Industrie 4.0 – What can the UK learn from Germany’s manufacturing strategy?
4 February 2014
How Industrie 4.0 Will Coin the Economy of the Future. The Results of the German High-Tech Strategy’s Strategic Initiative Industrie 4.0

Prof Dr Henning Kagermann

Royal Academy of Engineering
London, 4th February 2014
The High-Tech Strategy (HTS) and National IT-Summit cornerstones of the German Innovation Policy

<table>
<thead>
<tr>
<th>High-Tech Strategy (HTS)</th>
<th>German National IT-Summit</th>
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<tbody>
<tr>
<td>published in 2006</td>
<td>established in 2006 to bundle all ICT-forces in Germany</td>
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<tr>
<td>set new priorities and create lead markets</td>
<td>6 working groups, each chaired by a Minister and a CEO</td>
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<td>build bridges between industry and science</td>
<td>annual event with a keynote by the Chancellor</td>
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<td>improved framework for innovation in industry</td>
<td>3 ICT-Lighthouse projects: Internet of Things, Internet of Services, E-Energy</td>
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Industry-Science Research Alliance (Forschungsunion)
a key instrument of the High-Tech Strategy

For the following priority areas…

- climate/energy
- health/food
- mobility
- communication
- security

…the Promoters Groups

- develop strategic initiatives (2009 – 2013),
- identify innovation drivers and obstacles,
- establish research requirements,
- draw up road maps and
- highlight areas requiring action.
## Action Plan of the Federal Government

### 10 strategic initiatives selected

<table>
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<tr>
<th>Health &amp; Nutrition</th>
<th>Climate &amp; Energy</th>
<th>Mobility</th>
<th>Communication</th>
<th>Security</th>
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<tbody>
<tr>
<td>individualised medicine</td>
<td>climate adapted cities</td>
<td>sustainable mobility</td>
<td>industry 4.0</td>
<td>protection of communication networks</td>
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<tr>
<td>optimised diet</td>
<td>intelligent energy supply</td>
<td></td>
<td>smart services</td>
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<td>society of longer life</td>
<td>renewable resources as an alternative to oil</td>
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</table>
Their Selection Was Guided by the Following Principles

1) focus on **social challenges** and key information and communication **technology trends**.
2) focus on consistent **delivery** of market success and on Germany’s key industries.

**strategic initiative “Industrie 4.0”**
ICT-enabled convergence of technological and business processes will usher in a **new era** for **German industry**.

**strategic initiative “internet-based services for business”**
Deployment of **secure cloud infrastructures** and the provision of new service platforms will pave the way for the **internet economy in Germany**.

Source: Industry-Science Research Alliance
Social Challenges

- "value for business and society"
- all civil groups, especially NGO's, trade unions
Technology Trends

Internet of Things

- IP capability

Cyber-Physical Systems (CPS)

- networked with the Internet
- networked with each other (M2M)
  - wireless communication
  - semantic description

Embedded Systems

- sensors, actuators
- integration of high-performance microcomputers

physical objects, devices, …

Internet of Data and Services

Big Data
Cloud Computing
Smart Devices

1 user, several computers

Data Warehouses
Internet
PC

1 user, 1 computer

Mainframe

Several users, 1 computer
Platform of Collaboration

- **report** by promoter group communication
  - 2011

- **working group Industrie 4.0**
  (coordinated by acatech and Bosch)
  - 2012

- public presentation of Industrie 4.0
  - 2012

- handover **recommendations** for implementing to Federal Government
  - 2013

- **foundation** of Plattform Industrie 4.0
Working Group Industrie 4.0
16 companies, 10 institutes, 2 trade unions, 4 trade associations

Coordination: Siegfried Dais (Robert Bosch), Henning Kagermann (acatech)

WG 1: Smart Factory
Wittenstein, Trumpf, Daimler, VDMA, ZVEI, TUM, Fraunhofer IPA, wbk, KIT

WG 2: Real Environment
Siemens, Deutsche Telekom, ABB, Deutsche Post, RWTH Aachen, KIT, DGB

WG 3: Economic Environment
SAP, ABB, Hewlett-Packard, Software AG, IDS Scheer, BDI, BIBA Universität Bremen

WG 4: Human Beings & Work
BMW, Festo, ZVEI, VDMA, DFKI, TU Darmstadt, DGB

WG 5: Technology Factor
Robert Bosch, Infineon, Bitkom, TU München, Universität Oldenburg, Universität Bremen
Handover of the Final Report

Federal Chancellor Merkel and the Russia’s President Putin received the Final Report at the Hannover Messe 2013.
Industrie 1.0 to Industrie 4.0

- **networking** of human beings and smart objects
- **convergence** of the physical world and virtual world
- **collaboration**

1. **industrial revolution**
   - End of 18th century
   - Introduction of water- and steam-powered mechanical manufacturing

2. **industrial revolution**
   - Start of 20th century
   - Introduction of electrically-powered mass production based on the division of labour

3. **industrial revolution**
   - Start of 1970s
   - Use of electronics and IT to achieve further automation of manufacturing

4. **industrial revolution**
   - Today
   - Based on Cyber-Physical Systems

- First mechanical loom, Cincinnati slaughterhouses 1870
- First production line, Modicon 084 1969

Source: DFKI 2011
Vision for Industrie 4.0

- **individualization** (batch sizes of 1) at mass production prices will become a reality
- manufacturing will be **highly flexible**, extremely productive (up to +50%), will use fewer resources (up to -50%) and will be compatible with an urban environment
- **dynamic design** of business and engineering processes
- **work-life balance** taking account of availability of individual workers
- older employees supported by **smart assistance systems**
- existing infrastructure can be **upgraded gradually**

→ a high-wage economy that is still competitive
Industrie 4.0 Marks a Fundamental Paradigm Shift…

- from centralised control to decentralised self-organisation: ad hoc networking
  - from traditional value chains to virtual ad hoc organisation
  - from passive, pre-planned operation of manufacturing systems to active, autonomous, self-organising production units
- smart products actively support the manufacturing process
- human beings set the pace of production
- from rigid work patterns to flexible deployment of workforce (availability calendars and expertise catalogues)

→ convergence of industries
...and Enables New, Internet-Based Services and Business Models

- All the units in a manufacturing network make their capabilities and data available as semantically described services (Cloud Services).

