10th December, 2018 – Abu Dhabi, UAE

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

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

Our Customers:

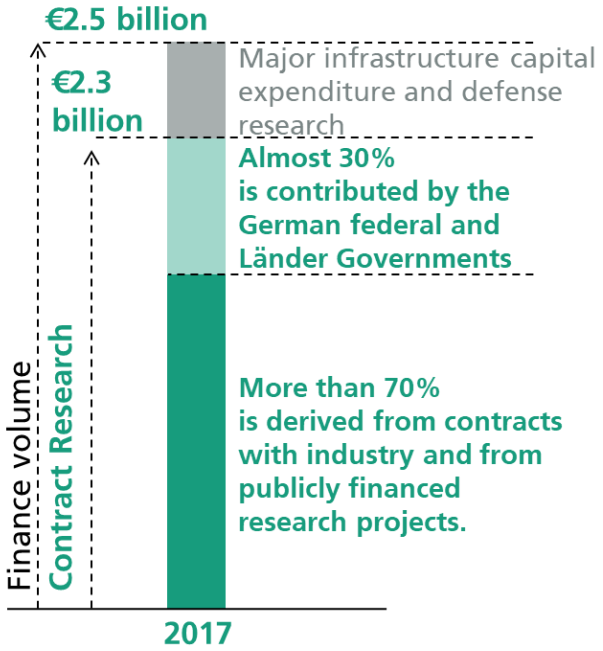
- Industry
- Service sector
- Public administration

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



Intellectual Property Rights of Fraunhofer

	2011	2012	2013	2014	2015
Active patent families *	5657	6103	6407	6618	6573
Invention disclosures reports p.a.	671	696	733	831	670
Patent applications p.a.	500	499	603	563	506

* 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

Deutsches Patent- und Markenamt

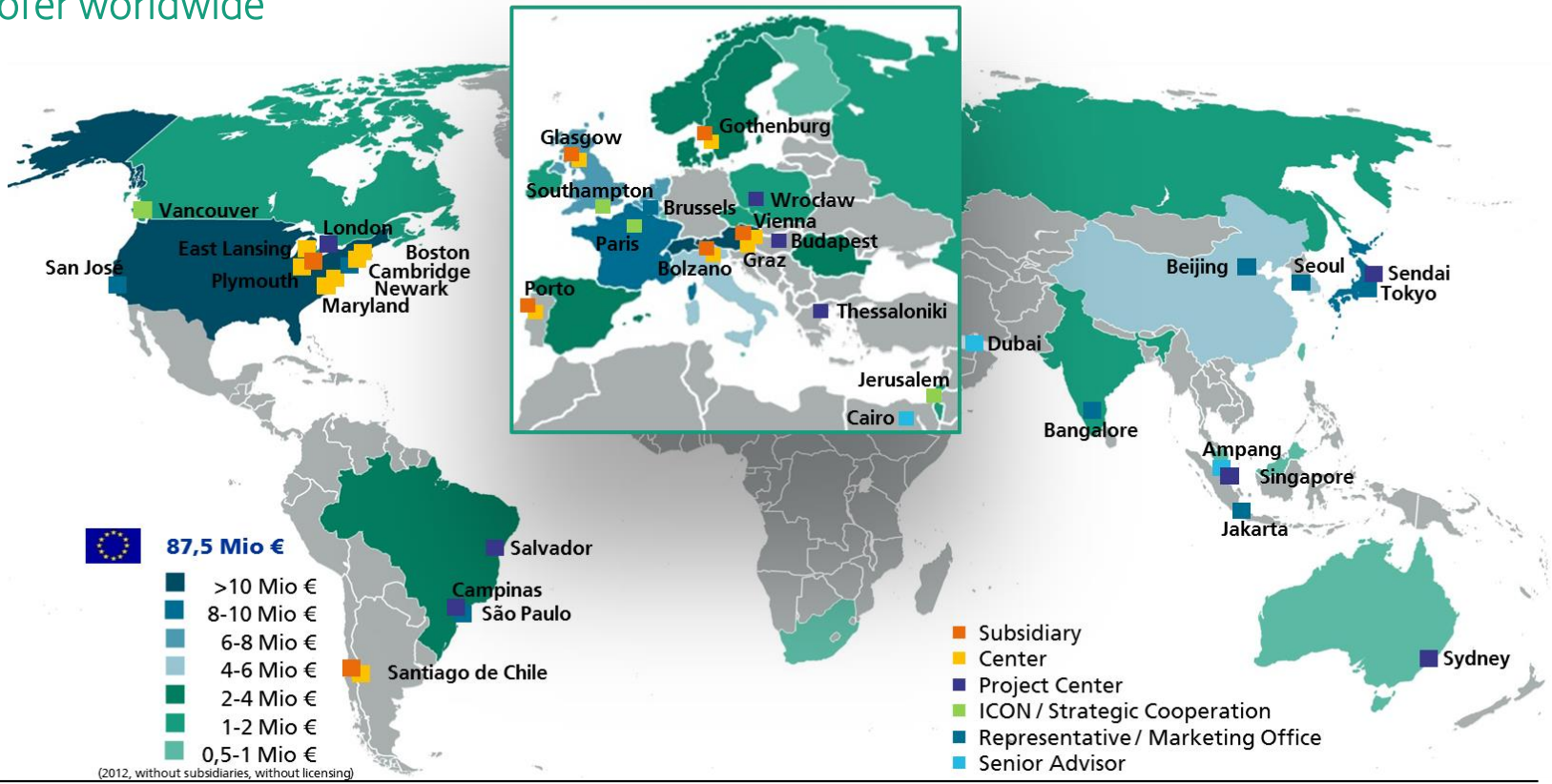
2015: Fraunhofer was
Nr. 55 of the most active **patent applicants**
at the European Patent and Trade Mark Office

