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# Transformation to Industry 4.0

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**Mehmet Kürümlüoğlu**

Fraunhofer Institute for Industrial Engineering IAO, Stuttgart

Istanbul, May 29<sup>th</sup>, 2015



# Fraunhofer-Gesellschaft

The largest organisation for applied research in Europe

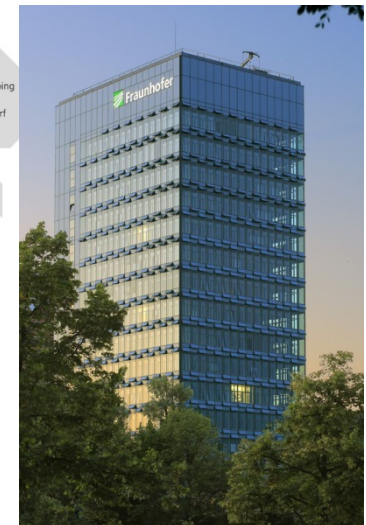
Fraunhofer-Gesellschaft zur Förderung  
der angewandten Forschung e. V.

**Staff:** approx. 24.000

**Annual  
research  
budget:** 2.1 billion euros,  
(incl. approx. 1.7 billion euros  
for contract research)

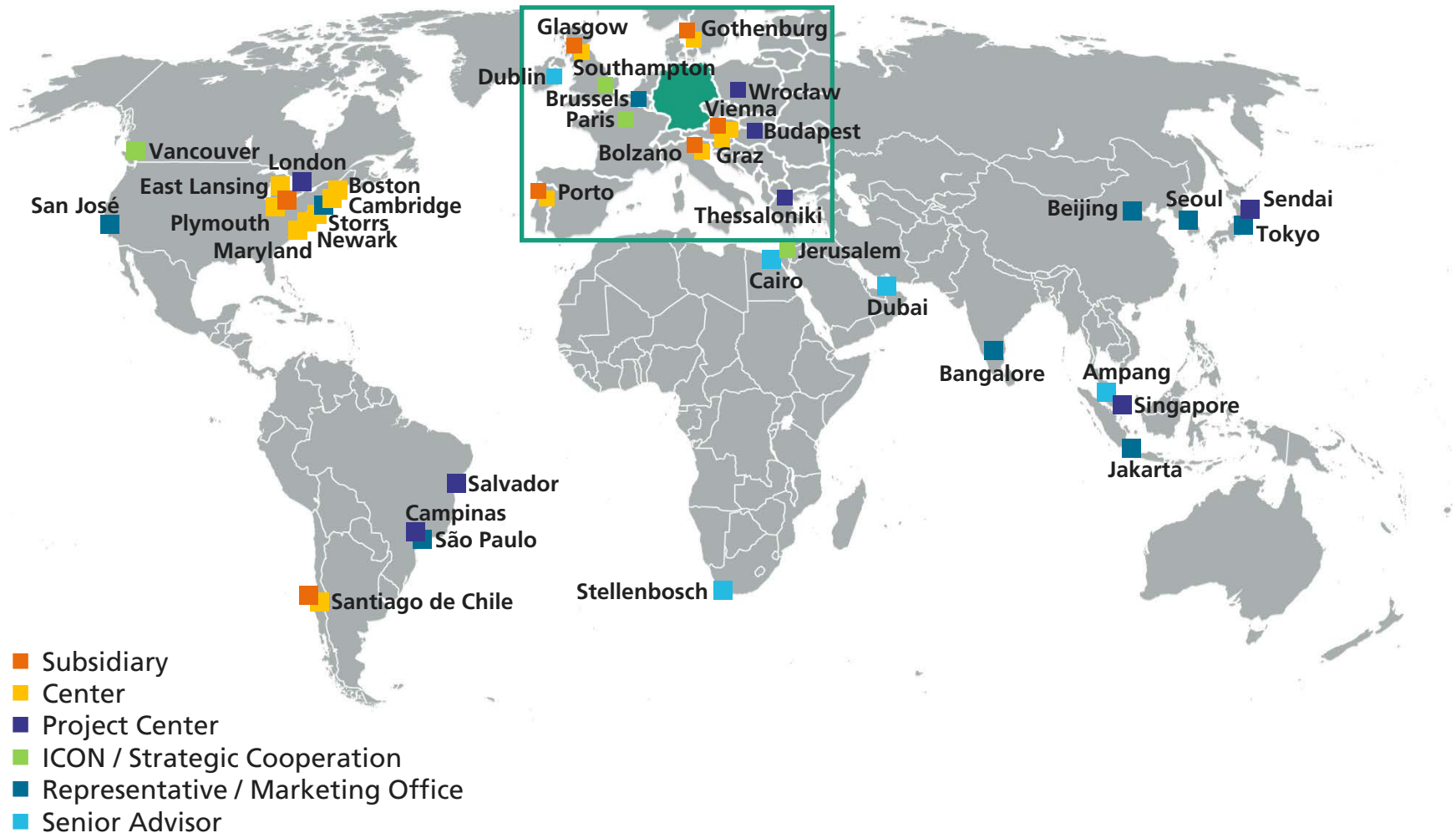
**Organization:** 80 research institutions,  
including 66 institutes  
at 40 locations

**Groups:** Information and Communication  
Technology, Light & Surfaces,  
Life Sciences, Microelectronics,  
Production, Defense and Security,  
Materials and Components



