Industry 4.0 and It‘s Impact on Tomorrow‘s Working Life

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Technische Universität Berlin, Fraunhofer IPK

Industry 4.0 – Digitization of Germany’s Economy
Berlin, April 1st 2019

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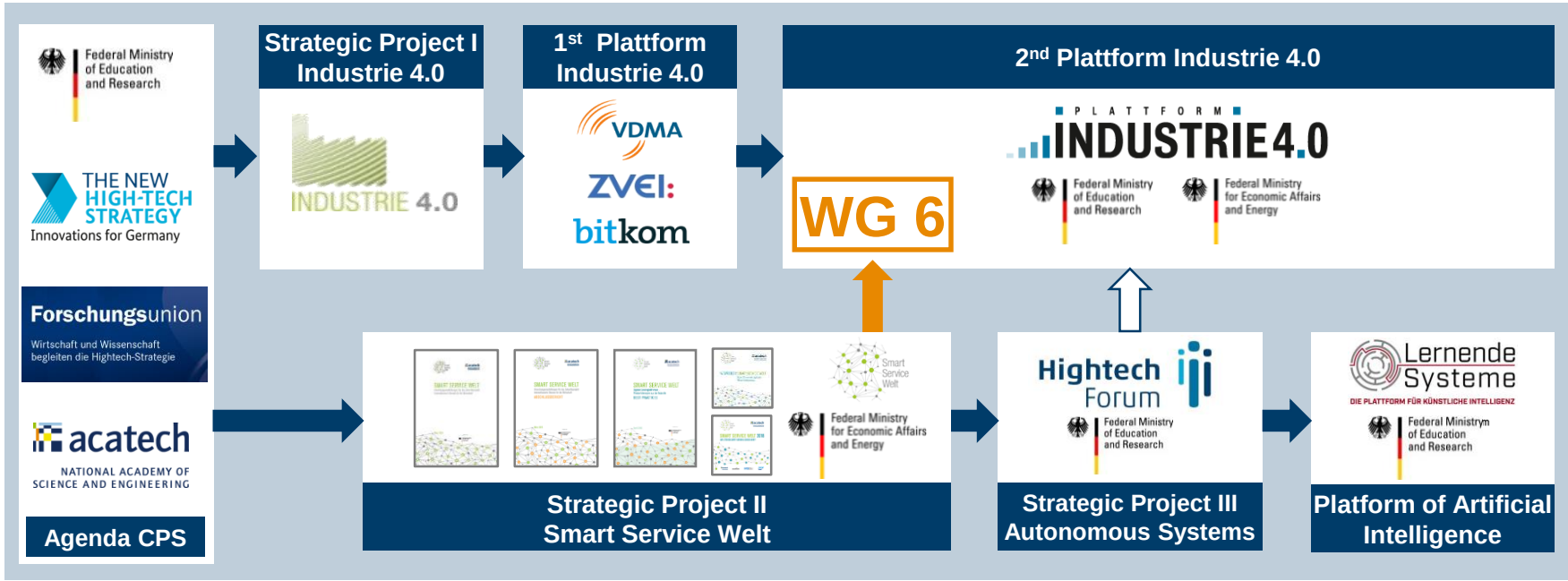
Germany's Digital Journey
The Second Wave of Digitalization



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Strategic Projects of the German Government

Ensure Competitiveness in the Digital Economy

2011 – 2013

Industrie 4.0

- IT/OT-Convergence
- SmartX, Ad-hoc connectivity, decentral

Rethink production processes and workplaces

2013 – 2018

Smart Service Welt

- Business model of the digital economy
- XaaS, data driven, platform based

Rethink business models and ecosystems

2015 – 2017

Autonome Systeme

- Ubiquity: at home, at work, on the way
- XBots & Artificial Intelligence

Rethink social, legal, and ethical implications

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Strategic Project I: Industry 4.0