Europäisches Patentamt
European Patent Office
Office européen des brevets

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)

2013 THOMSON REUTERS TOP 100 GLOBAL INNOVATORS

Fraunhofer worldwide



Fraunhofer IPK

INSTITUT
PRODUKTIONSANLAGEN UND
KONSTRUKTIONSTECHNIK

IWF

INSTITUT
WERKZEUGMASCHINEN UND FABRIKBETRIEB
TECHNISCHE UNIVERSITÄT BERLIN

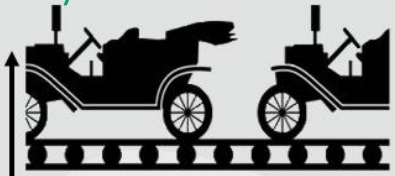
PTZ BERLIN

Two Institutes - One Roof

Application-oriented research

Fundamental research

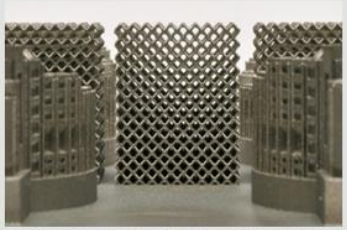
Increasing Complexity leads to new Value Chains



z. B. BMW Online Car Configurator

z. B. Global Process-management at KSB

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



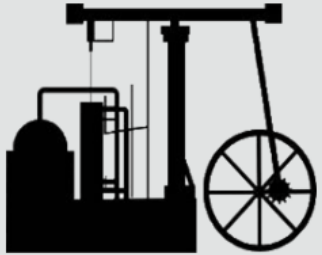
z. B. Additive Manufacturing

In Anlehnung an: The Global Manufacturing Revolution; Quellen: Ford, beetleworld.net, bmw.de, dw.de

On the Border to the 4th Industrial (R)evolution

1. Industrial Revolution

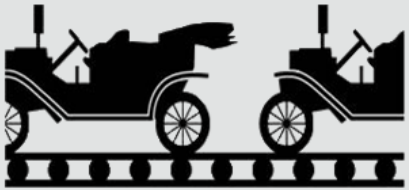
Implementation of mechanical production facilities supported by Water- and steam power.



1769
mechanization

2. Industrial Revolution

Implementation of division of labor production supported by electrical Energy



1870
division of labor and mass manufacturing

3. Industrial Revolution

Use of electronics and IT for further automation in production

1952
Numerical control

1969
Microprocessors in Production

Next Evolution

Digital penetration of the whole Production Chain

1973 - 1985
Computer Integrated Manufacturing (CIM)