# Fraunhofer worldwide

Promoting and conducting applied research in an international context, to benefit private and public enterprise and is an asset to society as a whole



# Fraunhofer IAO and IAT University of Stuttgart



**Workplace**



**Workspace**



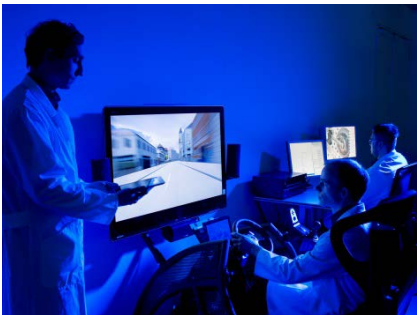
**Human-Computer-  
Interaction**



**Information  
Technology**

**Humans interacting with their living and working environments within a digitalized society and economy**

**Smart City**



**Smart Factory**



**Smart Services**



**Innovation**



[www.iao.fraunhofer.de](http://www.iao.fraunhofer.de), [www.iat.uni-stuttgart.de](http://www.iat.uni-stuttgart.de)

\* Figures from 2013, including IAT University of Stuttgart

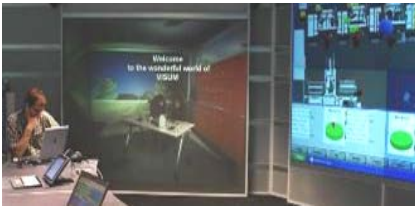




# R&D Management at Fraunhofer IAO

[www.rdm.iao.fraunhofer.de/en.html](http://www.rdm.iao.fraunhofer.de/en.html)

Organization of  
Research and  
Development



Strategic R&D  
and technology  
management



Innovative IT  
systems in the  
area of R&D



Corporate  
development for  
R&D-intensive  
enterprises



R&D processes,  
structures and  
cooperation, R&D  
efficiency and  
management of  
innovations

Detailed  
technology  
analyses, program  
planning and  
integrated R&D  
strategies

Concepts for  
“virtual product  
development”  
with integrated IT  
systems and an  
integrated  
perspective on  
processes

Identifying,  
creating and  
implementing  
development  
potentials



**Digital transformation  
is changing business  
and private life!**

# Internet of everything

## Living within the »system of systems«

### IN THE PAST:

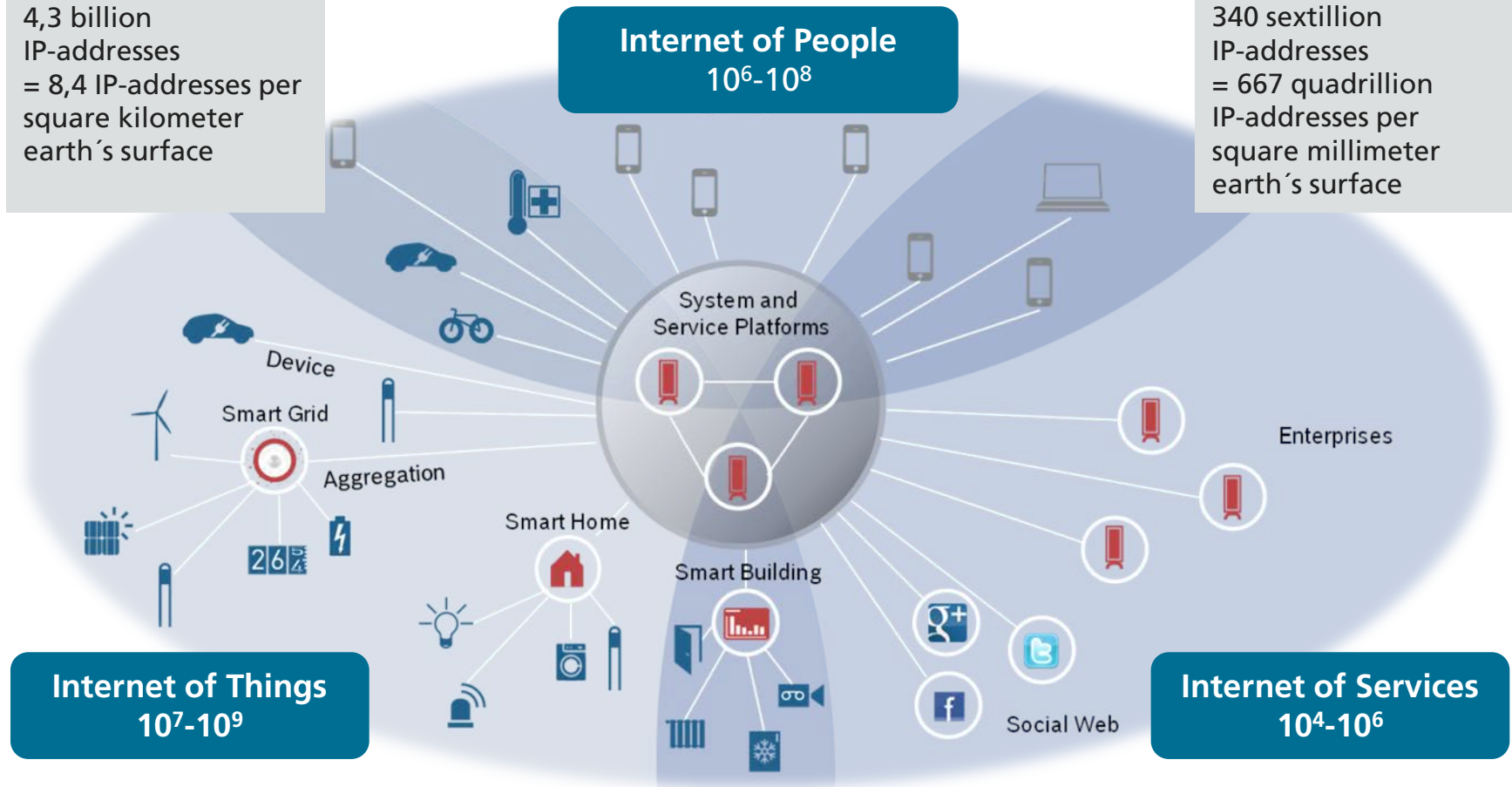
#### IPv4-Standard:

4,3 billion  
IP-addresses  
= 8,4 IP-addresses per  
square kilometer  
earth's surface

### IN THE FUTURE:

#### IPv6-Standard

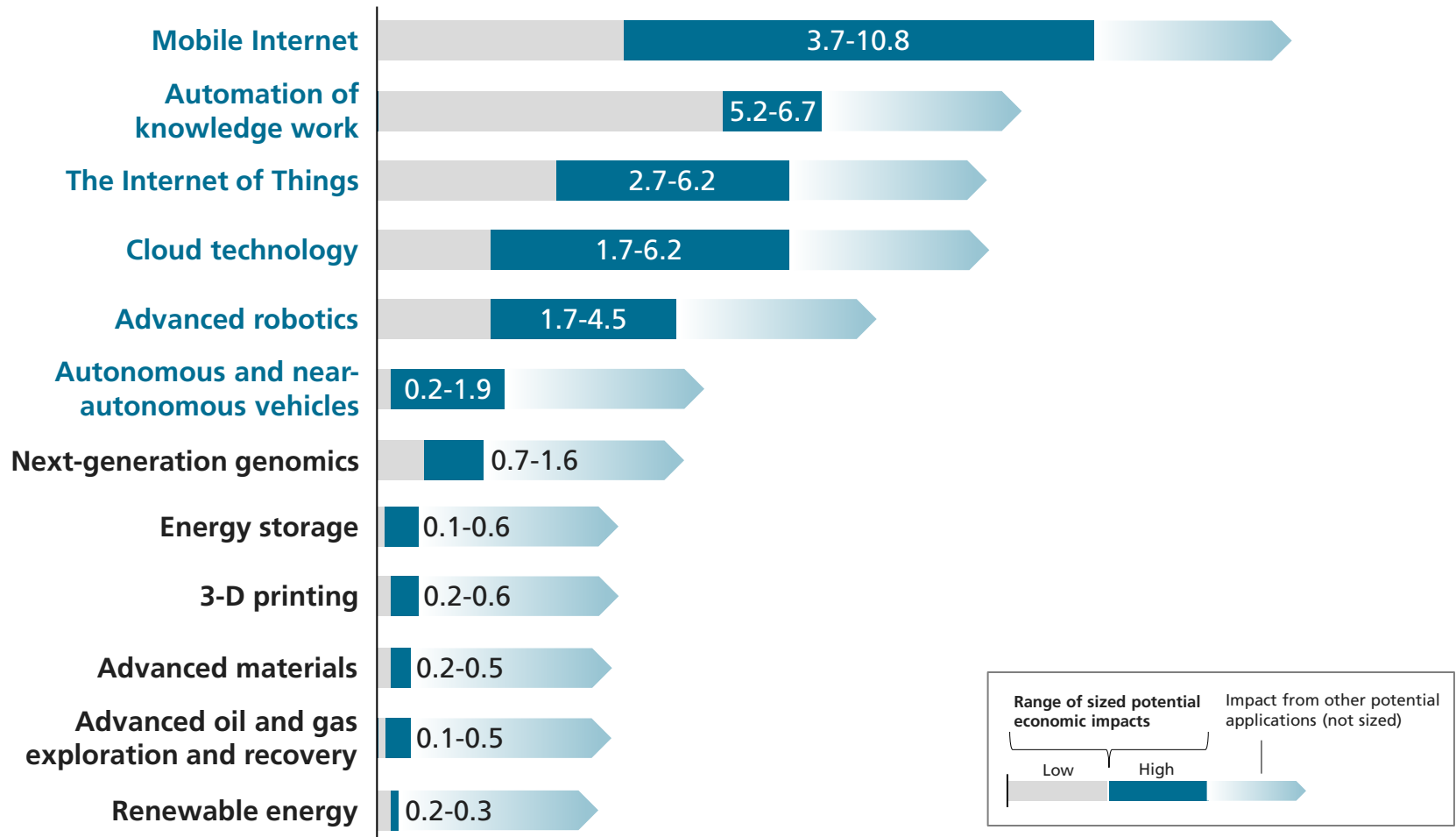
340 sextillion  
IP-addresses  
= 667 quadrillion  
IP-addresses per  
square millimeter  
earth's surface



Source: Bosch Software Innovations 2012

# Economic potential of technologies

Estimated economic potential of technologies of different applications in 2025 (in billion US-Dollar per annum)



