Shaping the Future of Production with Siemens: On the way to Industry 4.0

Siegfried Russwurm
Member of the Managing Board of Siemens AG
CEO Industry Sector
Press Conference
Hannover Messe 2013
April 8, 2013
Manufacturing is changing faster than ever before

- Shorter innovation cycles
- More complex products
- Larger data volumes
- Individualized mass production
- Volatile markets
- High productivity

Increasing competitiveness

1. Increase efficiency
   - Energy and resource efficiency are decisive factors of competitiveness

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

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

Increasing importance of manufacturing industry in all national economies …
Indicative changes on the global markets for production technology

**Market growth**

<table>
<thead>
<tr>
<th>Region</th>
<th>2012</th>
<th>2018</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging countries excl. BRIC</td>
<td>146</td>
<td>180</td>
<td>+4%</td>
</tr>
<tr>
<td>BRIC countries</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>12</td>
<td>55</td>
<td>+5%</td>
</tr>
<tr>
<td>BRIC</td>
<td>40</td>
<td>(38)</td>
<td></td>
</tr>
<tr>
<td>Developed countries</td>
<td>94</td>
<td>109</td>
<td>+3%</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>(22)</td>
<td>(28)</td>
<td></td>
</tr>
<tr>
<td>Patriot America</td>
<td>(17)</td>
<td>(18)</td>
<td></td>
</tr>
</tbody>
</table>

Increasing competitiveness differs from one region to another

**Prospects**

**Short and medium term**
- Industrial markets seem to be stabilizing
- China remains the global growth driver, but expectations are for more moderate growth

**Long term**
- Trend towards higher product quality by use of high-end technology
- Current industrial growth fueled by favorable oil and gas prices
- Volatile environment

**Emerging countries excl. BRIC**
- USA: +5%
- Deutschland: +1%

**BRIC countries**
- China: +3%

**Developed countries**
- Germany: +5%

---

1) Average annual growth  
2) Growth 2012-2018  
3) Relevant market for Siemens Industry Sector
The evolution to Industry 4.0 in production

From Industry 1.0 to Industry 4.0

**First Industrial Revolution**
- based on the introduction of mechanical production equipment driven by water and steam power
- First mechanical loom, 1784

**Second Industrial Revolution**
- based on mass production achieved by division of labor concept and the use of electrical energy
- First conveyor belt, Cincinnati slaughterhouse, 1870

**Third Industrial Revolution**
- based on the use of electronics and IT to further automate production
- First programmable logic controller (PLC) Modicon 084, 1969

**Fourth Industrial Revolution**
- based on the use of cyber-physical systems

Source: DFKI (2011)
Industry 4.0: Algorithmicized "production chess" within cyber-physical systems

Vision for Industry 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

Decentral cyber-physical systems (CPS) interact via embedded internet-based technologies
Human beings remain essential …

Step 1
Humans conceptualize and design the product

Step 2
Humans determine the production rules and parameters

Step 3
CPS simulates and compares production options on the basis of instructions

Step 4
CPS proposes compliant "optimal" production paths

Step 5
Selection of optimal production path and implementation of production

… as creative planners, controllers and decision-makers
The future needs a past
Siemens as trend-setter in production technology

Long-term compatibility
Open interfaces
Leadership in innovation

- SIMATIC PCS 7
- PLM Software
- SIMATIC IT
- TIA Portal V12
- S7-1500 plus TIA Portal
- S7-1200
- JT Standard

<table>
<thead>
<tr>
<th>Year</th>
<th>SIMATIC G</th>
<th>SIMATIC S3</th>
<th>SIMATIC S5</th>
<th>SIMATIC S7 and TIA</th>
<th>PLM</th>
<th>TIA Portal for Automation and Drives</th>
</tr>
</thead>
</table>

Unrestricted © Siemens AG 2013. All rights reserved.
"Digital Enterprise Platform"
Siemens is preparing the ground for Industry 4.0

Change of paradigm for the next productivity stage: integration of product planning and production can reduce time-to-market by 50%
Increasing importance of industry software for a competitive production environment

The market for industrial IT and software is expanding by about 8% each year

Billion EUR

- 18 in 2012
- 28 in 2018

Ø +8% p.a.

Industry software for
- Design and virtual production (PLM Software)
- Real production

- CAX
- Collaborative Product Data Management
- Digital Manufacturing
- 2D-3D process design and engineering analysis tools
- Manufacturing Execution Systems
- Command and Control

Siemens Industry employs approx. 7,500 software engineers
Over 70,000 clients with more than 7.5 million PLM licences
Siemens is linking digital product planning with physical production: 4 billion EUR invested since 2007.
Holistic concept covering the entire process of product development and production

The path to Industry 4.0: An integrated product planning and production process enhances productivity, efficiency and flexibility

Intelligent networking + Use of most efficient technologies
Siemens Industry at Hannover Messe 2013
Exhibition highlights

Product design:
Mars rover model

Production planning:
Robot energy efficiency software

Production engineering:
S7-1500 V12, TIA Portal

Production execution:
Integrated Drives Systems

Services:
Condition monitoring services
Product design: NASA has chosen Siemens' PLM software for developing its Mars rover "Curiosity"

Digital design, virtual assembly and function simulation in advance of the construction of the first physical prototype
Daimler selected our CAD software NX as their platform for worldwide car and truck development.