2012
Cyber-physical Systems
(Industrie 4.0)

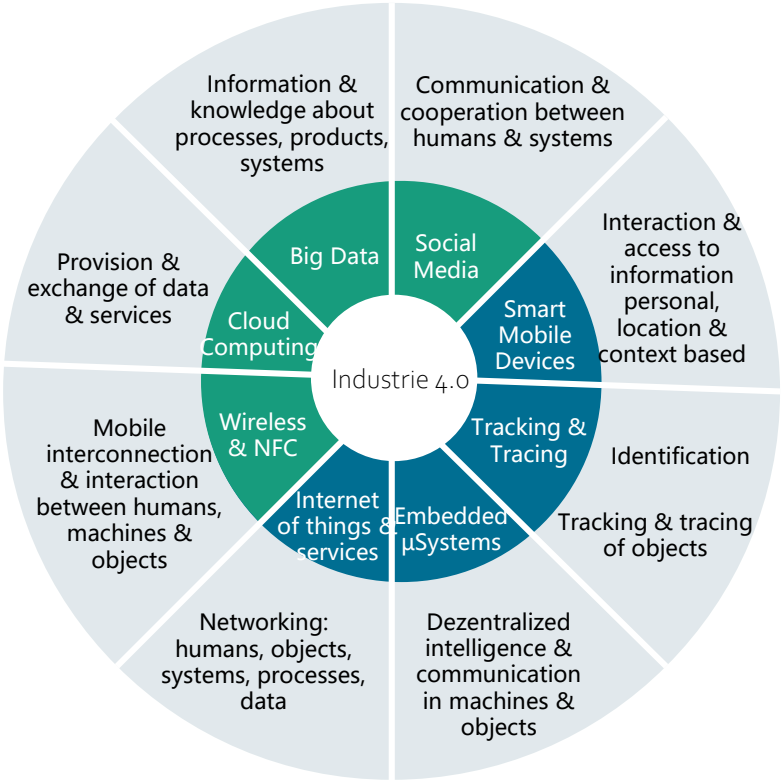
DIGITAL TRANSFORMATION
INDUSTRIE 4.0 – DEFINITION

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

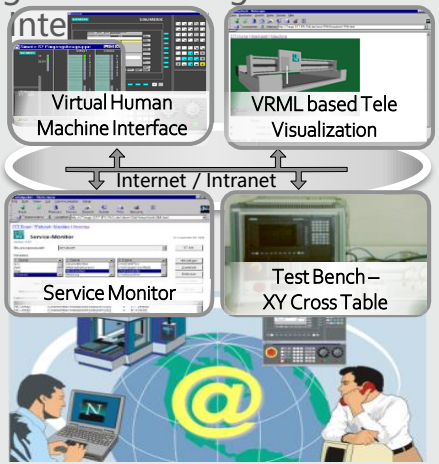
- Social Media
- Cloud Computing
- Big Data
- Wireless und NFC

