
Transformation to Industry 4.0

Mehmet Kürümlüoğlu

Fraunhofer Institute for Industrial Engineering IAO, Stuttgart

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Fraunhofer-Gesellschaft

The largest organisation for applied research in Europe

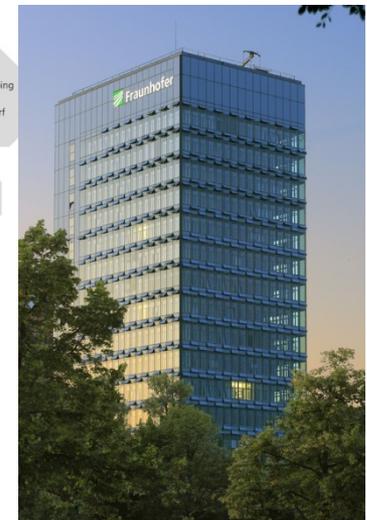
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.

Staff: approx. 24.000

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

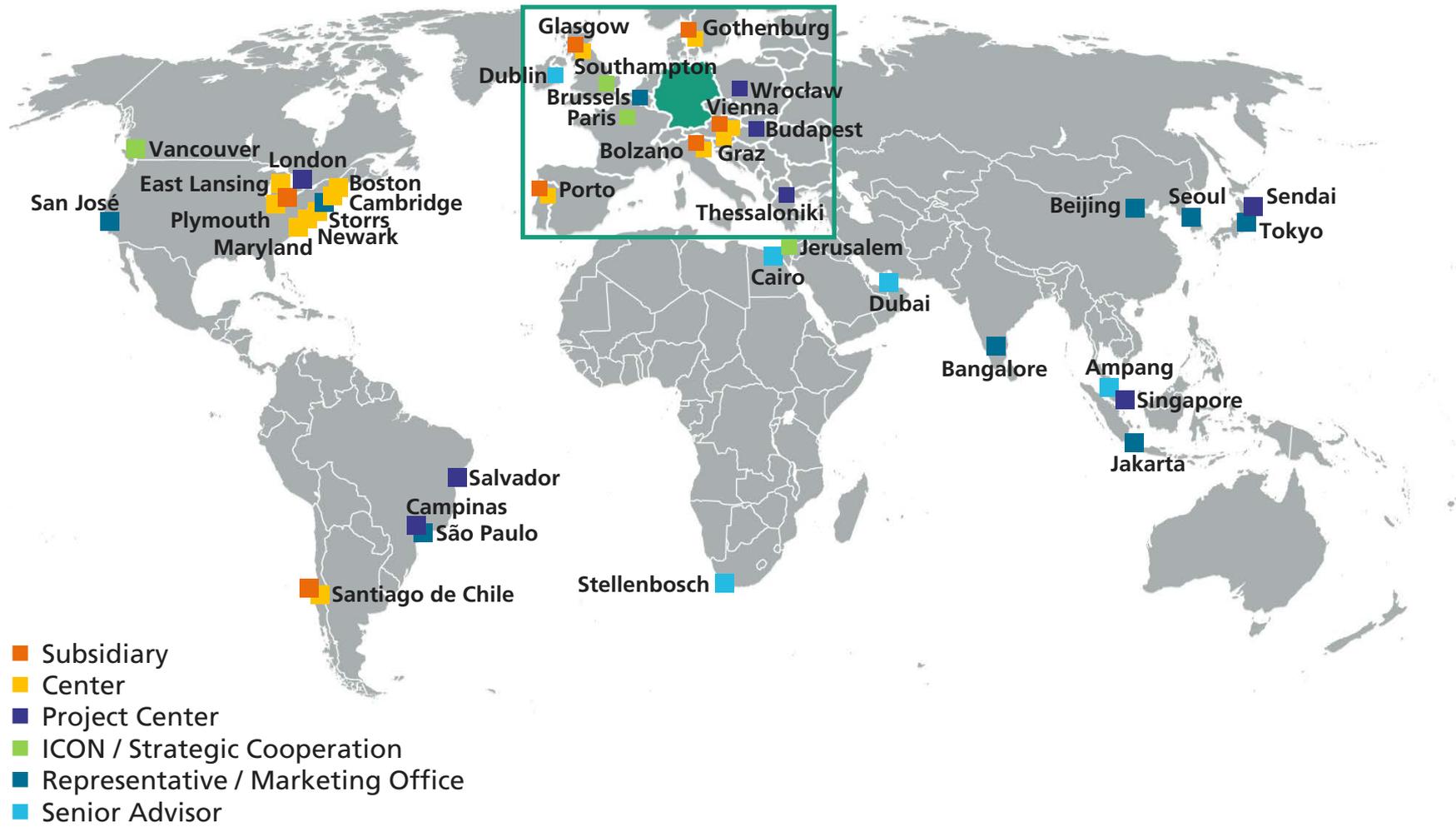
Organization: 80 research institutions, including 66 institutes at 40 locations