- Secure and trusted cloud infrastructures (Trusted Cloud) form the basis of an Internet of services and data.

- Semantic technology enables these basic services to be marketed, expanded and combined to create value-added services.

- Smart products, services and know-how are bundled to provide solutions that meet customers’ individual needs, creating new, innovative business models.

→ Industrie 4.0 will only deliver its full potential if it is combined with new business models and internet-based services.
Human Beings at the Centre
more opportunities to engage and take decisions

- fewer of workers involved directly in production, more **indirect jobs**
- interactive, interdisciplinary working environment
- highly **changing content** for employees
- shortened time for instruction and learning

→ fewer "blue-collar workers", more **decision makers** and **experienced employees**
→ fewer strict job instructions, **more self-organisation**
→ **lifelong learning; temporal and contentual flexibility**
Support by Different Assistance
example: navigation with 3D-Models

- **physical assistance** from skills augmentation systems
- **connected work** by multimodal human-machine and human-human interaction
- **innovative learning systems**: personalised, mobil, …

Source: W. Wahlster, DFKI
Industrie 4.0 as Part of a Smart, Networked World

- As a key component of Industrie 4.0, the smart factory brings the Internet of Things and Services to the manufacturing environment.
- In smart factories, humans, machines and resources communicate with each other as naturally as in a social network.
- Its interfaces with smart logistics and smart grids will make it a key component of future smart infrastructures.
Real and Virtual Environments Closely Integrated

Cyber-Physical Systems (CPS)

- "real world awareness"

high-resolution control

- more accurate information for supply chain

→ high-frequency data capture get cheaper and more available: big data

Source: W. Wahlster, DFKI
The Dual Strategy: Becoming a Leading Market and Supplier

→ In order to bring about the shift from industrial production to Industrie 4.0, Germany needs to adopt a dual strategy.

Implementation of Industrie 4.0 will focus on the following overarching aspects:

- horizontal integration through value networks
- end-to-end digital integration of engineering across the entire value chain
- vertical integration and networked manufacturing systems
- new social infrastructures in the workplace
- Cyber-Physical Systems technology
Organisation of the National Platform Industrie 4.0
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strategic initiative "Industrie 4.0"

ICT-enabled convergence of technological and business processes will usher in a new era for German industry.

strategic initiative “internet-based services for business”

Deployment of secure cloud infrastructures and the provision of new service platforms will pave the way for the Internet economy in Germany.

Source: Industry-Science Research Alliance
"Smart Services" (Second Strategic Initiative)
10 trade associations, 3 unions, 50 companies and 30 institutes

Coordination: Frank Riemensperger (Accenture), Henning Kagermann (acatech)

WG 1: Integrated Innovation in Production and Services
- SIEMENS
- ThyssenKrupp
- BOSCH
- TRUMPF
- Urban Software Institute GmbH
- SAP

WG 2: Internet- and Service Economy (WT)
- DAIMLER
- idalab
- Deutsche Post
- Zalando
- enova
- smava
- Beuth
- AGIV
- Boehringer Ingelheim
- PS-Team
- Vodafone
- Fresenius Medical Care
- Metro Group

WG 3: Enabling Technologies
- EMPOLIS
- T-Systems
- Sirrix AG
- neofonie
- Allianz

WG 4: Requirements for Company Organisations
- 4tune strategies
- Allianz

WG 5: General Conditions
- Lufthansa
- Miele
- RWE
- accenture
- TÜV
- EWE
- AOK
- spending
- Google
- Microsoft
- HP

Future of Manufacturing and Industrie 4.0, 4th February 2014
New Internet-Based Services and Business Models

- Supplier
- "Smart Factory"
- "Smart Services"
- "Smart Products"
- "Big Data Systems"
- "Smart Data"
- Trusted cloud-based networks

- Optimization: product, process, supply chain
- Visualization, MMI
- Intelligence flows back
- Decision support
- Extraction and storage of data
- Realtime data analysis and data fusion
- New insight
- New businesses
Next Steps

- Both strategic initiatives (Industrie 4.0, "Smart Services") are mentioned in the coalition agreement.

- "Smart Services": hand over initial recommendations to Federal Chancellor at CeBIT in Hannover.

- 16 thesis published by the scientific advisory committee.

- Forum Industrial IT organised by BITKOM, VDMA, ZVEI.
Thank You for Your Attention
Chair:
Professor Sir Mike Gregory CBE FREng
Head – Institute for Manufacturing, University of Cambridge

Panel:
Professor Henning Kagermann
President – acatech

Dr Peter Fitzgerald CBE FREng
Managing Director – Randox Laboratories

Bob Joyce FREng
Executive Director, Product Creation and Delivery – Jaguar Land Rover

Neil Mantle
Manufacturing technology Executive – Rolls Royce plc

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