Source: McKinsey Global Institute analysis, 2013



# How to deal with digitalization



Günther Oettinger  
EU-Commissioner for  
Digital Economy and  
Society

»We need to significantly increase the speed of our actions. The digitalization must be a top issue in Germany and Europe. The Revolution itself out faster than many actors in politics and economics wanted to admit it.«

ICT in Germany: 85 billion EUR total revenue,  
86.000 companies and over 900.000 employees

German Chancellor Merkel reinforcing the need of intelligent usage of  
»**Big Data**« and **Industry 4.0**:  
»Take chances – avoid risks!«



Angela Merkel  
Chancellor of Germany

# Manufacturing Industries in Germany, but

- **Leadership in innovation** in numerous manufacturing industries (e.g. automotive, wind power, medicine technology)
- Many **lead factories** for a global manufacturing (pioneering task for product and production technology)
- **Strong manufacturing equipment industry** (e.g. leadership in machine tools, measurement instrumentation, image processing, automation)
- **Internationally renowned trade fairs** (e.g. Metav, AMB, Automatica)
- Still very **efficient infrastructure** (e. g. energy, transport, IT)
- **University chairs** for production technology and industrial engineering, **basic knowledge and applied research, dual education**

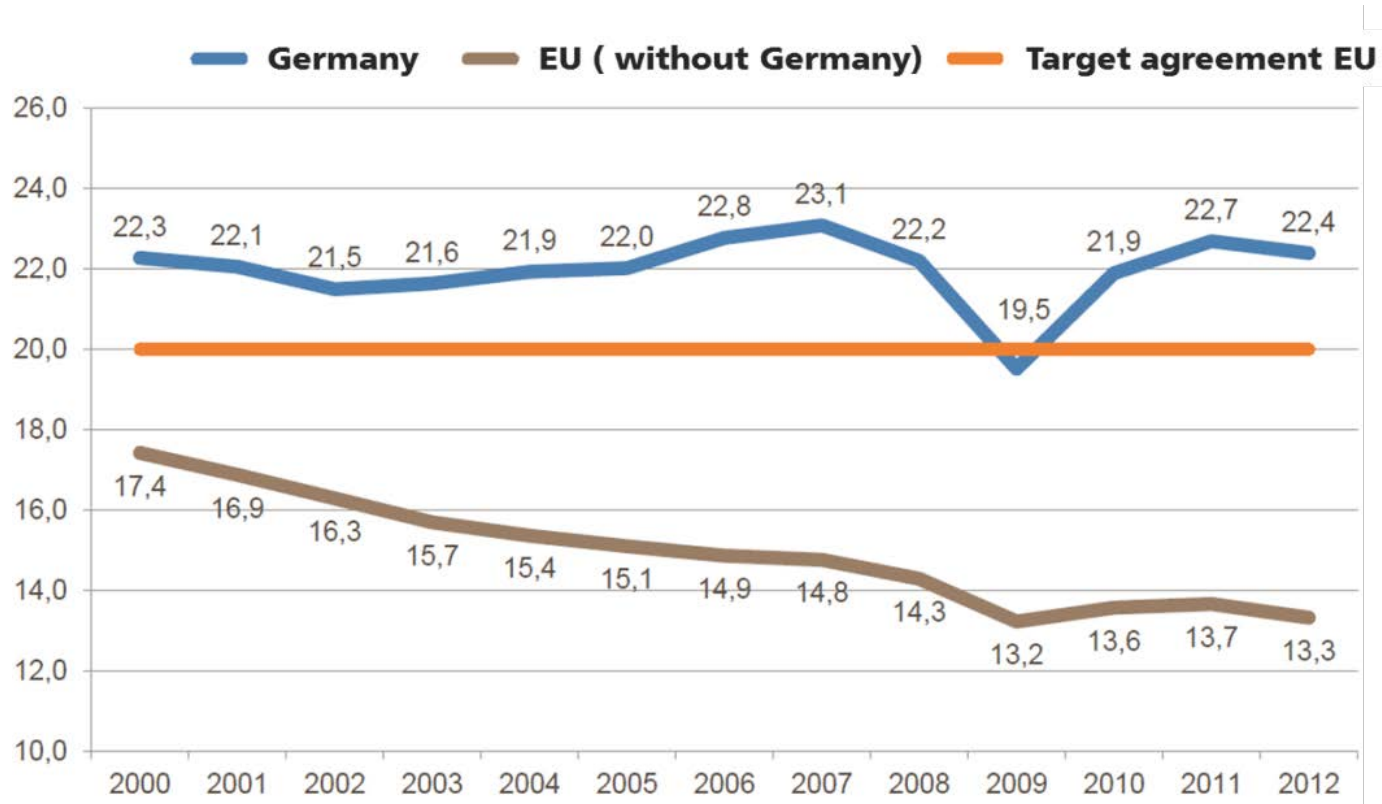


References:

IW Köln (Productivity), JD Power (Best Cars), IT-Performance TNS Infratest, patents: heise online, Intelligence PIAAC-Test

# Economic impact of the industrial sector in Germany (in%)

## Industry is making about 535 billion EUR to added value



**German Government invests 500 million EUR  
in industry 4.0 until 2017!**

# Industry 4.0 in a nutshell

## What does Industry 4.0 stand for?

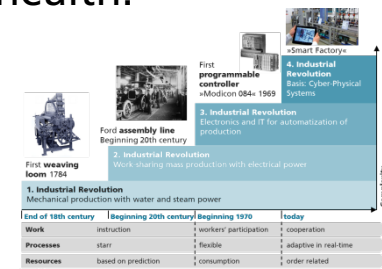


»Industry 4.0« stands for the expected **digitalization of industrial value chains.**