Revolutions in the industrial production

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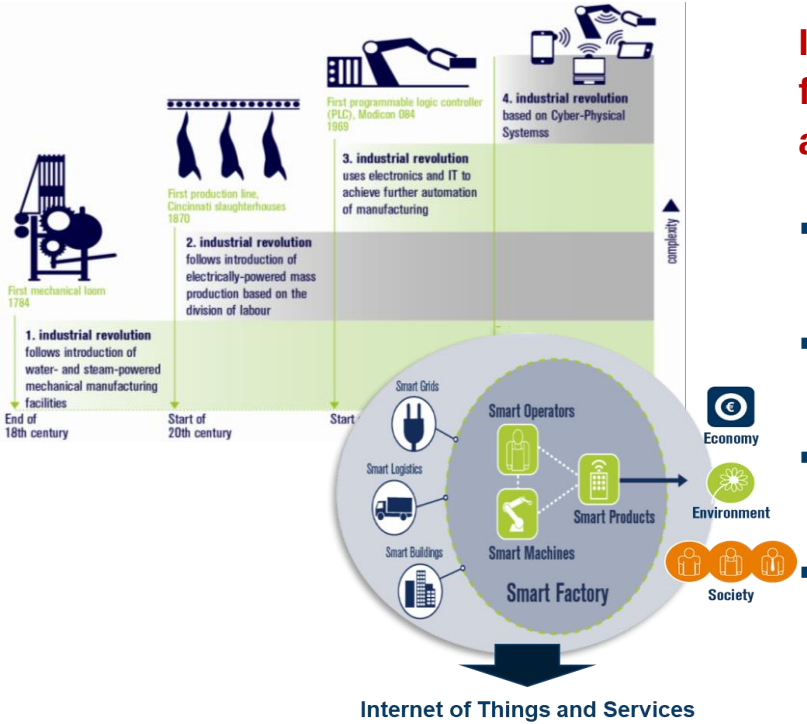
Industrie 4.0

Smart Factory, Service Platforms, and Digital Infrastructures



Internet of things combines the idea of a smart factory with the idea of smart products within an autonomous system

- The Smart Factory introduces the internet of things and services into the world of production
- Human beings, machines and products communicate like in a social network
- With interfaces to Smart Logistics, Smart Grid etc. the Smart Factory is part of future smart infrastructures
- Smart Factories produce Smart Products

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The Digital Transformation needs a Broad Foundation

Expanding the Scope of Plattform Industrie 4.0

PLATTFORM INDUSTRIE 4.0

Reference Architectures, Standardization and Norms 1	Technology and Application Scenarios 2	Security of Networked Systems 3
Legal Framework 4	Work, Education and Training 5	Digital Business Models in Industrie 4.0 6

Research Council

International Cooperations

SME Mobilization

Recommendations

LNI4.0 LABS NETWORK INDUSTRIE 4.0

STANDARDIZATION COUNCIL INDUSTRIE 4.0

→ actively supported by 300 stakeholders out of 150 organizations

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Orientation in the World of Industrie 4.0