DIGITAL INNOVATION

IPK ROADMAP TOWARDS INDUSTRIE 4.0

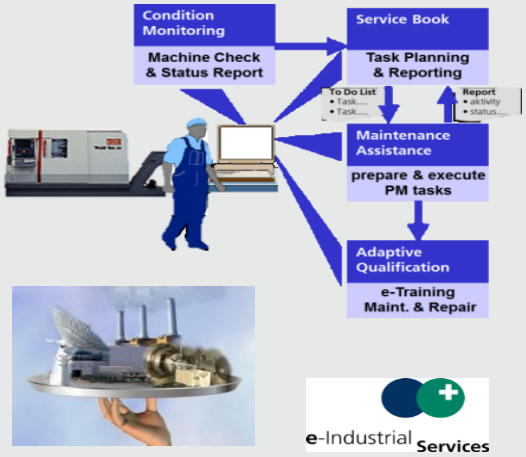
WebFactory

Connecting machine and programm-able logical control to the Inte



e-Industrial Services

Platform and services for e-Maintenance



Condition Monitoring

Use of control integrated data of CNC machines

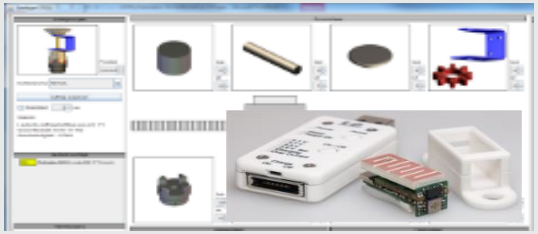
1998 — 2001 — 2007

DIGITAL INNOVATION

IPK ROADMAP TOWARDS INDUSTRIE 4.0

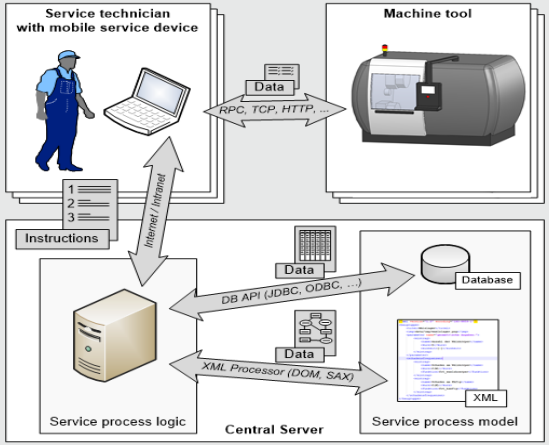
SOPRO

Distributed Intelligence in Self-organized Production



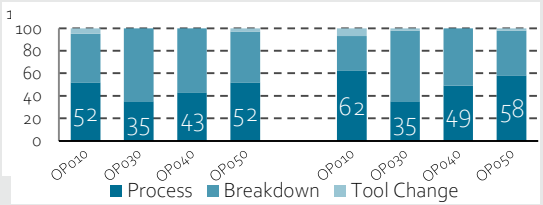
WeiMA

Human-Machine Interaction



iWePro

Intelligent Self-organized Shop Floor Production



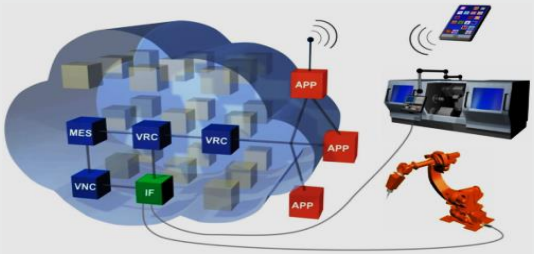
2009 — 2013

DIGITAL INNOVATION

IPK ROADMAP TOWARDS INDUSTRIE 4.0

pICASSO

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

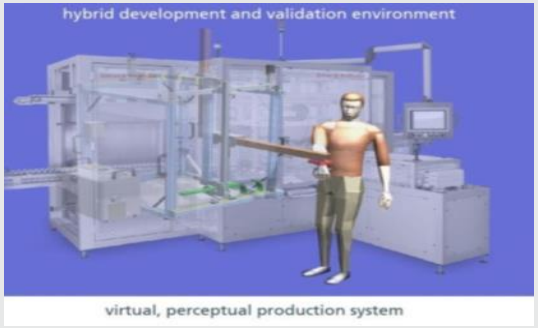


MetamoFAB

Control Cockpit for Industrie 4.0 Metamorphosis

VIB-SHP

Virtual Implementing with Smart Hybrid Prototyping



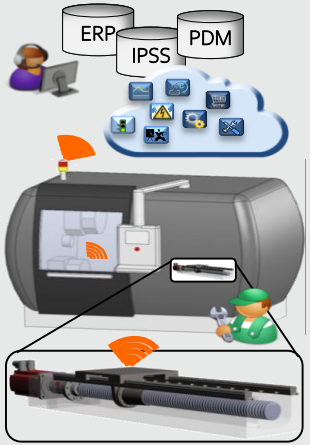
2013

DIGITAL INNOVATION

IPK ROADMAP TOWARDS INDUSTRIE 4.0

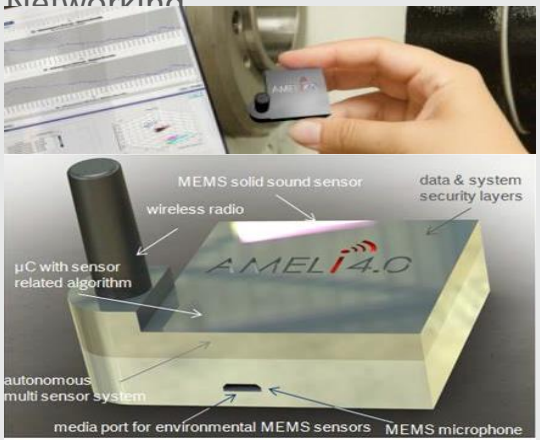
CPS **based**

Life Cycle Monitoring
and Management Systems



AMELI 4.0

Micro **E**lectronic **M**echanical
Systems based Machine-
Networking



Selected Industrial Partners

ZK simply genius
PSI PSIPENTA
STACKFORCE embedded.connectivity.solutions
SCHAUDT KÖRBER SOLUTIONS
MIKROSA KÖRBER SOLUTIONS
BOSCH
Binder
Hahn Schickard
INNOSOFT
CONTACT Software
infineon
FESTO
EDAG
OPEL
BECKHOFF