Industry 4.0 describes a **real-time-capable, intelligent integration** of humans, machines and objects **towards a management of systems.**

[according to Plattform Industrie 4.0; DB Research]

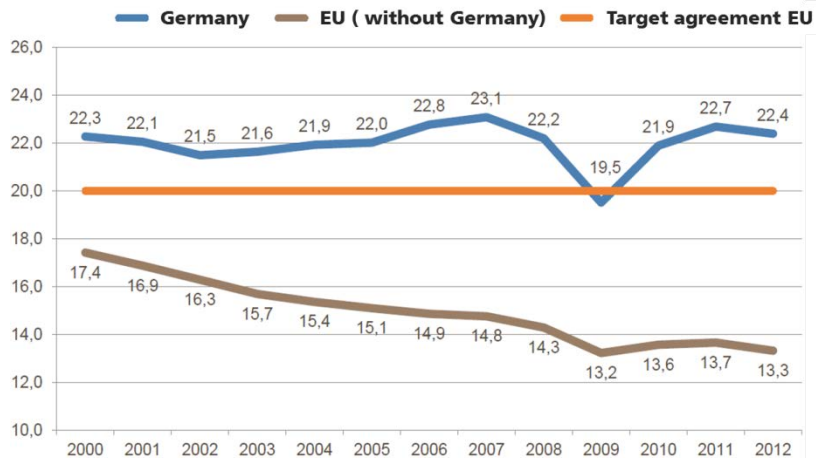
- Via IP addresses **connected objects** (IoT, IoS) with embedded hardware and software (Cyber-Physical Systems) interact with their environment
- The **self-organizing smart factory** accounts for vision and scope; similar to smart mobility, smart logistics, smart grid, smart building, smart health.
- Leaders expect the **impact of a fourth industrial revolution**, after mechanization, industrialization and automation
- Industry 4.0 has the potential to create **novel business models**



# Industry 4.0 as international competitive advantage

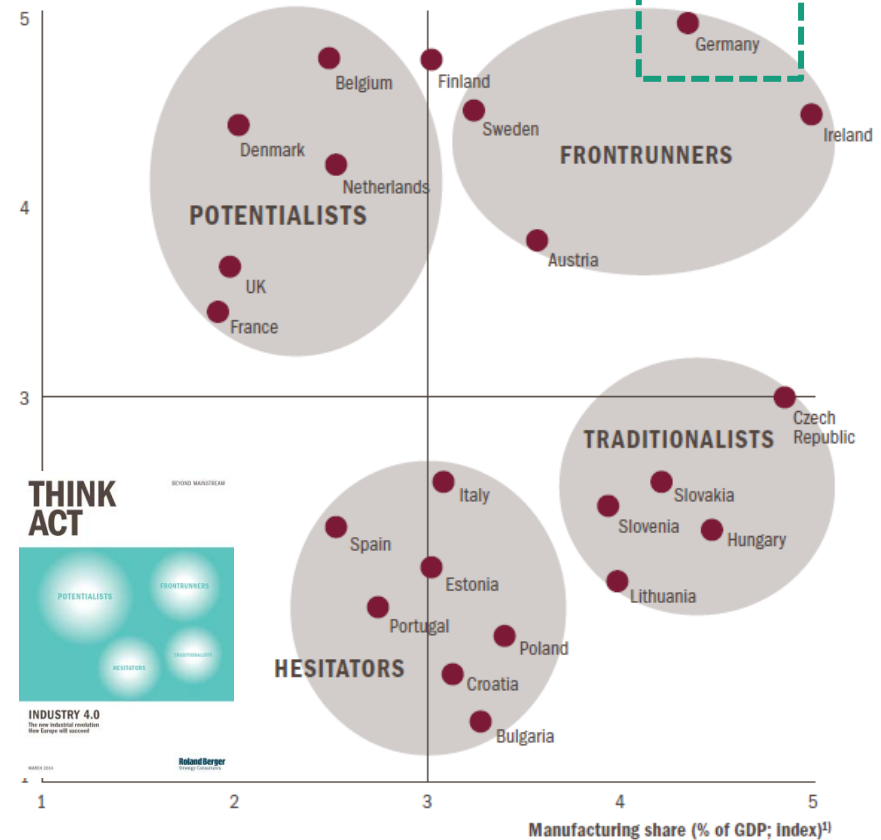
## German industry in good starting position

Industry is making about 535 billion EUR to added value  
[OECD, Eurostat, VCI, 2015]



The German industry is well prepared for the digitalization of industrial value chains (within a European scope)

RB Industry 4.0 Readiness Index<sup>1)2)</sup>



1) 1 = low, 5 = high

2) Adjusted for outliers Cyprus, Latvia, Luxembourg, Romania, Greece

[Roland Berger, 2014]