Compass Industrie 4.0 of the Plattform Industrie 4.0

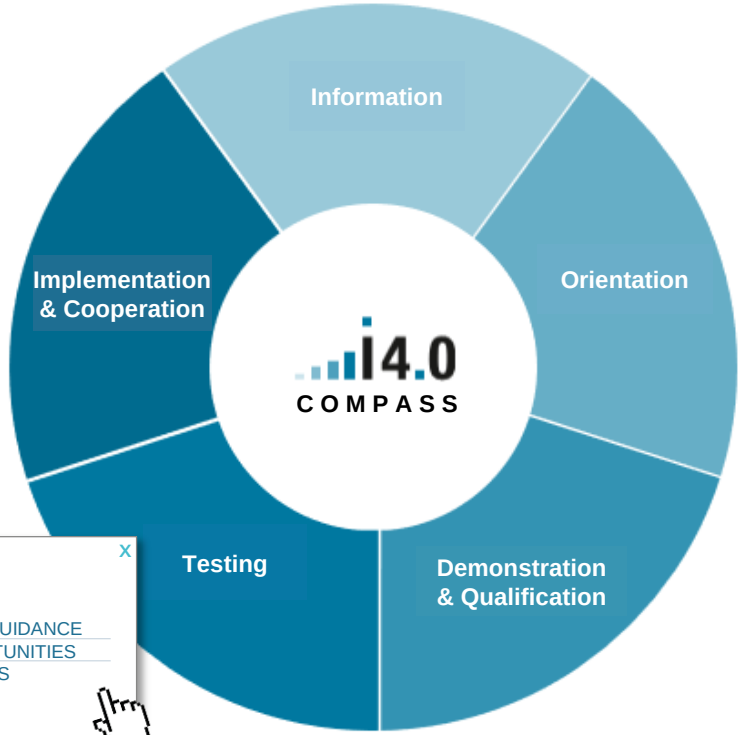
PLATTFORM INDUSTRIE 4.0

i4KMU

Mittelstand-Digital

Mittelstand 4.0 Kompetenzzentrum Saarbrücken

LNI4.0 LABS NETWORK INDUSTRIE 4.0



TESTING

- → PROFESSIONAL GUIDANCE
- → FUNDING OPPORTUNITIES
- → TESTING CENTERS

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International Cooperation is Reality

Focus so far: Standardization, Reference Models and Testbeds

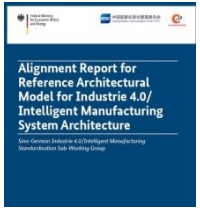
USA

- Industrial Internet Consortium
- Interoperability: RAMI 4.0 & IIRA

China

German-Chinese Intergovernmental Cooperation

- Action plan: “Shaping innovation together!“
- 3 German-Chinese cooperation strings
  → Cooperation in intelligent manufacturing/Industrie 4.0



Japan

- Robot Revolution Initiative
  ロボット革命イニシアティブ協議会
- IoT Acceleration Consortium

Czech Republic

- Narodni Iniciativa Prumysl 4.0

Alliance Industrie du Futur + Piano Nazionale Industria 4.0

Joint Road Map

Australia

- Memorandum of Understanding

Source (Images): Plattform Industrie 4.0; luzitanija – stock.adobe.com; BMWi/Maurice Weiss

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Strategic Project II: Smart Service Welt

From Smart Data to Smart Services and New Business Concepts

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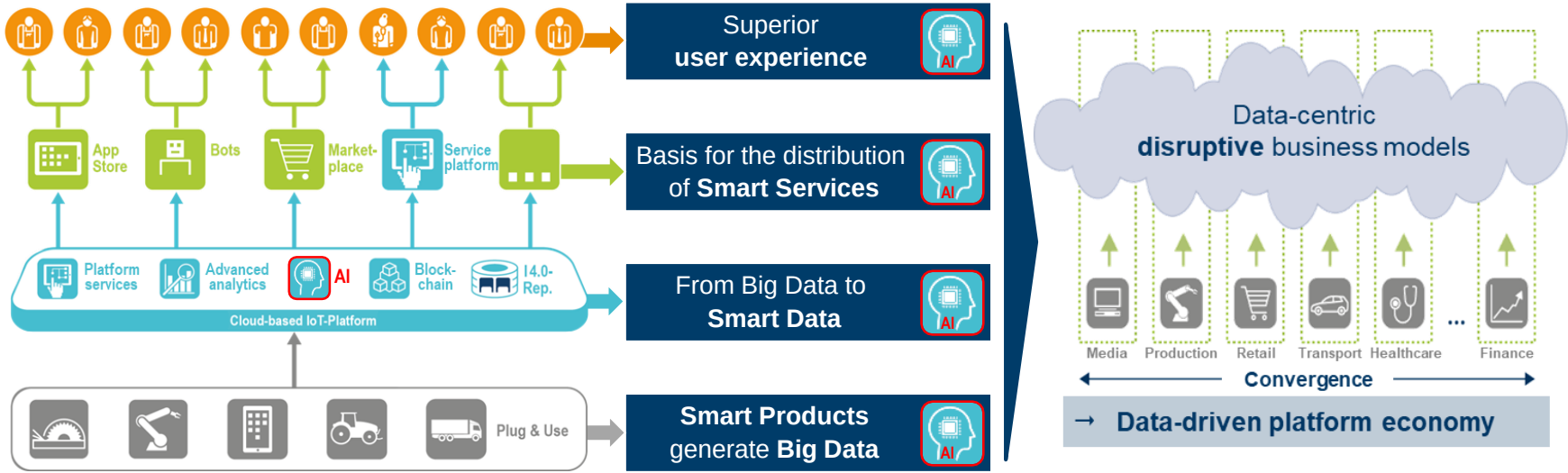
How are Smart Services Created?

