Capgemini’s PoV on Industry 4.0 and its business implications for Siemens

Siemens Digital Transformation Executive Forum
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Contents

- INDUSTRY 4.0: *Drivers for an industry on the verge into a new industrial era of connected enterprises*
- FROM SMART FACTORY TO AGILE SUPPLY CHAINS: *How technology solutions are shaping the future industry value chain*
- THE CAPGEMINI FRAMEWORK FOR INDUSTRY 4.0: *Business & Technology Transformation in the digital age*
- TRANSFORM TOGETHER: *Business Opportunities for Siemens to nurture the value chain*
Industry 4.0 is considered the fourth industrial revolution – materializing Digital Transformation in the Manufacturing Industry

**Digital Transformation** is a value-adding challenge that drives future manufacturing competitiveness

Our study revealed that in 2012 Manufacturing companies were rather laggards in regards of Digital Transformation

2. Cappgemini Consulting: The Internet of Things: Are Organizations Ready For A Multi-Trillion Dollar Prize?
Companies are leveraging technology innovations to respond to the Paradox of contradicting market challenges: increasing performance vs. reduced costs

**Market Challenges: The Paradox**

- Global markets and global manufacturing networks
- Increasing organization complexity
- Increasing product complexity
- Expectation for instant (real-time) response
- Need for more customization
- New competitors and cost pressure

**Technology Innovations**

- Internet of Things and Services
- Advanced Analytics
- Decentralization and autonomous control
- Additive Manufacturing
- Machine Intelligence & Robotics
- Virtual and Augmented Reality
- M2M* (Machine-to-Machine communication)
- Cloud
- Mobility
- Social media

*Machine-to-Machine communication*
Contents

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Through the emergence of cyber-physical systems together with other technology trends, the future manufacturing process will be organized and orchestrated differently.

The core element: the Cyber Physical System (CPS)

**CYBER-PHYSICAL SYSTEMS (CPS) ARE ...**

- Physical object with embedded system possessing own **machine intelligence** (CPU, memory)
- Additional **sensors and actuators**
- Connectivity via standardized interfaces to other IT or CPS (M2M-communication)
- Connecting all relevant physical objects with **virtual (“cyber”) counterparts**

**... THE LINKING ELEMENT OF AN INDUSTRY 4.0 ENVIRONMENT**

- **The virtual model** of the CPS serves as simulation object, in order to enable decision making
- **Sensors** and **actuators** provide real-time information and control options during **production** and **field usage**
- **Interfaces** and **communication platforms** enable M2M communication and **human** influence across different product lifecycle stages
The combination of Cyber-Physical Systems lead to the concept of the Smart Factory where products and systems are interacting and taking decentralized decisions.

- Central **integrated business planning** for demand management
- Order-specific variants ("**lot-size 1**") to enable customization
- **Machine-to-Machine communication** between Cyber-Physical-Products and Cyper-Physical Production Systems
- Embedded **analytics**
- **Decentralized decision making** for production control
- **Real-time** decision making
- **Multi-agent** technology
- **Corrective actions** based on quality data analytics
Extending the concept of the smart factory across the whole value chain, creates agile end-to-end processes leveraging multiple internal and external business services.

### From Smart Factory to Agile Value Chains

- **Service-oriented Business Architecture**
- **Business functions as** self-contained/independent services (internal and external)
- Cross-company, flexible process flow
- Process instances (products/orders) as self-organized ‘agents’
- Standardized or common interfaces/protocols
- A common ‘data lake’ as platform for analytics functions (Big Data)
- **Supply-Chain-Control tower** providing extended supply chain transparency
Industry 4.0 is characterized by maximized efficiency, interconnectivity and highly dynamic environments

**Summary: Characteristics and Benefit Potentials of Industry 4.0**

**Common Characteristics of Industry 4.0**

- Active/autonomous **cyber-physical objects** (products and production systems)
- **Decentralized** decision making
- **Process flexibility** to enable customer-specific solutions (‘lot-size-1’)
- **Vertical integration** from ERP and Planning to individual sensors
- Cross-factory and **cross-company** process flow (horizontal integration)
- **Virtual model** and integrated/embedded analytics capabilities

**Benefit Potentials**

- **Increased revenues** through new services and business models
- Better **utilization** of production capacities across global manufacturing networks
- Elimination/reduction of **logistic costs**
- Improved profitability/ **reduced costs** for small batch sizes
- Improved **quality** / reduced quality costs
- Reduced **lead-times**
- Increased **flexibility**
- Improved **customer value and satisfaction**

"Cisco and GE estimate that the size of the IoT pie is over $10 trillion."