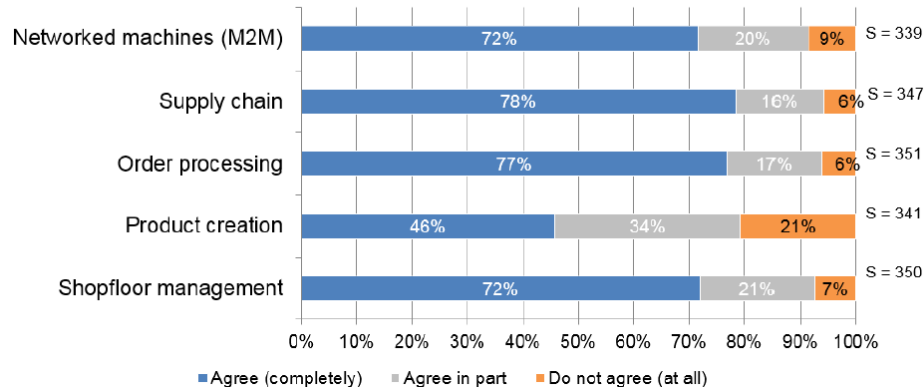
# Industry 4.0 raises high expectations

## Significant added value and investments expected



[ingénics, 2014]

The added value of Industry 4.0 is greater efficiency in the area of:

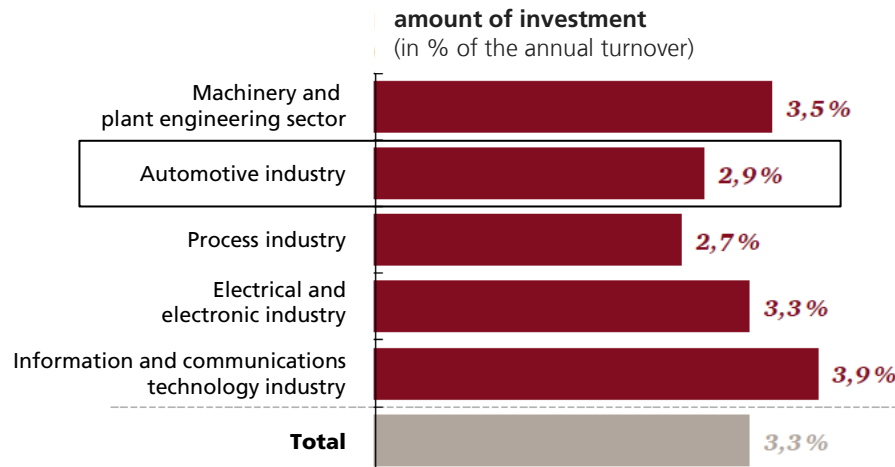


High expectations regarding efficiency gains by industry 4.0 – within own manufacturing and across the value chain.

Yearly investment in Industry 4.0 solutions until 2020



[PWC, 2014]



German enterprises expect efficiency and turnover gains and plan to invest annually further EUR 40 bn for industry 4.0 solutions.

# Digitalization of manufacturing - International mega trend



Several international initiatives towards smart manufacturing

# Industry 4.0 – a dual strategy

## Germany as leading market and leading supplier in order to strengthen Germany's Manufacturing Industry

### Germany as leading market

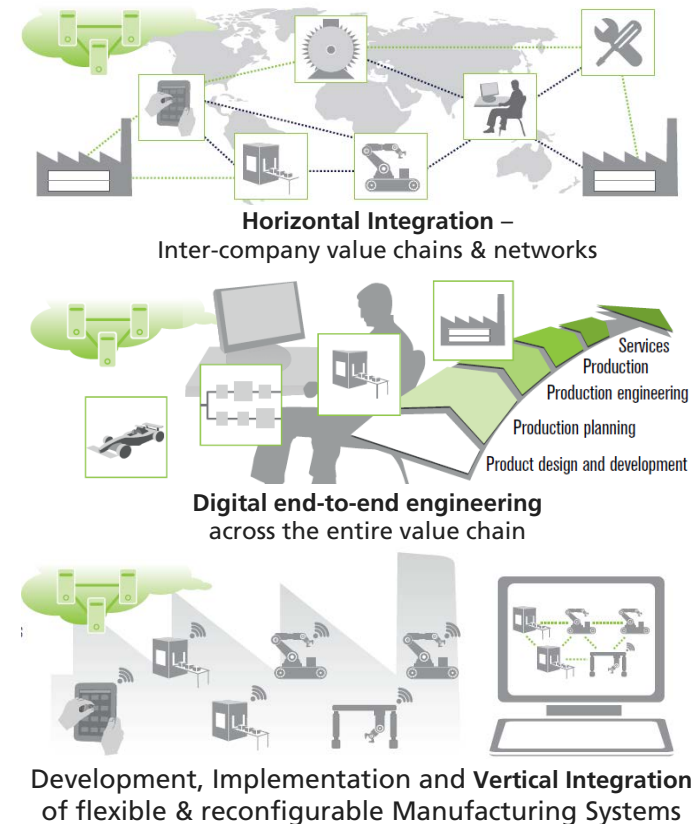
- Increase in process efficiency by implementation of IoT use cases (CPS) [e.g. mobile internet, MES, embeddeds, mobile robotics, control engineering, automation]

### Germany as leading supplier

- Realization of new market opportunities by innovative business models

Today, main focus is on process efficiency

—  
The competition for the best business models is just beginning



**Forschungsunion**

Wirtschaft und Wissenschaft  
begleiten die Hightech-Strategie

**acatech**

NATIONAL ACADEMY OF  
SCIENCE AND ENGINEERING


Picture: Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0, Abschlussbericht AK Industrie 4.0, 2013