In Dynamic Digital Ecosystems on Digital Technology Platforms



Source: acatech (2017), Wegweiser Smart Service Welt.

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The Future of the Business will be Bi-Modal

Symbiosis of Existing and Innovative Technologies & Business Concepts

Steer your business

- Strategic agility, learning organization, reconfigurable processes
- Cloud-based technology platforms

Mode 1

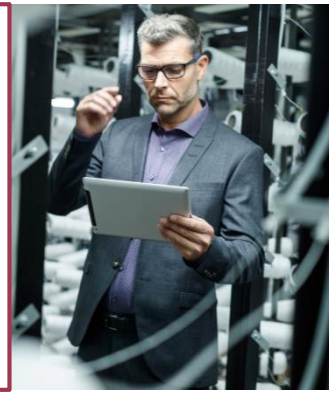
Optimize business

- Efficiency and automation
- Established business models
- Traditional production methods, digitally enhanced (smartening)
- Value chains
- Rigid automated processes (RPA)

Differentiate business

- Innovation and agility
- New digital business models
- Decentral connected autonomous systems & teams
- Business networks
- Adaptable processes (AI)

Mode 2



Data as a an independent resource: data richness

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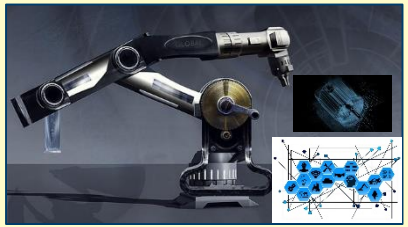
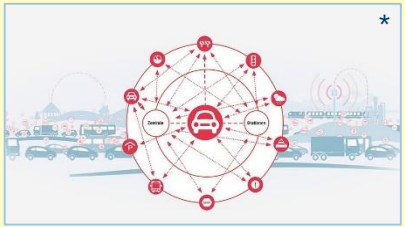
Key Success Factor: Smart Data

Smart Data is a Key Resource for Business Model Innovations

Manufacturing	Healthcare	Mobility	Farming
		 *	
• “Industrie 4.0” • Smart factory • Adaptive manufacturing • …	• Personalized medicine • Translational medicine • Smart healthcare devices • …	• Autonomous driving • Electric mobility • Smart mobility services • Intelligent traffic MM • …	• Work flow automation • Connected agricultural robots • ‘Digital Potato’ • …

Organizational Innovation ⟷ **Product Innovation** ⟷ **Service Innovation** ⟷ **Process Innovation**

Source: adapted from Otto (2018); *Image source: Nationaler IT-Gipfel.

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Strategic Project III: Autonomous Systems

Economic and Societal Potentials of the Digital Transformation

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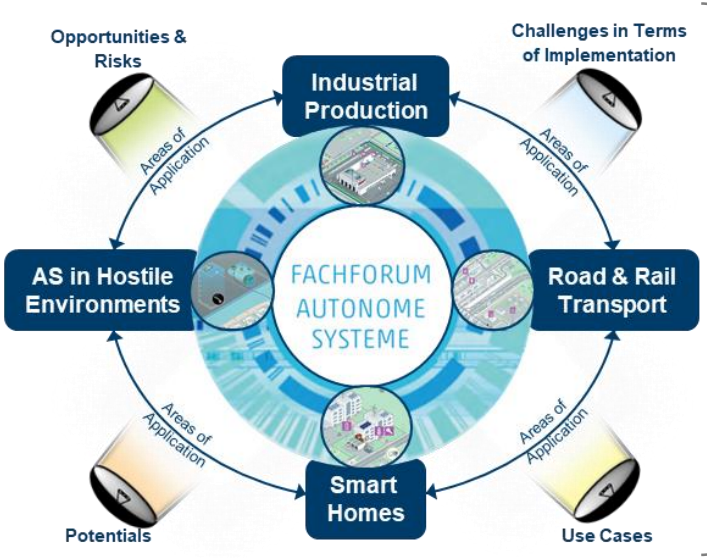
New Questions: “Autonomous Systems”