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1 Capgemini Consulting: The Internet of Things: Are Organizations Ready For A Multi-Trillion Dollar Prize?
In order to achieve the Industry 4.0 target scenario, several key elements need to be resolved/established.

As fundamental challenges, data security and communication standards are to be established.
Contents

▶ INDUSTRY 4.0: Drivers for an industry on the verge into a new industrial era of connected enterprises
▶ FROM SMART FACTORY TO AGILE SUPPLY CHAINS: How technology solutions are shaping the future industry value chain
▶ THE CAPGEMINI FRAMEWORK FOR INDUSTRY 4.0: Business & Technology Transformation in the digital age
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Industry 4.0 is essentially empowered by digital technologies. Manufacturing companies can drive growth and efficiency by addressing 8 key value drivers.

The Capgemini Consulting Industry 4.0 Framework

- **Future Manufacturing Business Model**
- **Agile Operation Model**
  - (Decentralized, Modular, Flexible, Boundless)
- **Growth Driver**
  - Smart Solutions
    - Smart Products
  - Customer Integration
    - Collaborative Innovation
  - After Sales Integration
  - Smart Supply Chain
    - Agile Collaboration Network
    - Connected Supply Chain

- **Efficiency Driver**
  - Smart Factory
    - Decentralized Production Control
    - Data-driven Operational Excellence

- **Infrastructure**
  - (connects Cyber-Physical Systems)

- **Technology Enabler (Selection)**
  - Mobile
  - Cloud
  - Analytics
  - M2M
  - Social
  - Robotics
Industry 4.0 is essentially empowered by digital technologies. Manufacturing companies can drive growth and efficiency by addressing 8 key value drivers.
Example: Collaborative Innovation

For a world-class aircraft and rocket engine manufacturer we established an end-to-end engineering platform to enable extended-enterprise engineering collaboration.

**Background**
- Need to globally collaborate all along product life cycle with more suppliers and partners
- Real time collaboration of internal and external users around digital mock up must be improved
- Communication must be facilitated
- Partners and suppliers don’t have a direct access to product configuration

**Solution**
- Implementation of a collaborative platform to share configurations and digital mock up with external partners and suppliers
- Definition of product data model
- Reengineering of modification processes in order to find the right balance about the rhythm of evolution into digital mock up and PLM corresponding configurations

**Benefits**
- Global transparency about demand and resource availability through consolidation across all levels of the network
- Validation of plans by checking sales plans against network planning quantities
- Reservation of agreed quantities to ensure delivery reliability
- Triggering the investment process at an early stage
Manufacturing companies can target supply chain complexity by connecting physical commodity flows with digital platforms.

**Horizontal Integration: Supply-Chain Control Tower**

- **Electronic interfaces**
  - Increased transparency and improved remote accessibility

- **Big data analysis**
  - Real-time processing and improves network monitoring

- **Instant cloud access**
  - Increased flexibility and improved decision-making

**Digital platform integration backbone**

- Master Data
- Tracking & Tracing System
- Supply Chain Event Management

- Supplier
- Logistic service provider
- Internal
- Logistic service provider

Cyber-physical supply chains interconnect and map value networks and thus provide a transparent and unique view for breaking down operational issues.
Using a Control Tower provides E2E supply chain visibility, reduces transport costs and increases supply chain and LSP control.