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, 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

Organization of
Research and
Development



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

Strategic R&D
and technology
management



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

Innovative IT
systems in the
area of R&D



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

Corporate
development for
R&D-intensive
enterprises



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:

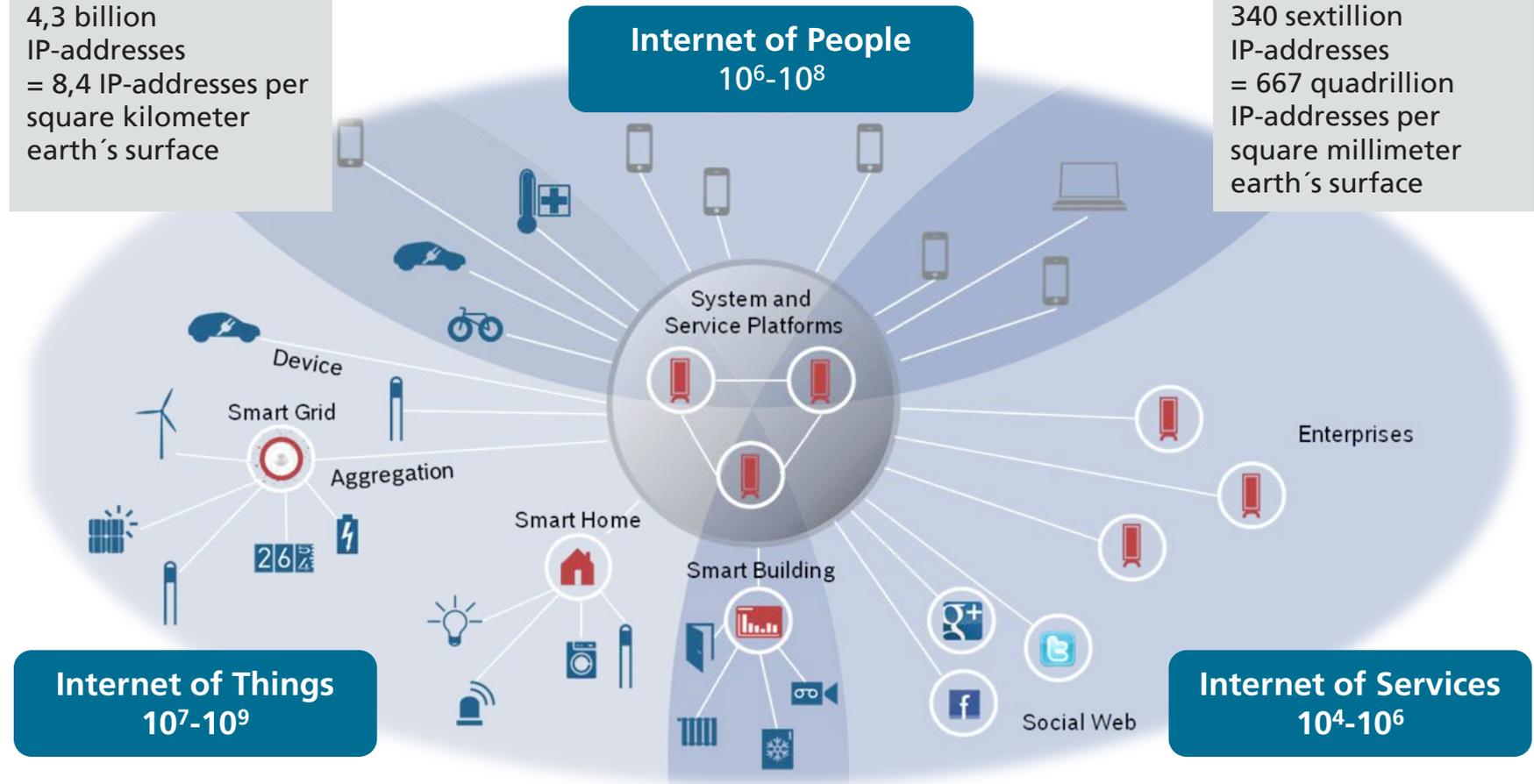
IPv4-Standard:

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

IN THE FUTURE:

IPv6-Standard

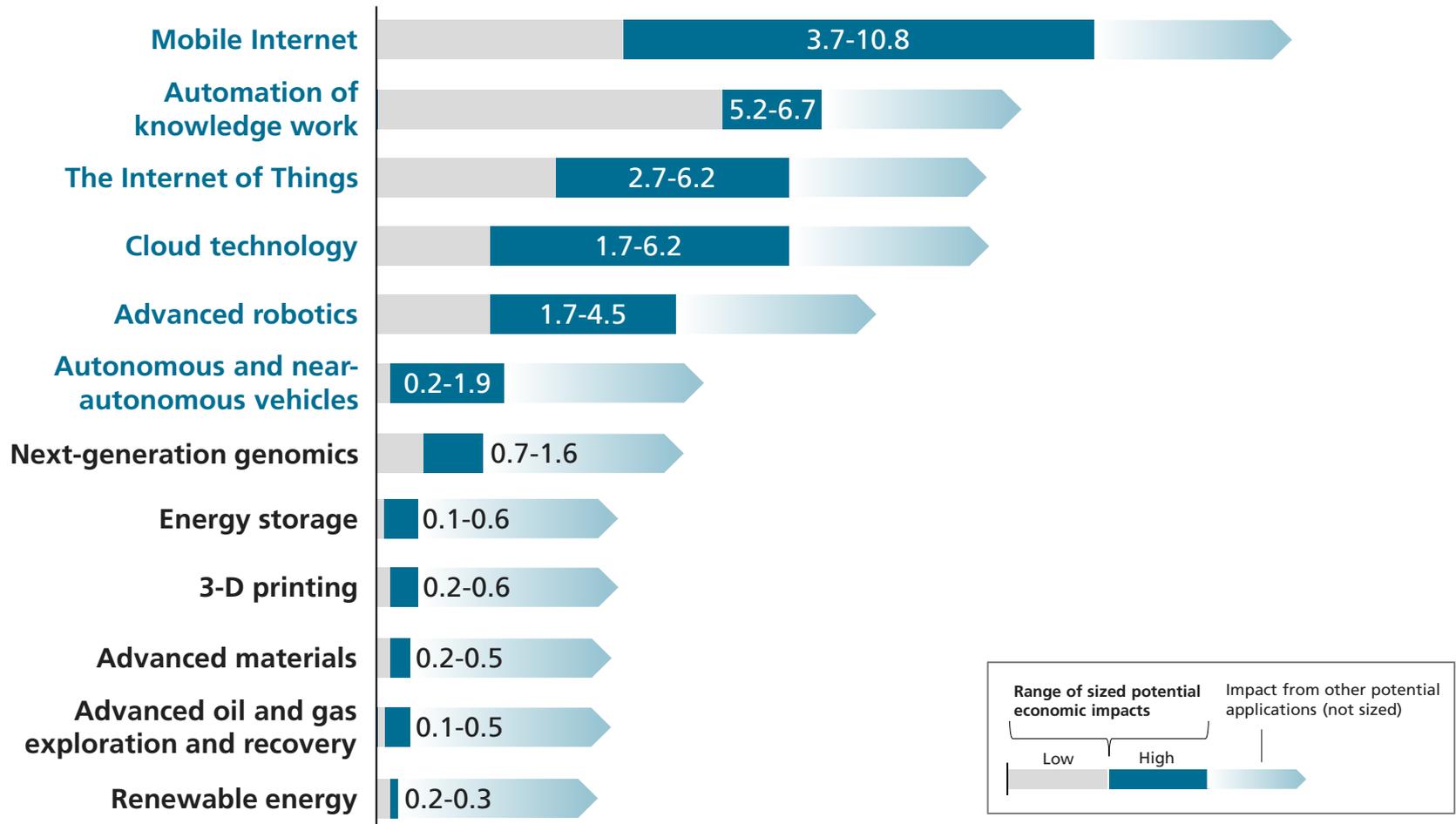
340 sextillion
IP-addresses
= 667 quadrillion
IP-addresses per
square millimeter
earth's surface



