Global Organisational Excellence Congress
A roadmap for excellence in organisational performance & nation building

Industrie 4.0
Introduction – Status – Outlook

Fraunhofer-Institute for Production Systems and Design Technology (IPK) Berlin

Prof. Dr.-Ing. Holger Kohl
Vice-Director
Director Division Corporate Management
holger.kohl@ipk.fraunhofer.de
The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.

Our Customers:
- Industry
- Service sector
- Public administration
The Fraunhofer-Gesellschaft at a Glance

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society.

25,500 staff

72 institutes and research units

Finance volume Contract Research 2017

- €2.5 billion
- €2.3 billion
- Major infrastructure capital expenditure and defense research
- Almost 30% is contributed by the German federal and Länder Governments
- More than 70% is derived from contracts with industry and from publicly financed research projects.
Intellectual Property Rights of Fraunhofer

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td>Active patent families *</td>
<td>5657</td>
<td>6103</td>
<td>6407</td>
<td>6618</td>
<td>6573</td>
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<td>Invention disclosures reports p.a.</td>
<td>671</td>
<td>696</td>
<td>733</td>
<td>831</td>
<td>670</td>
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<tr>
<td>Patent applications p.a.</td>
<td>500</td>
<td>499</td>
<td>603</td>
<td>563</td>
<td>506</td>
</tr>
</tbody>
</table>

* Portfolio of active rights (patents and utility models) and patent applications at year end.

2014: Fraunhofer was

Nr. 15 of the most active **patent applicants** and

Nr. 6 of the most active **trade mark applicants**

at the German Patent and Trade Mark Office

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2015: Fraunhofer was

Nr. 55 of the most active **patent applicants**

at the European Patent and Trade Mark Office

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2015: according to international media and information firm Thomson Reuters, Fraunhofer is one of the »**Top 100 Global Innovators**«

(only 3 German companies made it into TOP 100)
Fraunhofer worldwide
PTZ BERLIN
Two Institutes - One Roof

Application-oriented research

Fundamental research
Increasing Complexity leads to new Value Chains

"People can have the Model T in any colour – so long as it's black."
Henry Ford (1913)

1850

1913

1955

1980

2000

Mass Manufacturing

Customer individual Mass Manufacturing

Manual Manufacturing

Globalization

Regionalization

Personalization

Complexity

Production Output per Variant

Product Variety

z. B. BMW Online Car Configurator

z. B. Global Process-management at KSB

z. B. Additive Manufacturing

Fraunhofer IPK

Institute for Production Engineering and Factory Technology
Technische Universität Berlin
On the Border to the 4th Industrial (R)evolution

1. Industrial Revolution
Implementation of mechanized production facilities supported by water- and steam power.
- 1769 mechanization
- 1870 division of labor and mass manufacturing

2. Industrial Revolution
Implementation of division of labor production supported by electrical energy.

3. Industrial Revolution
Use of electronics and IT for further automation in production.
- 1952 Numerical control
- 1969 Microprocessors in Production
- 2012 Cyber-physical Systems (Industrie 4.0)

Next Evolution
Digital penetration of the whole Production Chain
Basic idea and approach of Industrie 4.0:

- Implementation and use of internet of people, things, services and processes in industry, in manufacturing companies
- Ubiquitous, surrounding networking, assistance and intelligence people, machines, objects, IT-systems

Approach:

- **Horizontal integration** in value added networks
- **Vertical integration** of production and IT-systems
- Digital **consistency in engineering**
- **Decentralization** of intelligence and functions
- **Sociotechnical system design**
DIGITAL TRANSFORMATION
MARKET POTENTIAL: ENABLING TECHNOLOGIES AND PREREQUISITES

Initial Core Technologies
- Internet of Things and Services
- Tracking & Tracing
- Smart Mobile Devices
- Embedded µSystems

New Enabling Technologies
- Social Media
- Cloud Computing
- Big Data
- Wireless und NFC
DIGITAL INNOVATION
IPK ROADMAP TOWARDS INDUSTRIE 4.0

WebFactory
Connecting machine and programmable logical control to the Internet

- Virtual Human Machine Interface
- VRML based Tele Visualization
- Internet / Intranet
- Service Monitor
- Test Bench – XY Cross Table

e-Industrial Services
Platform and services for e-Maintenance

- Condition Monitoring
  - Machine Check & Status Report
- Service Book
  - Task Planning & Reporting
- Maintenance Assistance
  - prepare & execute PM tasks
- Adaptive Qualification
- e-Training
  - Maint. & Repair

Condition Monitoring
Use of control integrated data of CNC machines

- Report
  - Service Monitor
  - Condition Monitoring
  - Service Book
  - Data Recording

DIGITAL INNOVATION
IPK ROADMAP TOWARDS INDUSTRIE 4.0

**SOPRO**
Distributed Intelligence in Self-organized Production

**WeiMA**
Human-Machine Interaction

**iWePro**
Intelligent Self-organized Shop Floor Production

2009

![Image of SOPRO and WeiMA projects]

2013

![Image of iWePro project]
DIGITAL INNOVATION

IPK ROADMAP TOWARDS INDUSTRIE 4.0

**pICASSO**
Industrial Cloud-based Control Platform for a Production with Cyber Physical Systems

**MetamoFAB**
Control Cockpit for Industrie 4.0 Metamorphosis

**VIB-SHP**
Virtual Implementing with Smart Hybrid Prototyping

---

2013
DIGITAL INNOVATION
IPK ROADMAP TOWARDS INDUSTRIE 4.0

CPS based
Life Cycle Monitoring and Management Systems

AMELI 4.0
Micro Electronic Mechanical Systems based Machine-Networking

Selected Industrial Partners

Fraunhofer IPK
INSTITUTE MACHINE TOOLS AND FACTORY MANAGEMENT
TECHNISCHE UNIVERSITÄT BERLIN
SME Application - Industrie 4.0 in a suitcase
DIGITAL INNOVATION
INDUSTRY 4.0 IN A SUITCASE