Strategic Project III (2015 – 2017)



Technological Enablers

Societal Challenges & Regulatory Framework

Recommendations

New **societal, legal** and **ethical challenges**

Germany: Platform Learning Systems established in 2017

Lernende Systeme
GERMANY'S PLATFORM FOR ARTIFICIAL INTELLIGENCE

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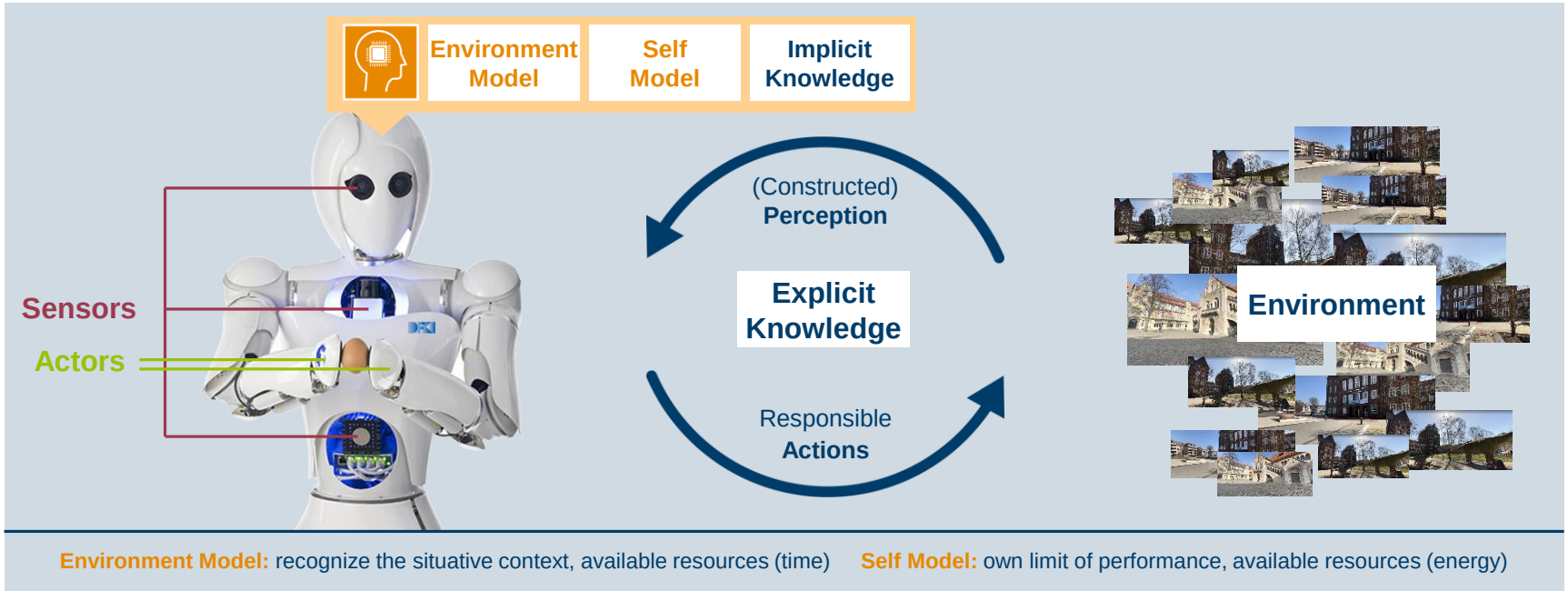
Basic Principles of Autonomous Systems



Environment Model: recognize the situative context, available resources (time) **Self Model:** own limit of performance, available resources (energy)

