First Insights of German Industrie 4.0 Projects

First Insights of Industrie 4.0 Projects in the German Machinery and Plant Engineering Industry
The UNITY Consulting Approach

UNITY [ˈjuːnɪti]; UNITY with clients to create customized improvement:
- Consulting and innovation;
- Overall management expertise;
- Team spirit in project work;
- Think ahead, enable, execute.

Our Spirit, Your Success.

- **Customer Benefits**
  sustainable increase of clients‘ success through innovative processes and business models

- **Clients**
  19 of the DAX-30-companies and SMEs, more than 1.000 client projects since 1995

- **Execution**
  from the initial concept to the successful execution

- **Locations**
  8 branch offices in Germany, 6 international branch offices, project sites throughout the world

- **Heinz Nixdorf Institute**
  strong ties to science and research

- **Facts**
  Founded: 1995
  Employees worldwide: 210
Is the business strategy based on a vision (future draft)?

Do the processes follow a business strategy?

Are the targeted business processes defined?

Industrie 4.0
Each industrial revolution caused an improvement in productivity and was accompanied by fundamental changes in society.
Industrie 4.0 helps us to control variances, to reduce complexity and to make manufacturing processes more transparent.
The Vision of Industrie 4.0

- **Individualization** (batch size 1) of the economic conditions of a mass manufacturer becomes reality.

- Production is **highly flexible**, highly productive (up to +50%) and urban friendly, resource-friendly (up to -50%).

- Value creation processes are optimized in **real time demand**: education ad-hoc virtual organizations.

- **Reconciliation of work and family** with regard to the individual availability of employees.

- Older workers benefit from **intelligent assistance systems**.

- The existing infrastructure can be **upgraded step by step**.

A high wage economy competitiveness is secured. Made in Germany.

Source: Kagermann, 2013
1.7% Additional Growth each Year through Industrie 4.0

Gross value added 2013 of selected industries in Germany (billion €)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Value 2013</th>
<th>Value 2025*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals</td>
<td>40.1</td>
<td>52.1</td>
</tr>
<tr>
<td>Automobiles &amp; Parts</td>
<td>74.0</td>
<td>88.8</td>
</tr>
<tr>
<td>Engineering</td>
<td>76.8</td>
<td>99.8</td>
</tr>
<tr>
<td>Electrical equipment</td>
<td>40.3</td>
<td>52.4</td>
</tr>
<tr>
<td>Agriculture and forestry</td>
<td>18.6</td>
<td>21.3</td>
</tr>
<tr>
<td>ICT-Industry</td>
<td>93.7</td>
<td>107.7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>343.3</strong></td>
<td><strong>422.1</strong></td>
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*Prediction

Industrie 4.0 is a vision of the future, which begins today. Almost all major economies have launched several initiatives in order to use the digitization of traditional industry for a competitive advantage in the world market.

Source: Fraunhofer IAO/BITKOM
“Industrie 4.0” Understanding
Evolution and Categorization

Source: German Research Union And acatech, 2013
It not only concerns production, but also the digitalization and networking of all environments. New risks as well opportunities as are created for all participants!

Source: Forschungsunion, 2012; Nokia 2016
Key Questions:

- What level of development have leading industrial nations attained?
- What framework conditions must exist in order for Germany to become a leading market?
- Where are the markets for the German leading provider industry and what do they require?
- What competitors will the German supplier industry encounter?
- How does the supplier industry need to develop in order to be successful in future markets?
- How does this affect work organization and structure? Is Industrie 4.0 accepted by relevant stakeholders?
- What kind of dedicated Business Models based on Industrie 4.0 principles evolve?
Digitalization in Production is a Global Trend
Feasible Scenarios per Country

1. Reindustrialization makes the USA a leading market and a leading Industrie 4.0 provider
2. Expansion of its dominating position in the area of Smart Services
3. The USA falls behind in terms of high quality industrial connectivity