Large-scale rollout of NX within Daimler and its suppliers:

- Move engineering work to one new consistent product development platform:
  - > 20 development centers
  - most important suppliers
- Increase flexibility and innovation:
  - Representation of digital product information in one single worldwide information environment
  - Based on NX and JT standard file format
- Start in first product series in 2012

Commitment to Siemens PLM Software and its products for mission critical processes.
Production planning:
Virtual optimization of production processes

Cooperation between VW, Fraunhofer Institut and Siemens

Simulation of robot motion using PLM software

10–50% reduction in energy consumption for the same process time

Production steps are virtually optimized in terms of productivity and energy consumption
VW: Boosting productivity in existing drive system through simulation

Press Line Simulation (PLS) for retrofit of a 17-year-old press line

- Control, drive and safety technology from Siemens
- Virtual model simulates all mechanical, electrical and software components for motion control
- Combined use of SIMOTION and PLM software
- Direct data link between PLS and press working line control units
- Performance enhancement and energy savings of up to 40%

Industry software from Siemens can also leverage productivity in already installed systems
Production engineering:
Seamless data integration right through to drive technology

SIMATIC Controller
- S7-300/400
- WinAC
- S7-1200
- S7-1500

SIMATIC HMI
- Basic panels
- Comfort panels
- WinCC runtime

SIMATIC NET
- Profibus
- Profinet
- IWLAN

SINAMICS
Complete Integration of Sinamics G 120-Series via Startdrive V12

SIMOTION
Integration of communication- and HMI-features*

SINUMERIK
Next expansion phases

TIA Portal can enhance engineering efficiency by up to 25%

*work in progress

TIA = Totally Integrated Automation
Page 17 8 April 2013 Siegfried Russwurm

Unrestricted © Siemens AG 2013. All rights reserved.
BMW:
Efficient production with TIA Portal and S7-1500

Long-term partnership with BMW

- Efficient development of production standard at BMW
- First customer to use TIA Portal in the automotive industry
- In all plants worldwide until 2027
- Use of SIMATIC products and solutions
- S7-1500 for state-of-the-art automation

BMW commits to Siemens for 15 years as single preferred supplier of new automation technology – globally
**Production:** From individual drive components to Siemens Integrated Drive System

<table>
<thead>
<tr>
<th>Then</th>
<th>Now</th>
<th>Tomorrow</th>
</tr>
</thead>
</table>
| ![Motor and inverter](image1.png) **Optimization of single products**  
- Versatile product portfolio: motors, gearboxes, converter and couplings | ![Motor and inverter](image2.png) **Integrated Drive System**  
- Functional integration of drive train  
- Complete integration of drive technology into the world of Totally Integrated Automation (TIA)  
- Integration of lifecycle phases for products and production | ![Digital Enterprise Platform](image3.png) **Seamless Integration**  
- Seamless interplay of all components, with distributed intelligence  
- Common database, integrated tool chain – throughout the entire lifecycle for products and production |

*Unrestricted © Siemens AG 2013. All rights reserved.*
Production:
Integrated Drive System @ vertical mill

SINAMICS
Perfect Harmony inverter

Motor H-Compact plus
2nd generation

FLENDER
RUPEX RWM 710 coupling

FLENDER
KMPS 396 gear unit

Increase in output
of up to 15%

Enhanced energy
efficiency (+5%)

Higher availability with
shorter restart times and
higher reliability

Vibration simulation for
the entire system, incl.
working machine

Horizontal integration for higher efficiency and availability
Services:
IT-based services showing strong market demand

- Simatic Remote Services
  - Remote access solution for automation customers
  - Monitoring, maintenance and repair of plants and machines
  - Flexible, affordable, reliable

- Condition Monitoring
  - Proactive condition monitoring of plants, machines and networks
  - Early detection and remedy of faults
  - e.g. motor condition monitoring

- Industry Online Support
  - Information, advice and dialog forum
  - Over 300,000 documents, case studies and tools
  - ~1.5 million visits per month
  - Smartphone App for mobile access

- Energy Data Management
  - Integrated services for greater data transparency
  - Energy data management system
  - Simatic b.data
  - Identification of concrete energy efficiency measures

Enhanced productivity and efficiency
Predictable maintenance, reduced downtimes
Information available worldwide, 24/7
Energy consumption and emission transparency
Airbus: Technology-based services for enhanced availability

Plant in the Toledo Province: Production of composite material components for the A320, A380, A350

Since January 2013 Siemens has been responsible for maintenance of production facilities

3-year contract including repairs and spare parts management

Targets: enhanced availability and less downtime

Integrated plant maintenance allows boosting productivity in aerospace production
Optotech: Combining CAD software with high-performance hardware creates new precision level

Machine design and virtual optimization of mechatronics with NX

SINUMERIK 840D with personalized user interface

SINAMICS drive for 8-axis ultraprecision grinding machine

Integrated workpiece measurement with 30 nanometer accuracy

Result: The largest precision optics machine in the world for telescopes gazing three billion light years into the universe
From vision to reality: Shaping the future of manufacturing

Then

Local automation technology

Now

Communication-driven automation

Tomorrow

Optimization of the entire production process by means of innovative software systems

Thereafter

Self-optimizing of cyber-physical systems on the basis of analyses of virtual models of action scenarios
Thank you!