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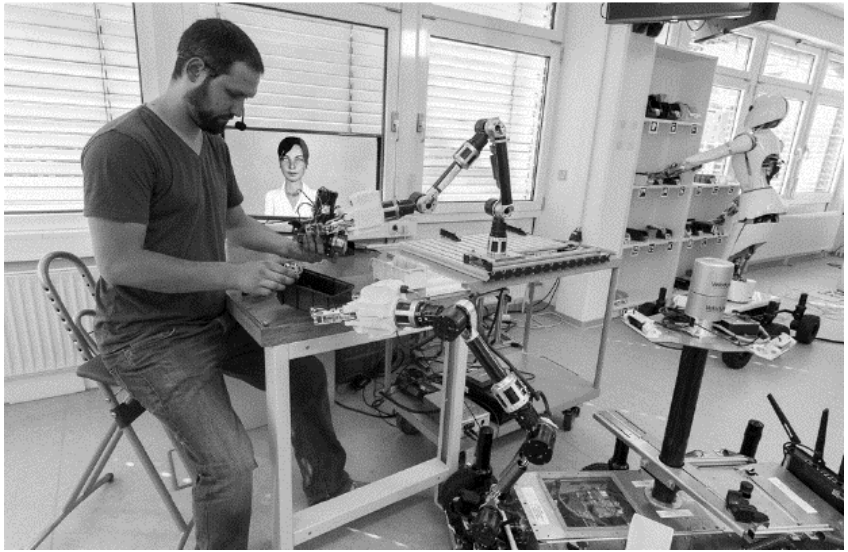
Autonomous Systems in Industrie 4.0
Collaboration in Hybrid Teams



- **Hybrid teams:**
  - Humans (supported by augmented reality)
  - Autonomous robots and softbots as partners
- **Joint problem solving:**
  - Work sharing according to specific capabilities
- **Self-reorganization:**
  - In case of unexpected incidents

→ Robots have to adapt to human‘s behavior

Source: Wahlster (2017): Künstliche Intelligenz als Grundlage autonomer Systeme

AI is Key Technology of the 4th Industrial Revolution

Economic Competitiveness

- **Individual products** under the conditions of mass production
- **Increased productivity** and **agility**: minimize time to market
- **Value generating processes** are optimized to customer demand in real-time

Quality of Environment

- **Energy- and resource-efficiency** (up to -50%)
- **Circular Economy**: Increased sustainability
- **'Urban production'**: Closer to employees' homes

Quality of Life

- **'Better Work'**: Work-life-balance and appeal of work
- **Social Inclusion,** supported by **autonomous systems**
- **Enhancement** in **safety**

→ **AI has a potential to double annual economic growth rates***

*Source: Accenture (2016), Why Artificial Intelligence is the Future of Growth.

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New Ways of Work

Digitizing Innovations and their Impact on Tomorrow´s Working Live

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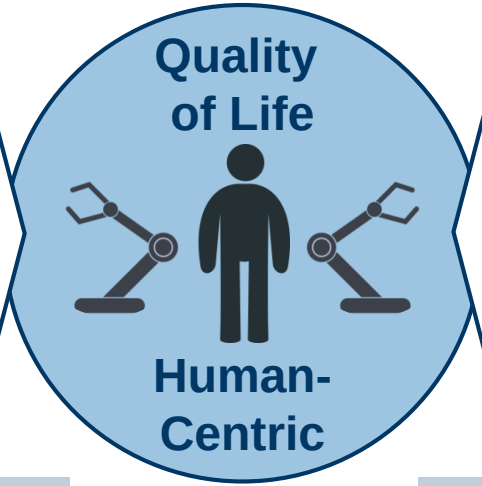
Promise to Employees: Quality Education & Better Work

Agile working

- Flexible working time
- Individual skills management
- Innovative workplace design
- Design thinking / scrum
- Human-machine-interaction



Lifelong learning

- Tailored to individual needs
- On-the-job / on-demand
- Digital tools (e.g. MOOCs)
- AI-based mentoring
- Nanodegrees
- Joint responsibility

→ Ambidextrous structures

→ Life-long employability

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Central Action Fields of the Transformation