Source: INBENZHAP, International Benchmarks, Future Options and Recommendations for Action in Production Research
<table>
<thead>
<tr>
<th>TECHNOLOGY-CULT</th>
<th>„Problems, give us problems“</th>
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<tbody>
<tr>
<td></td>
<td>- Technicians, not sales people dictate decisions in Silicon Valley</td>
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<tr>
<td></td>
<td>- Difficult tasks will be taken on.</td>
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<tr>
<td></td>
<td>- The greater the challenge, the better</td>
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<tr>
<td></td>
<td>- What appears to be hopeless is often the most profitable</td>
</tr>
<tr>
<td></td>
<td>- Wealth is more likely to be created by chance</td>
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<table>
<thead>
<tr>
<th>UNLIMITED INNOVATION</th>
<th>„No one is safe from constant attacks from below“</th>
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<tbody>
<tr>
<td></td>
<td>„Disruptive Innovation“ is the magic formula. Silicon Valley is a master at recognizing weaknesses in the business models of well established companies. It attacks aggressively and is often victorious.</td>
</tr>
<tr>
<td></td>
<td>„If someone wants to eat your food, be sure that it is you.“</td>
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<tr>
<td></td>
<td>Gilles BianRosa, CEO von Fanhattan</td>
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<th>SCALE OR LOSE</th>
<th>„From the age of platforms“</th>
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<td></td>
<td>Everything that can be, will be digitalized. In the future, automobiles, airplanes and refrigerators will be mere sheets of metal that will barely generate revenue. Winners will be the intermediaries, thanks to network effects.</td>
</tr>
<tr>
<td></td>
<td>„Information is currency in an information society.“</td>
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<td></td>
<td>Geoffrey Moore</td>
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Source: Silicon Valley, Christoph Keese, 2014, page 91
Industrie 4.0
Strategies in Countries and Regions!

Critical focus areas | Strategic direction | Recommendations for action

“ENGINEERING EXCELLENCE”
Visionary concepts that integrate technology, society and the economy

“RADICAL INNOVATION”
Internet of Things (IoT) start-ups and a renaissance in production

“SPEED”
Use of mature technologies to develop strategic key technologies
Overcoming the Bridging Challenges with Office Work 4.0
The Dual Management System for Aligning Employees with Organization

INDUSTRIE 4.0
- Corporate Management Level
- Operational Management Level
- Process Management Level
- Control Level
- Field Level

OFFICE WORK 4.0

DOING
CREATING

ROLE OF THE EMPLOYEE IN VALUE CREATION

Source: Technology Management Gruppe
Overcoming the Bridging Challenges with Office Work 4.0
The Dual Management System for Aligning Employees with Organization

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**OFFICE WORK 4.0**

**Innovators | 10-15%**
- Suppliers
- Corporate Strategy
- R&D

**Marketing & Sales**
- Producers
- Consumers

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**INDUSTRIE 4.0**

**Stabilizers | 20-30%**
- Monitor
- Operative business processes
- Highly automated

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**Role of the Employee in Value Creation**

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**Chaos Organization**

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**Controlled**
- Integrators 55-70%
  - Broker

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**Integrated**
- Suppliers
- Corporate Strategy
- R&D
- Marketing & Sales
- Producers
- Consumers

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Source: Technology Management Gruppe
Development of Business Models
Technology Area: Shop Floor/Core Business

- Real time KPI's on enterprise level
- Customer specific configuration of products
- Horizontal Integration
- Smart Sourcing
- Smart Planning
- Smart Distribution

SHOP FLOOR/ CORE BUSINESS
- Location bound
- Manufacturing/Production
Development of Business Models
Technology Area: Company

- Real time KPI's on enterprise level
- Customer specific configuration of products

COMPANY

- View of the entire company
- Spans all locations
- Across all functional areas
Development of Business Models
Technology Area: Open Company

- Real time KPI's on enterprise level
- Customer specific configuration of products

3 OPEN COMPANY
- Company-wide and cross-sector
- Overall added value
- Involvement of all stakeholders
Development of Business Models
Technology Areas

Real time KPI’s on enterprise level
Customer specific configuration of products

1. SHOP FLOOR/CORE BUSINESS
2. COMPANY
3. OPEN COMPANY
Digitalization and Development of Business Models
Action Areas for Companies

Smart Services, Smart Products:
Develop new **business models** to generate revenue and services that do not yet exist.

Smart Factory, Plant, Production:
Increase productivity by driving the level of automation and IT expansion (**digitalization**).

Shopfloor Operating Technologies (OT)

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<th>Control Level</th>
<th>Operator Level</th>
<th>Field Level</th>
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<td>Machines</td>
<td>Things</td>
<td>...</td>
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Business IT (Office Systems)

- ERP
- PDM
- MES

Interfaces & Interpreter

Big Data
Analytics
Cloud
Services
On the way to Industrie 4.0 there are 6 levels of maturity. More advanced companies have a higher capability to create value!
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**Trend Setters on the Way to Industrie 4.0**
Machinery and Plant Engineering

**INDUSTRIE 4.0 – MILESTONES**

**KOLBUS GMBH & CO. KG**
- Use of augmented reality in the assembly of complex clamping systems
- Virtual template – immediate comparison of the real image with the 3D CAD model
- Color coding when fitted incorrectly
- Fast training of new assembly processes