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**

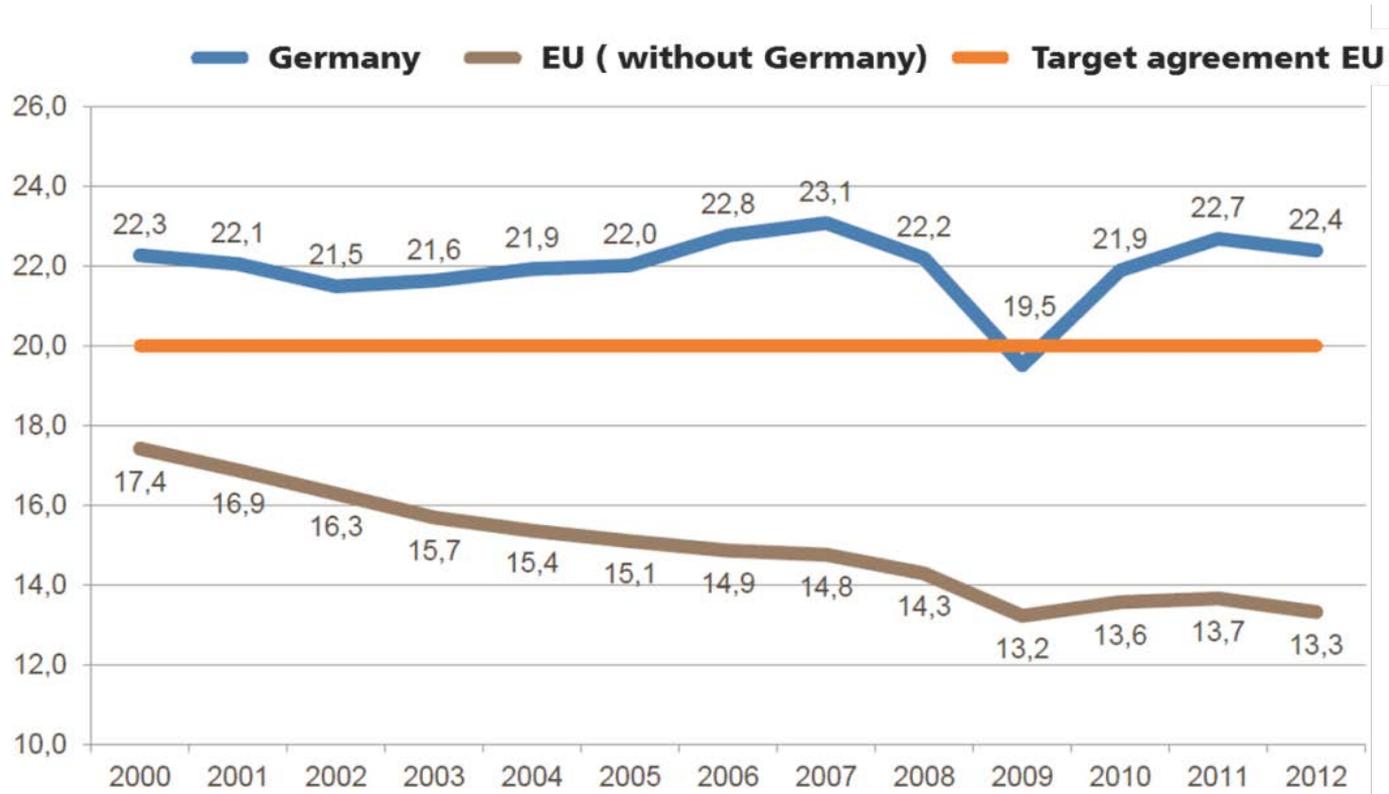


References:

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!**

Sources: OECD, Eurostat, VCI, 2015

Industry 4.0 in a nutshell

What does Industry 4.0 stand for?

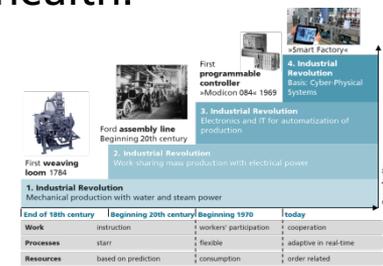


»Industry 4.0« stands for the expected **digitalization of industrial value chains.**