HR 4.0

Sustainable Work Organization

- Workplaces that promote creativity
- New working styles
- Fostering flexibility and teamwork

Professional Development and Learning on the Job

- Re- and up-skilling – on-the-job
- Individualization, self-determination
- Excellence in knowledge transfer

Management of Ambidexterity

- One organization – two operating systems
- Avoiding the digital divide
- Empowering management

No one-size-fits-all-solution → Transformation requires experiments

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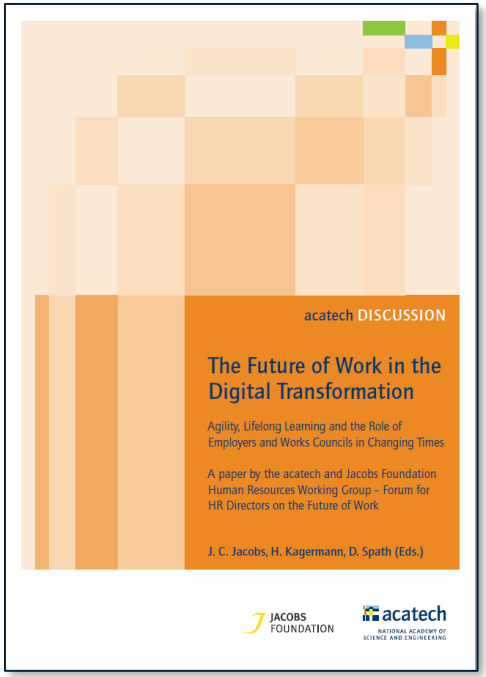
Key Success Factor Cultural Change
Shaping the Future of Work – Together!

Transformation must be shaped in a way that benefits businesses and employees in equal measure (win-win)

- **Agility** – helping companies to adapt faster **and** increasing flexibility for employees
- **Lifelong learning** – boosting companies' productivity and innovativeness **and** enhancing employees' ability to perform their duties and employability
- **Innovation-oriented co-determination** – reconciling companies' need for adaptability **with** employees' interests



QR-Code

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acatech Initiatives

Scientific and Industrial Experts Supporting the Digital Transformation

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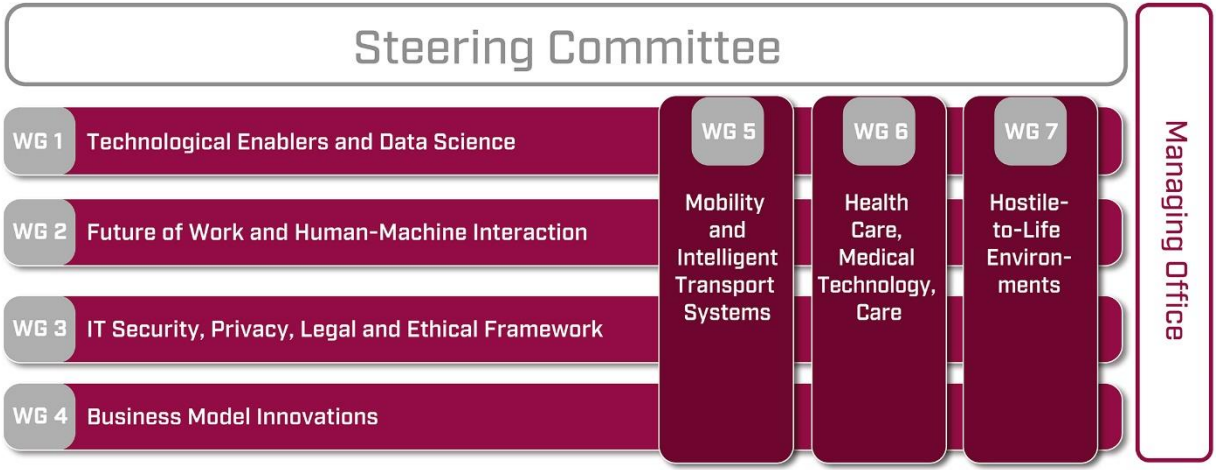
The Digital Transformation requires a Broad Foundation