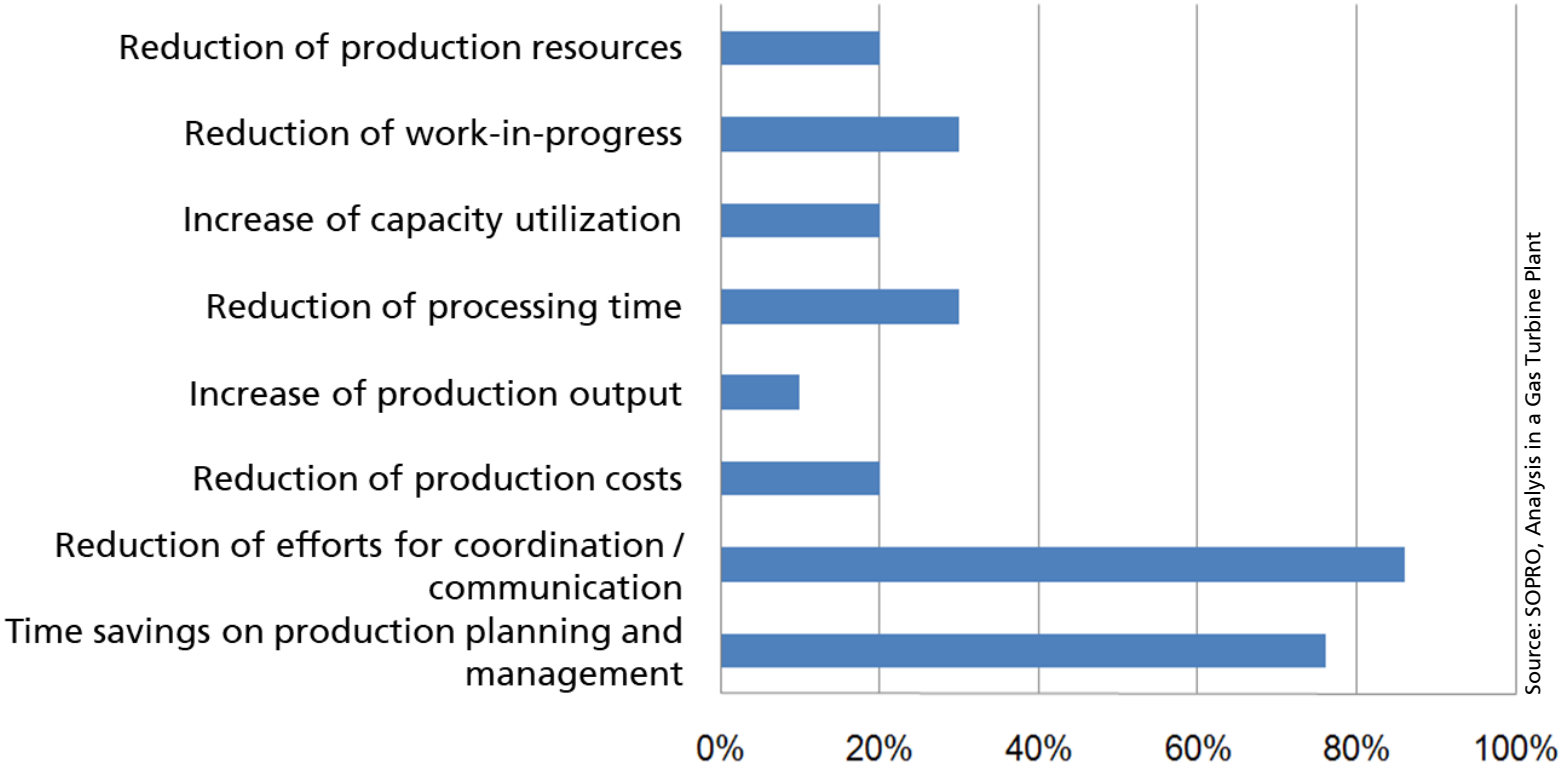
2015 → 2016

SME Application - Industrie 4.0 in a suitcase

DIGITAL INNOVATION
INDUSTRY 4.0 IN A SUITCASE

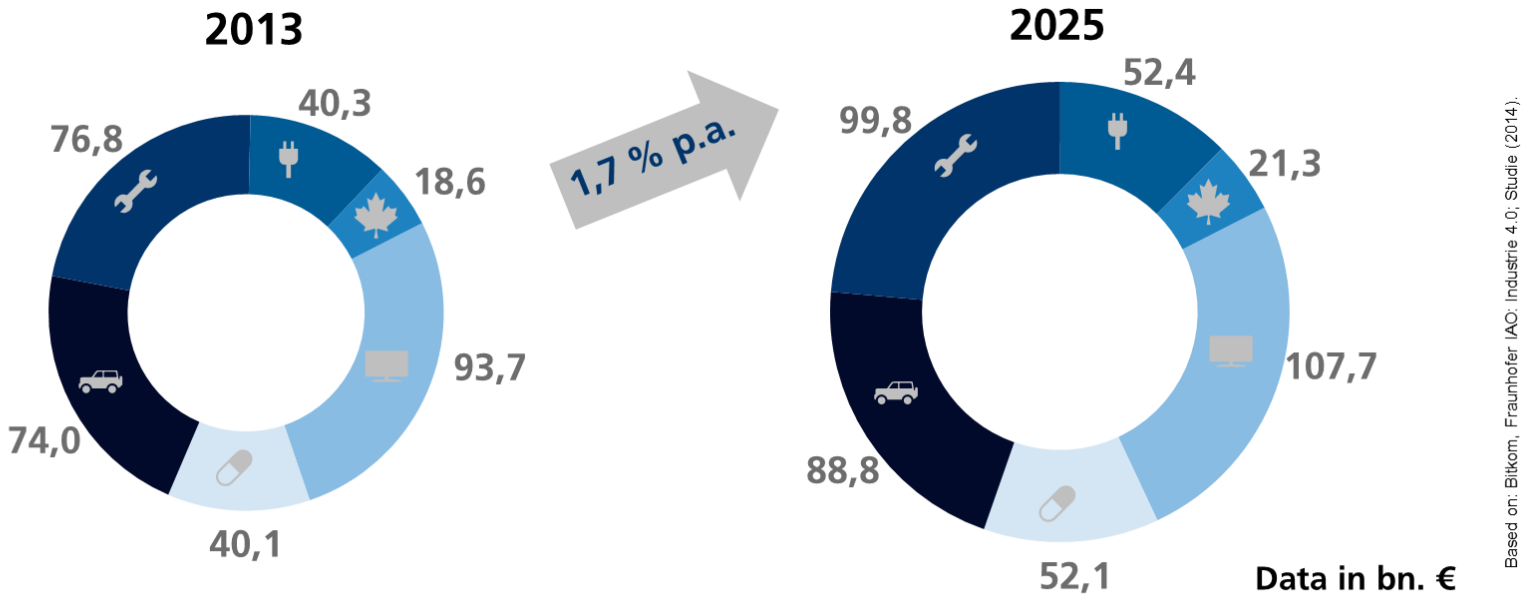
- Provision of configurable Industrie 4.0 components and software for SMEs
- Easy accessible digitization solutions as generic prototype for SMEs
- Fast configuration of digital integrated production (DIP) with Cyber Physical Systems
- Application in different branches such as gas & oil, food & beverage,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