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**

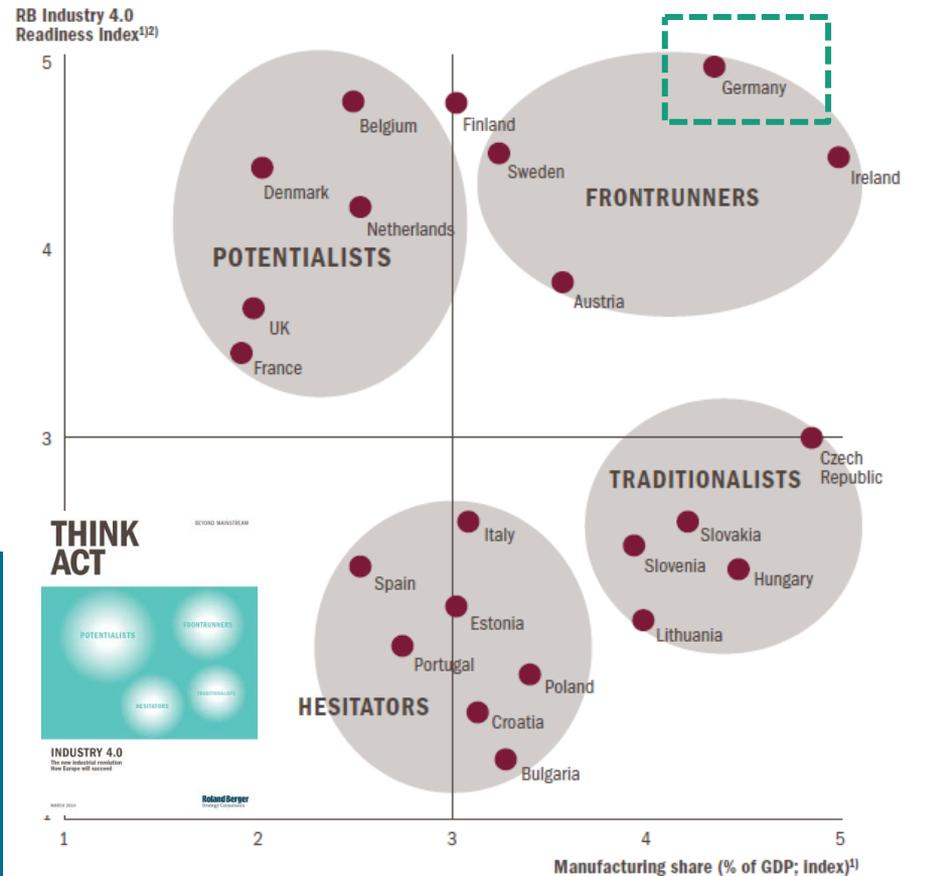
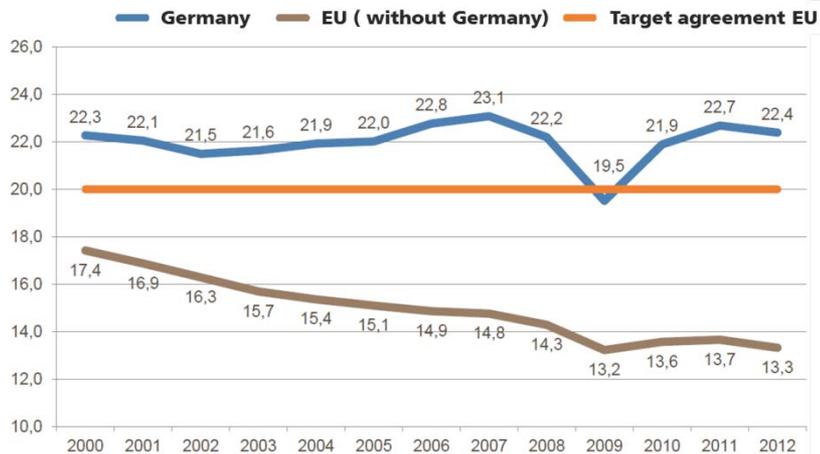


IoT - Internet of Things, IoS - Internet of Services

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]



1) 1 - low, 5 - high 2) Adjusted for outliers Cyprus, Latvia, Luxemburg, Romania, Greece [Roland Berger, 2014]

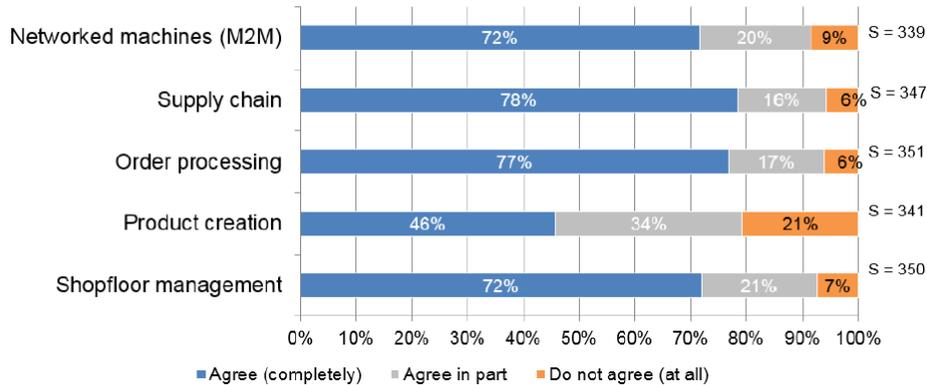
The German industry is well prepared for the digitalization of industrial value chains (within a European scope)