# Economic potentials of Industry 4.0

Increase of gross value added from 15 % to 30 % until 2025 possible

- Potentials of business models not considered sufficiently yet
- Conservative Estimation
- Core industries with highest leverage

Industrial sectors	Gross value added [Bill. €]		Potentials Industry 4.0	Increase per annum	Increase [Bill. €]
	2013	2025*	2013-25	2013-25	2013-25
Chemical industry	40,08	52,10	+30%	2,21%	12,02
Automobile and components	74,00	88,80	+20%	1,53%	14,80
Machine and plant construction	76,79	99,83	+30%	2,21%	23,04
Electrical equipment	40,27	52,35	+30%	2,21%	12,08
Agriculture and forestry	18,55	21,33	+15%	1,17%	2,78
ICT	93,65	107,70	+15%	1,17%	14,05
<b>Potentials of the 6 chosen sectors</b>	<b>343,34</b>	<b>422,11</b>	<b>+23%</b>	<b>1,74%</b>	<b>78,77</b>
Exemplary projection for gross value added in Germany	2.326,61	2.593,06**	+11,5%**	1,27%**	267,45**



Source: Bitkom/Fraunhofer IAO 2014, [www.bitkom.org](http://www.bitkom.org)

# Implications for enterprises

## Why should you think about industry 4.0 today?

### Leading market

(Focus: process efficiency)

### Leading supplier

(Focus: business models)



Data is the oil of the 21st century.  
The **use and control of data** will be the **first significant business advantage**.

**Differentiation** is realized **by IT** and **software functionality**.  
**Rol** will be increasingly made **by profits of service business**.



IoT solutions, cloud software, mobile IT and robotics offer **new opportunities of efficiency** gains  
»Beyond Lean«.

Market requirements of **individuality, quality and delivery performance** will **not be satisfied with existing manufacturing processes**.



# Impact on production work

## Big discussions between experts

### Main risks of an »Industry 4.0«:

- Data security
- Process and work organization
- Standardization
- Labor resources
- Professional development
- Research activities
- Regulatory framework
- Available products
- New business models



**Risk of up to 45 %  
job losses within  
the next 20 years**

#### Bring on the personal trainers

Probability that computerisation will lead to job losses within the next two decades, 2013 (1=certain)

Job	Probability
Recreational therapists	0.003
Dentists	0.004
Athletic trainers	0.007
Clergy	0.008
Chemical engineers	0.02
Editors	0.06
Firefighters	0.17
Actors	0.37
Health technologists	0.40
Economists	0.43
Commercial pilots	0.55
Machinists	0.65
Word processors and typists	0.81
Real estate sales agents	0.86
Technical writers	0.89
Retail salespersons	0.92
Accountants and auditors	0.94
Telemarketers	0.99

Source: "The Future of Employment: How Susceptible are Jobs to Computerisation?" by C.Frey and M.Osborne (2013)

**Experiences on employment cannot be foreseen (quantified) yet –  
»old« jobs are threatened; »new« jobs will develop!**