- Provision of configurable Industrie 4.0 components and software for SMEs
- Easy accessible digitization solutions as generic prototype for SMEs
- Fast configuration of digital integrated production (DIP) with Cyber Physical Systems
- Application in different branches such as gas & oil, food & beverage, automotive & aerospace, manufacturing industry...
Quantitative Benefits from Energy Equipment Production

- Reduction of production resources
- Reduction of work-in-progress
- Increase of capacity utilization
- Reduction of processing time
- Increase of production output
- Reduction of production costs
- Reduction of efforts for coordination / communication
- Time savings on production planning and management

Source: SOPRO, Analysis in a Gas Turbine Plant
DIGITAL TRANSFORMATION
MARKET POTENTIAL: EXPECTED EFFECTS OF INDUSTRIE 4.0

2013
76.8
18.6
93.7
74.0
40.1

2025
99.8
21.3
107.7
88.8
52.1

1.7 % p.a.

- Mechanical Engineering (+30 %)
- Electrical Engineering (+30 %)
- Agriculture and Forestry (+15 %)
- ICT (+15 %)
- Mobility (+20 %)
- Chemical (+30 %)

Data in bn. €

Based on: Bitkom, Fraunhofer IAO: Industrie 4.0, Studie (2014).
Roland Berger – Industrie 4.0 demands higher investments

- Already today, the risks of implementing modern IT systems no longer be accepted by many medium-sized enterprise (Computerwoche 2012)

- Even regarding successful implementations, the investment costs are too high and the ROI too low for many SME – the more integrated IT becomes, the higher are expenses for interfaces and maintenance

Fraunhofer IPK – Industrie 4.0 solutions lead to:

- Lower capital intensity
- SME-adjusted solutions (Berlin Suitcase for Industrie 4.0)
- Better data and failure safety (Industrial Cloud)
DIGITAL ECONOMY
STATE AND PERSPECTIVES OF THE WORLDWIDE DEVELOPMENT

Bringing Digital Innovation to the physical World
Start-ups for the Internet of things and a renaissance of production

USA
»Radical Innovation«

Bringing excellent engineering to the digital world
Visionary concepts that integrate technology, society and the economy

Europa, Germany
»Engineering Excellence«

Pragmatic application of quick wins and long-term strategy
Use of mature technologies, strategic key technology development

China
»Speed«

Innovation through application
Solid realization of smart factories and very large manufacturers, which strengthen their products through internal demand

Japan, South Korea
»Ability to Scale«
Support of setting SGIMRI:

- Duration of the project: November 2016 to October 2021
- Construction of a learning factory for smart production
- Planning and design, construction and management of a demonstration centre
- Development of services for companies and local government authorities
- Management training and strategy development
- At the same time platform for research and consultancy for the Fraunhofer-Gesellschaft
Meeting between German Chancellor Angela Merkel and Chinese Premier Li Keqiang 13.06.2016 in Beijing
SGIMRI Service Portfolio
German Engineering Excellence meets Chinese Speed

- Demonstration Center
  - Demonstration of possibilities in the field of industry 4.0
  - Possibilities for strategical partners, to exhibit self created technologies and integrate those

- Training Center
  - Change Management Training for the top und middle-management
  - Interactive training in a industry 4.0 learning factory for operational staff

- Application Center
  - Prototype development of industry 4.0 – solutions for production
  - Fast integration of German technologies in Chinese applications
DIGITAL NETWORKING
BERLIN CENTER »DIGITAL NETWORKING«

Fraunhofer
FOKUS, HHI, IPK and IZM

Health & Medicine
Mobility & Future City
Industry & Production
Critical Infrastructures & Energy
American University of Sharjah

Plan for the development and implementation of the American University of Sharjah project for a SRTI Park (Science, Research, Technology and Innovation)

- **Duration:** 6 Monate
- **Area:** 1.7 sqkm

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<tr>
<th>Analysis &amp; Preparation Phase</th>
<th>Business Model Definition Phase</th>
<th>Operation/Financial Planning Phase</th>
<th>Implementation Planning Phase</th>
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<tbody>
<tr>
<td><strong>Objectives</strong></td>
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<tr>
<td>- Build understanding of RTI Parks research field and main technology areas</td>
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<td>- Analyze national business environment and market potential</td>
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<td>- Analyze competitors’ services &amp; value propositions</td>
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<td>- Identify main industry demand</td>
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<td>- Define RTI Parks main service areas</td>
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<td>- Focus promising market segments</td>
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<tr>
<td>- Prioritize RTI Parks future business areas</td>
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<td>- Derive product portfolio and value propositions for industry</td>
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<td>- Define general go-to-market strategy</td>
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<tr>
<td>- Derive technological requirements and competencies for future business areas</td>
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<td>- Plan human resources strategy</td>
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<td>- Analyze public-private and institutional-governmental partnerships for developing the park</td>
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<td>- First estimation of revenues, costs, investments and financing need</td>
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<td>- Analyze strengths and weaknesses according to future business model</td>
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<td>- Plan actions to implement the RTI Park</td>
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<td>- Design management structure and align RTI Parks management services</td>
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<tr>
<td>- Identify collaboration potential within the RTI Park and with potential partner organizations worldwide</td>
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</table>
10th December, 2018 – Abu Dhabi, UAE

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