Industry 4.0 raises high expectations

Significant added value and investments expected

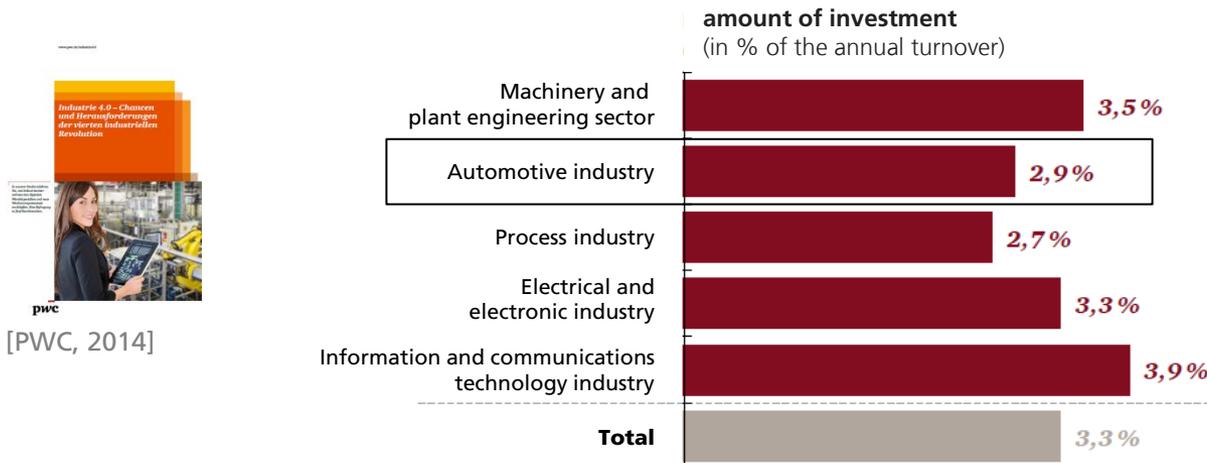


The added value of Industry 4.0 is greater efficiency in the area of:



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



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

Chicago Tribune BUSINESS
Chicago picked as site for Obama's manufacturing initiative
 February 22, 2014 | By Melissa Harris and Christi Parsons | Tribune reporters

Report of the MIT taskforce on INNOVATION and PRODUCTION

HORIZON 2020
 The New EU Framework Programme for Research and Innovation
 2014-2020

The Korea Herald
Robots herald brave new world
 Despite some concerns, robots seen complementing human activities rather than replacing them

The role of Internet of Things in China's 12th Five Year Plan
 Joanne Chien, DIGITIMES Research, Taipei [Monday 31 October 2011]

EU-level Initiatives

- Application PPPs: FoF, SPIRE
- I4MS
- Smart Anything Everywhere
- ICT PPPs

Multi-region Initiatives

- Vanguard

Sweden
 Produktion 2020

Netherlands
 Smart Industry

United Kingdom
 ➤ High Value Manufacturing
 ➤ Scottish Initiative

Germany
 ➤ Industrie 4,0
 ➤ Smart Service World
 ➤ Il's Owl
 ➤ Allianz Industrie 4,0

Belgium
 Flanders Drive

France
 Usine du Futur

Austria
 Produktion der Zukunft

Portugal
 Protech

Italy
 ➤ Industria Sostenibile
 ➤ Fabbrica Intelligente
 ➤ Ass. Fabbr. Intell. Lombardia