Quantitative Benefits from Energy Equipment Production



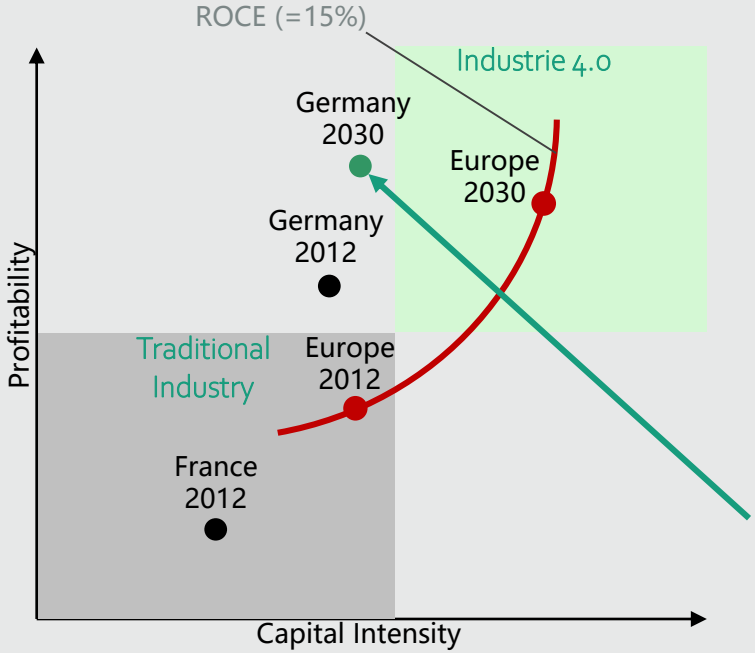
DIGITAL TRANSFORMATION

MARKET POTENTIAL: EXPECTED EFFECTS OF INDUSTRIE 4.0



DIGITAL INNOVATION

MARKET POTENTIAL: CONSEQUENCES FOR THE BUSINESS LOCATION GERMANY



Roland Berger – Industrie 4.0 demands higher investments

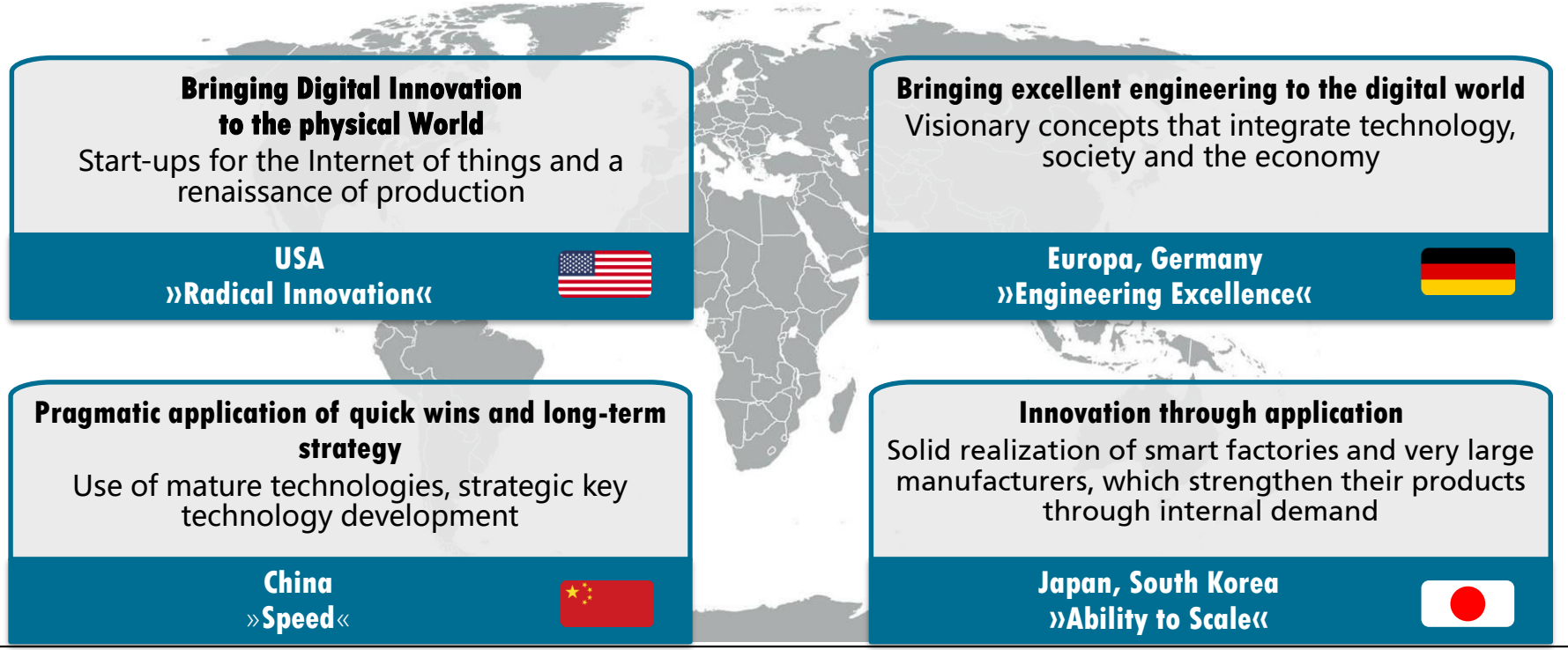
- Already today, the risks of implementing modern IT systems no longer be accepted by many medium-sized enterprise (Computerwoche 2012)
- Even regarding successful implementations, the investment costs are too high and the ROI too low for many SME – the more integrated IT becomes, the higher are expenses 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)

Based on: Roland Berger - Think Act Studie (2014).