Source: Plattform Industrie 4.0

# Industry 4.0 at Fraunhofer IAO

## Surveys



## Research & industrial projects



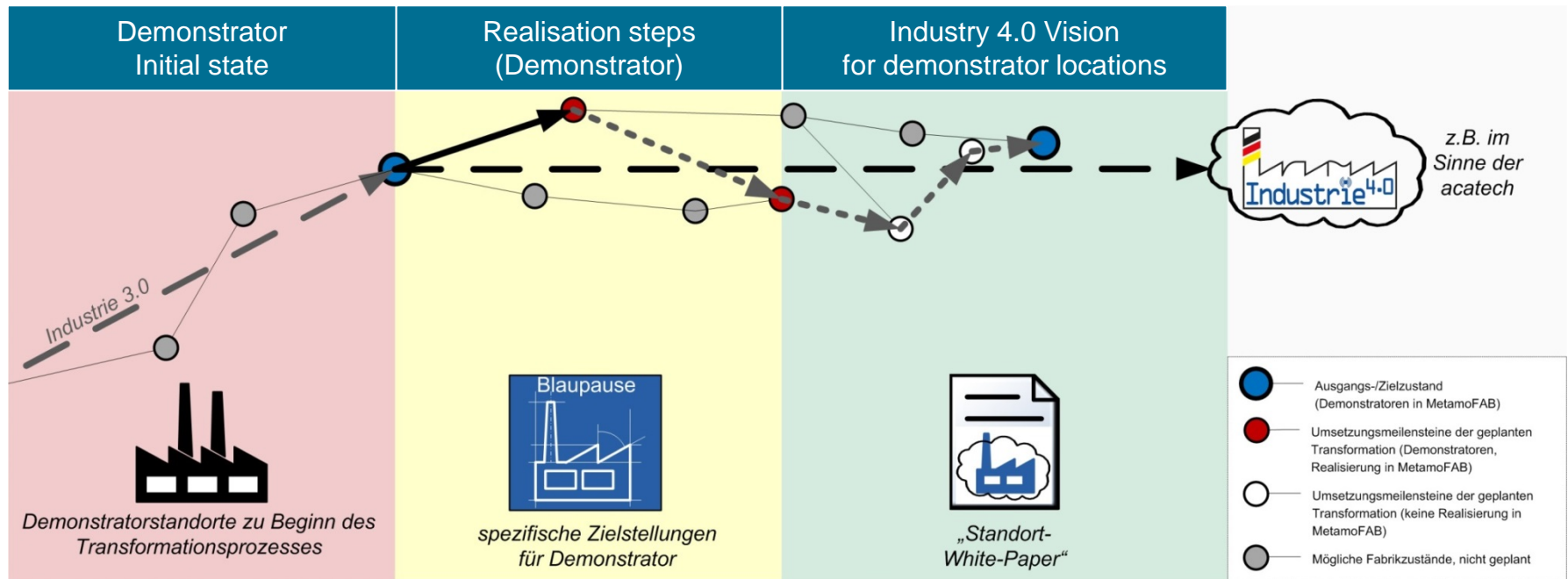
## Implementation



# Industry 4.0 - MetamoFAB Project

## Transformation to CPS Factories

**Start:** 11/2013 **Duration:** 36 months



Transformation of "Brown Fields" to networked and intelligent CPS (Cyber Physical Systems) Factories



# Industry 4.0 – JUMP 4.0 Project

Processes management on shop floor level for SME

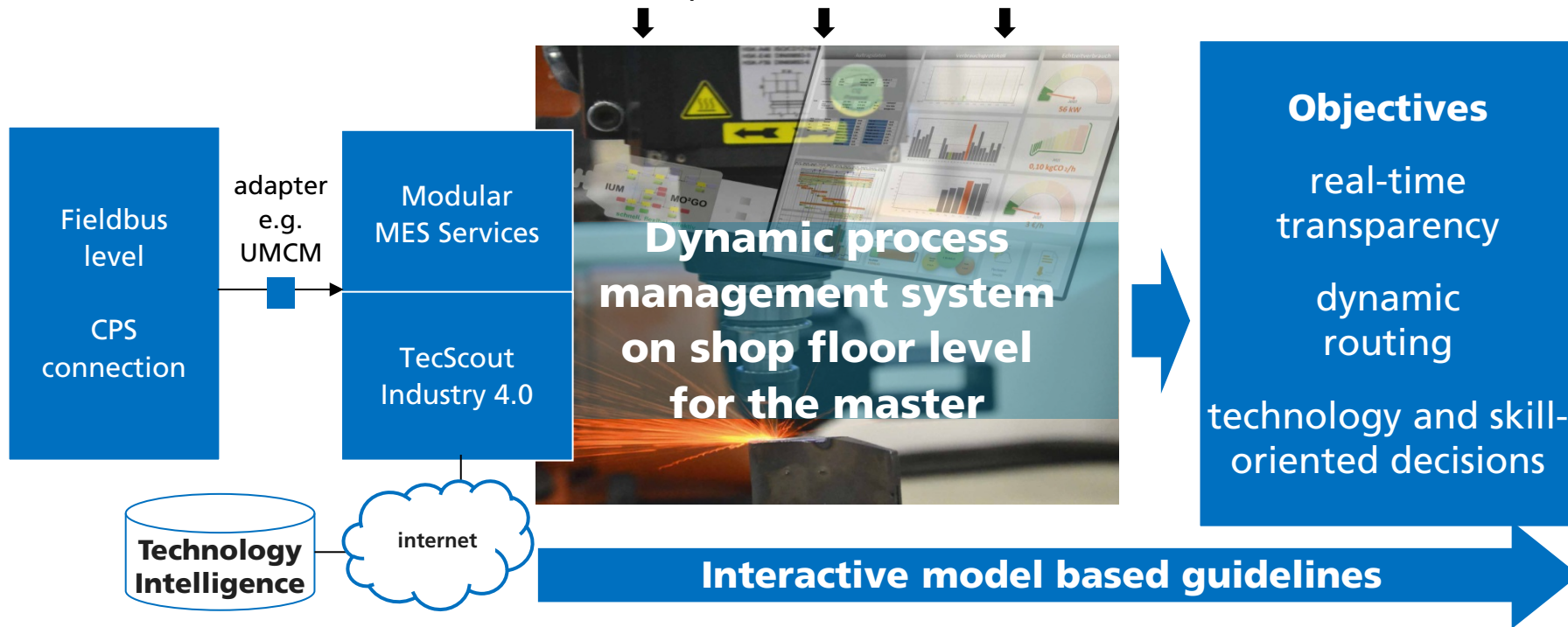


Federal Ministry  
of Education  
and Research

## JUMP 4.0

**Start:** 09/2015 **Duration:** 36 months

customer request, modifications, order etc.



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PRODUKTIONSANLAGEN UND  
KONSTRUKTIONSTECHNIK

Universität Stuttgart  
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TECHNISCHE  
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DRESDEN

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MAIER

cirp

pickert

budatec®  
Equipment for semiconductor and photovoltaic industries

Mobile and dynamic job scheduling support on shop floor level for the master within a Industry 4.0 production





# Thank you for your kind attention!

## Teşekkür ederim!

**Mehmet Kürümlüoglu**

Dipl.-Ing.

DEP Head of Competence Centre R&D-Management  
Head of PLM Consultancy Center



Fraunhofer IAO  
Nobelstraße 12 | 70569 Stuttgart | Germany

Phone: +49 711 970-2280  
mehmet.kueruemplueoglu@iao.fraunhofer.de  
<http://www.iao.fraunhofer.de>