Spain
 ➤ National Initiative
 ➤ Basque Initiative

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

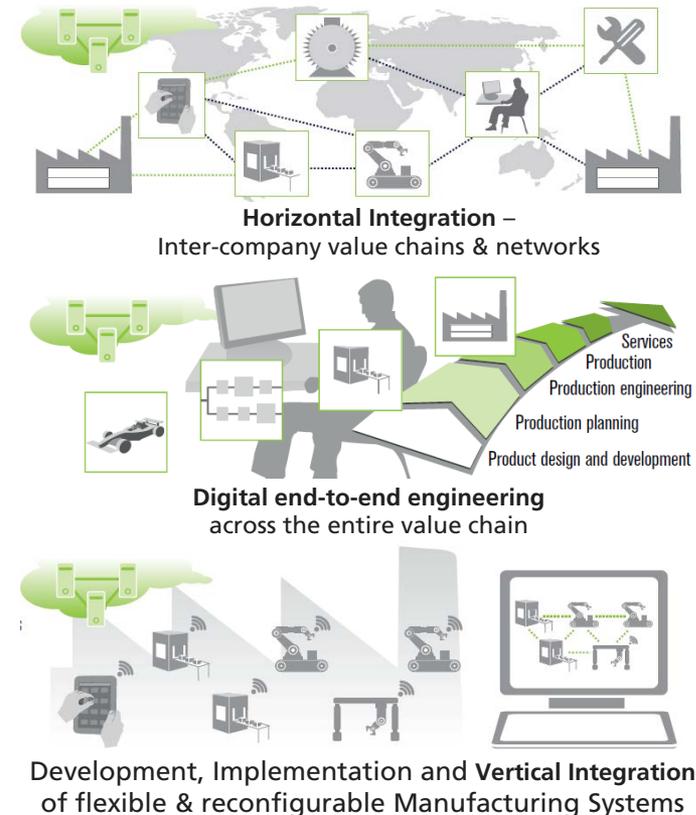
- Increase in process efficiency by implementation of IoT use cases (CPS) [e.g. mobile internet, MES, embeddeds, mobile robotics, control engineering, automation]

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
Potentials of the 6 chosen sectors	343,34	422,11	+23%	1,74%	78,77
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

Implications for enterprises

Why should you think about industry 4.0 today?

Leading market

(Focus: process efficiency)

Leading supplier

(Focus: business models)



»Supplier«
(Manufacturing technology, mechanical engineering, industrial IT)

Implications for products

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**. **RoI** will be increasingly made **by profits of service business**.



»Operators«
(User, OEM, value chain partners)