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«

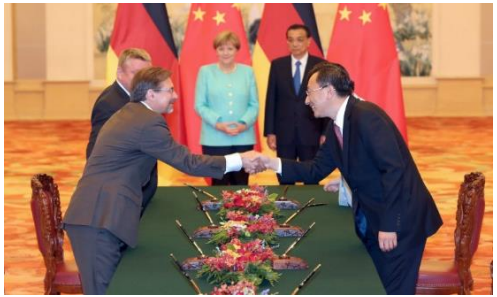
Innovation through application
Solid realization of smart factories and very large manufacturers, which strengthen their products through internal demand

Japan, South Korea
»Ability to Scale«

Quelle: IUniversität Paderborn^, WZL: ndustrie 4.0 –Internationaler Benchmark, Zukunftsoptionen und Handlungsempfehlungen für die Produktionsforschung. 2016

Sino-German Intelligent Manufacturing Research Institute (SGIMRI)

Nanjing, China



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 und strategy development
- At the same time platform for research and consultancy for the Fraunhofer-Gesellschaft

Strategic Cooperation

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

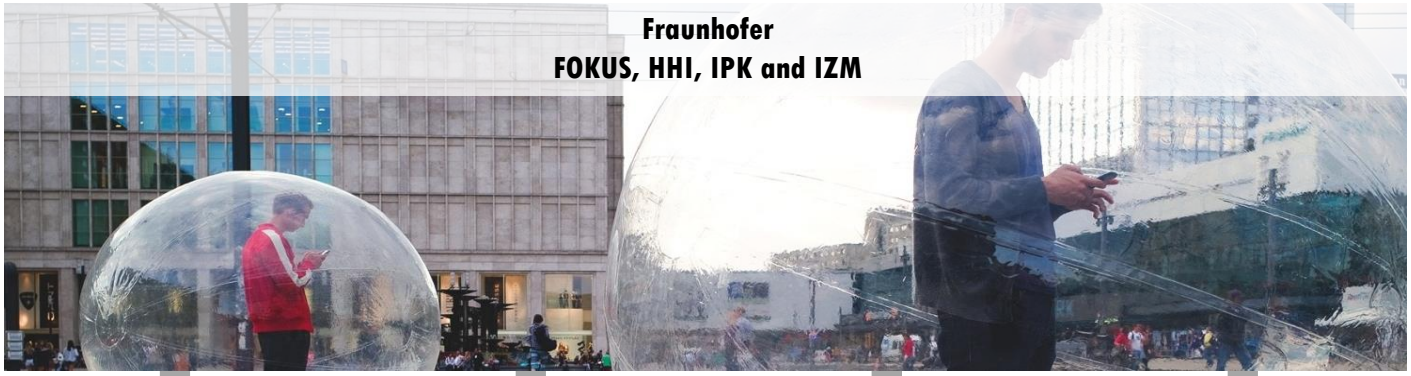
- Prototype development of industry 4.0 – solutions for production
- Fast integration of German technologies in Chinese applications

SGIMRI 中德智能制造研究院

Fraunhofer IPK
INSTITUTE PRODUCTION SYSTEMS AND DESIGN TECHNOLOGY

INSTITUTE MACHINE TOOLS AND FACTORY MANAGEMENT TECHNISCHE UNIVERSITÄT BERLIN

DIGITAL NETWORKING
BERLIN CENTER »DIGITAL NETWORKING«



Health & Medicine

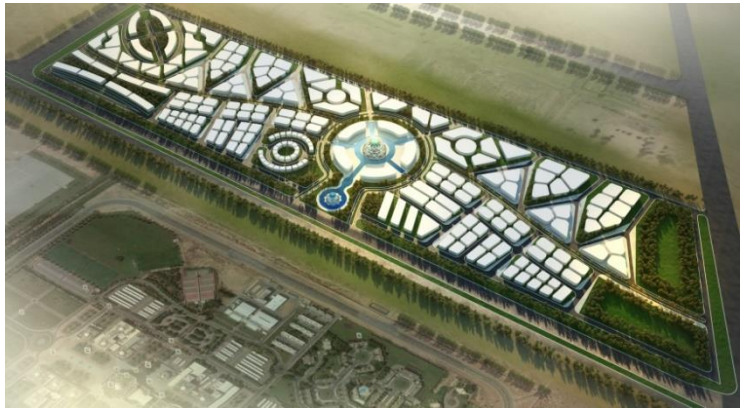
Mobility & Future City

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

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

Business Plan

Implementation Rodmap

Fraunhofer IPK
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