Example ‘Connected Supply Chain’: Supply Chain Control Tower

**Background**
- Warehouse and distribution activities are outsourced; further supply chain optimisation within current organisation is complex
- Purpose is to increase E2E supply chain control, improve efficiency by using best-in-class carriers and become less dependent on their LSP’s
- Activities on the tactical level (e.g. carrier management, high level planning, contracting) will be executed by a Control Tower

**Solution**
- Integrated management organisation (LSP ‘s and Samsung) for steering, planning & controlling IT product flow from Port-to-Customer
- Develop and implement logistics buying function for procurement and contract management of warehousing and transport services
- Set up new administrative organisation in such a way that all required cost data is captured automatically
- Carrier (selection, evaluation, invoicing) and inbound (terminal planning, customs status) integration

**Benefits**
- More efficient, integrated organisation
- Increases load efficiency
- Improved tracking and customer services
- Improved customer satisfaction
- Improved transport efficiency using best-in-class carriers and redesign transport solutions (e.g. x-border domestic)
- Improved Performance Measurement and Freight

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With the help of digital technologies, integrated business planning transforms counteracting functional goals into an overall value orientation for the entire organization. IBP consolidates planning activities of supply chain, marketing, production and finance and optimizes operational performance as well as capital costs.
For a global component manufacturer, we established a platform for integrated business planning in order to enable optimized demand and production planning.

### Example ‘Vertical Integration’: Integrated Business Planning

#### Background
- Customer was operating in an optimized global supply chain network
- Delivery performance was below industry standard
- Low degree of supply chain planning process integration
- Supply chain cost transparency was missing; the “real” logistic costs were not taken into account although they were forming a crucial part of the total costs

#### Solution
- The entire S&OP process was re-designed, following an IBP logic and based on the principle “one plan - one number”
- Development of an integrated business planning (IBP) process aligning all sales and supply activities with financial planning
- Implementation of IT solution to support integrated planning process from Demand-to Production Planning (modules: DP, SNP, PP/DS, gATP)

#### Benefits
- Accelerated order confirmation and improved on-time-delivery
- Reduced inventory levels and order lead-times
- Reduction of transport costs due to improved material availability
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To exploit the opportunities of Industry 4.0, the various Siemens divisions should evaluate all dimensions of the Industry 4.0 framework.

- Review the product portfolio and determine the level of integration (e.g. sensor vs. turbine vs. control system)
- Implement multi-agent technologies
- Develop and establish standards for M2M-communication across the portfolio
- Develop and establish security standards capable for Industry 4.0 scenarios
- Establish cross-enterprise integration platforms (e.g. 3D-printing grid)
- Leverage and develop more cloud-based solutions to increase flexibility
- Establish Industry 4.0 processes in own factories
- New services reaching out to end-customers (B-2-B-C) e.g. healthcare or drives
- Evaluate value chain for data driven business models (e.g. energy efficiency management)
- Establish stable digital process management to ensure fast response and process compliance
- Establish agile team culture
- Enable agile and decentralized decision making
- Prevent ‘not-invented-here’ culture
Leveraging our broad cross-discipline capabilities, Capgemini is committed to support Siemens in the exploitation of the business potential of Industry 4.0

### How can Capgemini support Siemens in this Transition?

<table>
<thead>
<tr>
<th><strong>Strategy &amp; Roadmap</strong></th>
<th><strong>Product &amp; Service</strong></th>
<th><strong>Operational Execution</strong></th>
<th><strong>Transformation</strong></th>
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<tbody>
<tr>
<td>Assess your <strong>digital maturity</strong> and market potential</td>
<td>Review of the <strong>product and service portfolio</strong> for adaptation requirements</td>
<td>Design, implementation and operation of <strong>digital platforms</strong> (e.g. the service cloud and infrastructure)</td>
<td><strong>People and culture</strong> transformation</td>
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<tr>
<td>Identify and develop business opportunities</td>
<td><strong>Re-engineering</strong> of product portfolio to CPS</td>
<td><strong>Integration</strong> platforms (vertical and horizontal integration)</td>
<td><strong>Leadership skills</strong> transformation</td>
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<tr>
<td>Design the <strong>business model</strong></td>
<td><strong>Service innovation</strong> and implementation</td>
<td>Referenzarchitekturen</td>
<td><strong>Transform towards end-to-end engineering integration</strong></td>
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<tr>
<td>Develop the <strong>roadmap</strong> towards Industry 4.0</td>
<td>Apply <strong>customer value analytics</strong> to improve revenue and profit</td>
<td><strong>Design and implementation of digital business processes</strong></td>
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Definition & establishment of **security** and **communications standards** (e.g. security solution on device level and corporate M2M-communication standards)
Thank you for our attention!