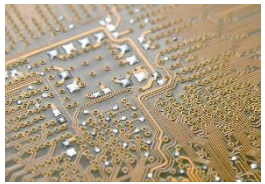
Germany's Platform for Artificial Intelligence



Lernende Systeme
GERMANY'S PLATFORM FOR ARTIFICIAL INTELLIGENCE

Federal Ministry of Education and Research

- started in January 2018
- Managing Office: acatech



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Building Blocks for Transforming the Mobility Sector…

acatech's Activities

Connection	Automatization	Shared Mobility	Electrification	Future Mobility
▪ Intelligent Controlling of the traffic flow **(Smart Traffic)** ▪ The vehicle as node in the Internet **(Smart Car)**	▪ Increase in **road/ traffic safety** ▪ Easier **access to mobility** ▪ Enhancing the **quality of life** (time)	▪ **Mobilit-as-a-Service (MaaS)** ▪ Mobility- and Vehicle-on-Demand ▪ Platform-based mobility	▪ Key topic of an **integrated** - climate - energy - mobility and - resource **strategy**	▪ **Enabling** an - efficient - eco-friendly - sustainable - flexible & secure - affordable and - resilient **high-quality mobility**

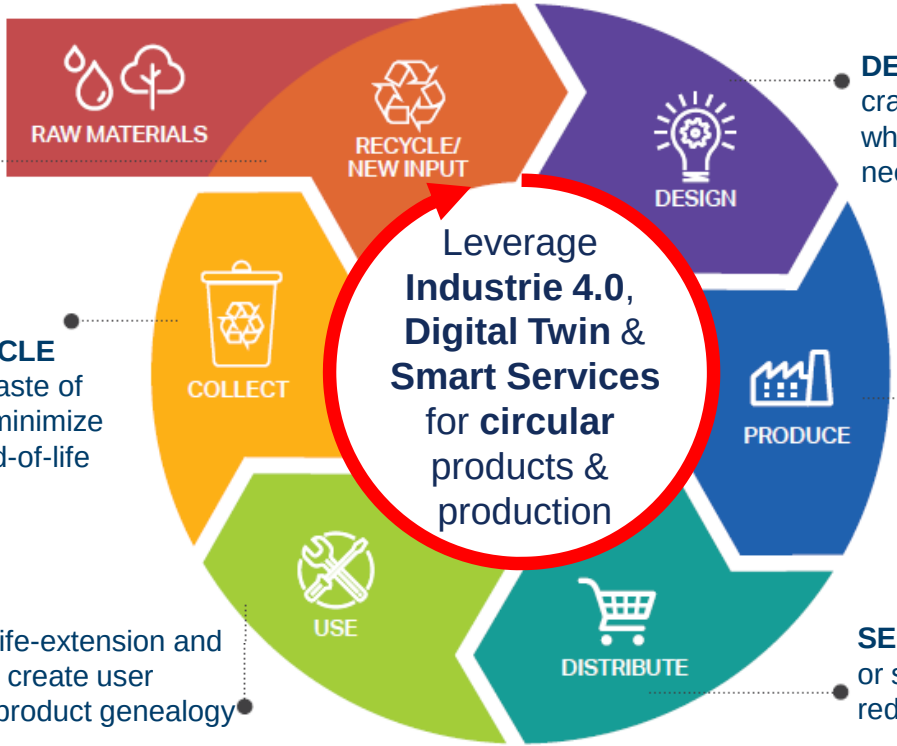
+Sustainability: cross-cutting issue sustainability

ESYS

Circular Economy

Promise to Society: Sustainable Circular Economy

Circular Economy Initiative started in March 2019



BUY materials that are regenerative or recycled

DESIGN
cradle-to-cradle products which are reusable or if needed can be recycled

COLLECT AND RECYCLE
to reduce waste of resources; minimize need for end-of-life

MAKE products as waste-free, local and resource-efficient as possible

Monitor **USE** for life-extension and improved design; create user transparency on product genealogy

SELL access, leasing or sharing products, reduce transport

Source: adapted from BCG, 2018, THE NEW BIG CIRCLE.

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Thank you very much for your attention.

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