm:**
- **DisV**: Sollwerte
- **SP**: Sollwertvorschlag
- **ProV**: Prozess
- **DPO**: Optimierungsablauf
- **Optimierer**: Optimierungsziel & Nebenbedingungen
- **Modellgenerierung**: Stationäre Zustände im laufenden Betrieb
- **Black-box Betrachtung**: Flexible Anbindung via OPC
- **Automatische I/O Modellgenerierung**: Kontrolle bleibt beim Anlagenfahrer
- **Iterativ**: kleine, sichere Änderungsschritte

**Siemens**

*Ingenuity for life*
### Agenda

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MindSphere – an open cloud platform for the Industry

Optimization of plants and machines as well as energy and resources

- **Open standards** for connectivity of Siemens and Third-party products
- **Plug & play connection** of Siemens products (engineering in the TIA Portal)
- **Cloud for industry** with open application interface for individual customer applications
- Transparent **pay-per-use pricing model**
- Opportunities for completely new **business models** (e.g. selling machine hours)
Digital Fiber Initiative – Forming an Ecosystem of different partners contributing to the evolution of Digitalization

Digital Enterprise Software

From Integrated Engineering
New fiber applications
Process Simulation
Virtual commissioning
Operator training

to Integrated Operations

Process Automation
Remote Monitoring
Process Analytics & Optimization

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Participation in the Ecosystem – The contribution of every single member is key to success

**Consulting / Strategy partners**
- Provide digital transformation services based on MindSphere
- Develop vertical apps

**Application Developer / ISV**
- Develop vertical apps
- Sells apps based on MindSphere

**System Integrator**
- Connect other enterprise systems on the cloud (ERP, CMMS, etc.)
- Provide connectivity & implementation services

**Technology Partners**
- Enhance capabilities as well as adoption of MindSphere platform utilizing analytics, AI & Big Data

**Hybrid OT Partners**
- Partners from automation, instrumentation background who will develop IoT applications and provide services

**Connectivity Partners**
- Develop connectivity into products
- Sell connectivity products

MindSphere
- Optimization of the performance of assets, energy and resource consumption, maintenance, services...

MindApps
Open ecosystem of applications

- SIMATIC
- SINUMERIK
- SINAMICS
- SCALANCE
- PCS 7
- Third-party products

MindSphere – Siemens Cloud for Industry

End customer Apps

End customer Apps

MindSphere Apps

Own Apps

OEM Apps

Developer Apps
Siemens Software and Digital Services – operational or soon to be released on MindSphere

Product Intelligence
- SIRIUS App

Analyze MyDrives
- Omnetric Planning and Outage Intelligence
- Energy Manager Pro
- Grid Diagnostic Suite
- Mind Connect Edge Analytics
- Analytics Starter Kit
- Reclalm Belt Monitoring
- Logical Operations Manager (LOM)
- Climatix IC
- Building Operator IC
- Smart Thermostat
- Synco IC
- Manufacturing Performance
- Manufacturing Intelligence

Manage My Machines
- O²M – Order OEE Monitor
- Drive System Analyzer
- Simotics IQ
- SIDRIVE IQ
- Electrification Fleet Manager
- Dock and Yard Mgmt
- Condition Analyzer for Prod. Mach.
- Security Vulnerability Information
- SIMATIC Performance Insight
- SIMATIC Machine Insight
- SIMATIC Machine Monitor
- SIMATIC Energy Manager
- SIMATICNotifier

MindSphere
The cloud-based, open IoT operating system
Platform as a Service

Enabler: Infrastructure as a Service (storage, processing power, provider agnostic)

Field devices

1) Application suite powered by MindSphere

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Digitalization Maturity Assessment – The SIPAPER first step in the digital transformation

Customer-centric approach
- Top-down
- Holistic and multi-disciplinary

Assessment of the whole value chain
- From Product Design to Services

Industry-specific approach
Addressing the challenges and the states of the art in the industry

Your benefits
- Overview of your company digital maturity
- Benchmark based on industry data
- Easy access to dedicated consulting
## Outlook

| 1 | Main target is to stay competitive in global markets |
| 2 | In many branches and levels Digitalization is in progress already, Pulp&Paper is advanced in the Process industry compared to others |
| 3 | Digitalization tools are on the market and integrated already in the process industry and discrete manufacturing |
| 4 | APC is becoming more and more commodity – and is merged at the same DCS level |
| 5 | On-site and Off-site solutions are applicable |
| 6 | Data is becoming more relevance than hardware to generate more value |