Implications for value chain

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: Platform Industrie 4.0

Industry 4.0 at Fraunhofer IAO

Surveys



Research & industrial projects



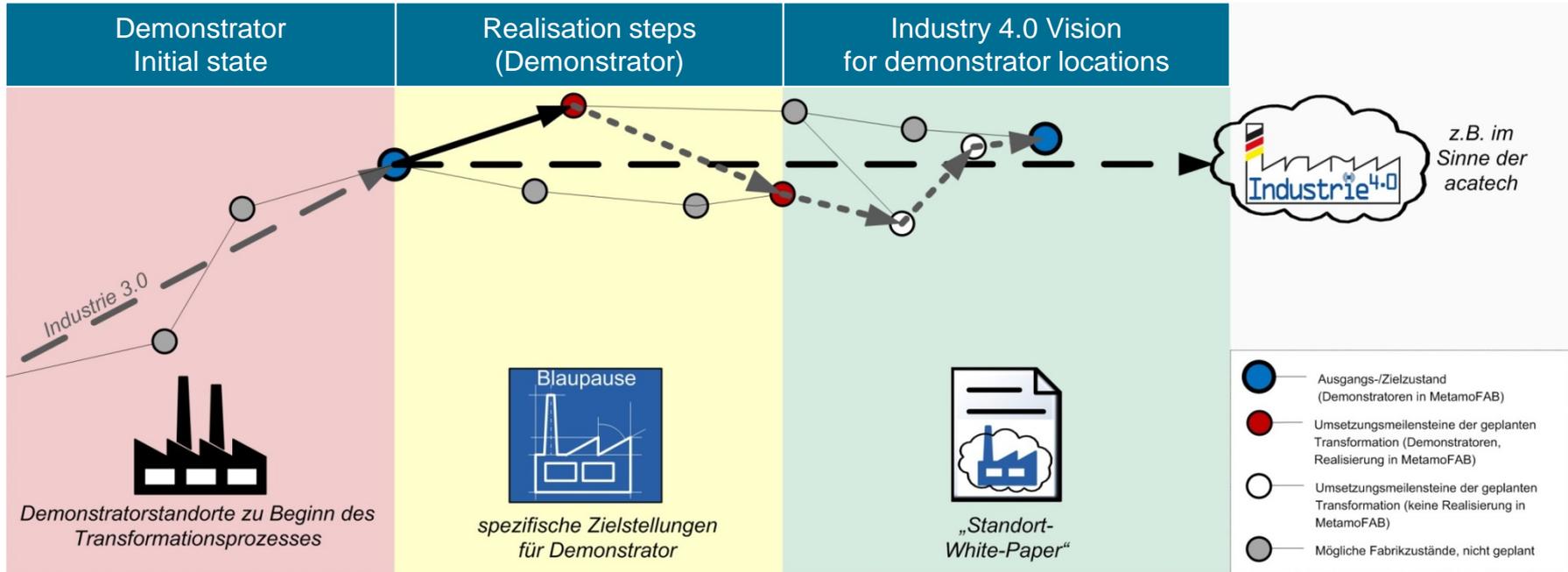
Implementation



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

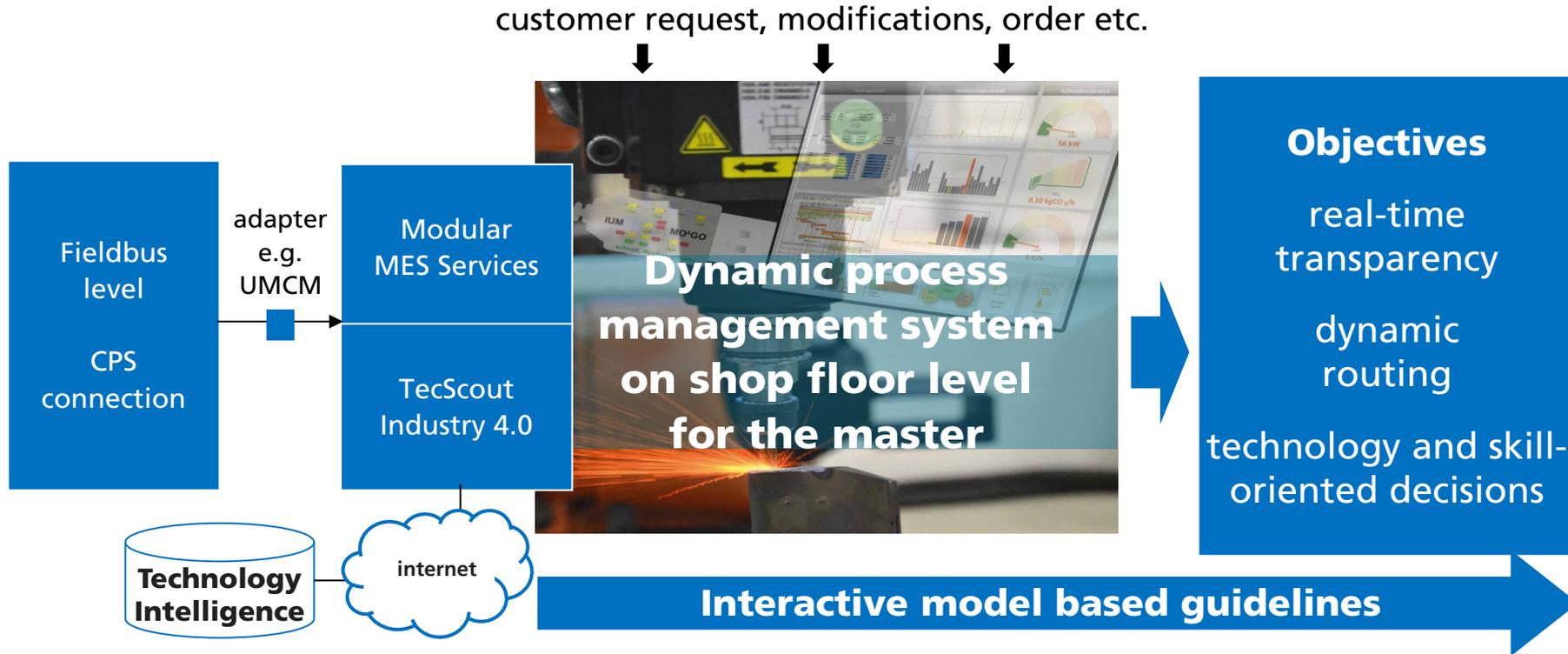
Processes management on shop floor level for SME



Federal Ministry
of Education
and Research

JUMP 4.0

Start: 09/2015 Duration: 36 months



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

A Kind of Conclusion

Industry 4.0

- is a strategic Initiative and with its “Dual Strategy” will have a significant impact on manufacturing Industry
- can be an enormous competitive advantage and has a huge economic potential
- needs some *transformation* and particularly *change* to become a real Factory 4.0

You need to start!



Industrie 4.0 –
Volkswirtschaftliches Potenzial
für Deutschland

Studie



Thank you for your kind attention!

Teşekkür ederim!

Mehmet Kürümlüoğlu

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.kueruemluoglu@iao.fraunhofer.de
<http://www.iao.fraunhofer.de>