**SIEMENS AG**
- Independent control of parts throughout the factory
- Communication at every work station and retrieval of processing operations
- Realization of multi-variant production capabilities

**DMG MORI SEIKI AG**
- Innovative machine operating concept: continuous and digitalized management, documentation and visualization of order, process and machine data
- Networked with ERP and MES systems as well as CAD-CAM applications

**WEIDMÜLLER INTERFACE GMBH & CO. KG**
- Self-correcting machines in production
- Integration of measurement technology
- Self-correcting algorithms for intelligent controls enable continuous fulfillment of product requirements
Concepts and technologies (based on IoT Analytics)

**Big Data (Analytics)**
Collect, analyze, process data

**Cloud (Computing)**
Global real-time provision of data, applications and infrastructure

**Internet (as we know it)**

**Internet of Everything (IoE)**
Global concept of encompassing connectivity of objects, processes and humans

**Internet of Things (IoT)**
Interaction of all physical objects and devices in open and closed networks mainly based on sensors and actuators.

**M2M (Communication)**
Machine-to-Machine communication with direct exchange of information between multiple devices and objects in a closed system

**Industrial Internet**
Specific concept for IoT applications for industrial equipment in Smart Factories

**Concepts and Technologies (based on IoT Analytics)**

**WORLD**

**USER**

**OBJECTS**

**MACHINES**

**IT**

**OT**

**Virtual**

**Physical**

**Digitalization**

**Trends & Concepts**

**Technologies**

**Scenarios**

**Drivers**

**Industrie 4.0**

**Farming 4.0**

**Connected Car**
Computerization of traditional industries beyond IT – additional technologies like 3D printing and augmented reality
Reference Architectures for Industrie 4.0
Current Architectures and Models

CPS WITH DISTRIBUTED SERVICES

CENTRAL CONNECTIONS BETWEEN OFFICE FLOOR AND SHOP FLOOR

“SINGLE-SOURCE“ SOFTWARE DEVELOPMENT

MES AS A CENTRAL PLATFORM

OPEN BASIC CONCEPT OF THE IOT PLATFORM

REFERENCE ARCHITECTURAL MODEL INDUSTRIE 4.0
INDUSTRIE 4.0-CAPABLE MES-SYSTEM

- Integrated networking of all equipment and systems involved in production
- Autonomous/customized rough plan and detailed order scheduling considering delivery times, capacity and resources
- Provision of all production information at required locations
- Complete transparency of orders, capacity and resources

Break-Even-Point

€0 – €2.000.000 – €4.000.000 – €6.000.000

Source: Maschinenfabrik Reinhausen GmbH, 2010
UNIVERSAL MACHINES

- Complete machining of up to four different processes on one machine
- Operator guidance during order planning and set-up
- Integrated management, documentation and visualization of all data including tools and material management
- Innovative machining operations: Kinematics testing and correction, laser measurements, dynamic workspace monitoring etc.

Break-Even-Point

€0
€2,000,000
€4,000,000


Source: DMG Mori Seiki AG, Universalbearbeitungszentren
DIGITAL MAINTENANCE SERVICE

- Rapid elimination of machine downtimes
- Real-time sharing of image, audio and video files with Technical Support
- Editing of images and supplementing it with additional information

Source: Trumpf GmbH & Co. KG, Digitaler Instandhaltungsservice
DATA GLASSES (AUGMENTED REALITY)

- Data glasses assist employees when dealing with multi-variants and manual assembly processes.
- Part specific assembly instructions appear after automated identification.
- Recognition of movement, assistance in individual steps.
- Notification of correction when an error occurs.
- Documentation of work processes.

Source: VW
MILKRUN 4.0

- Control of “Milkrunners” by software
- Intelligent scheduling algorithm for calculating the optimal travel times
- Demand detection in real-time and accurate virtual image of material supply and parts
- Consumption-based supplies on the machine

Source: share.sew-eurodrive.de
AUTONOMOUS WAREHOUSE SYSTEMS

- Product storage and retrieval by autonomous systems
- Managing storage processes using intelligent software
- Real-time monitoring
- Commissioning support through assistance systems

Source: www.techbriefs.com
Anyone dismissing this development as temporary hype is in danger of ending up just like Quelle or Karstadt: these trading companies did not take the use of internet within their business seriously meaning that the new players in this sector are now eBay, Amazon, and Zalando. This is a mistake which should not be repeated in the manufacturing industries.

The two key action areas for companies are digitization, i.e. an increased degree of automation to boost productivity, and the development of new business models to generate services and sales.