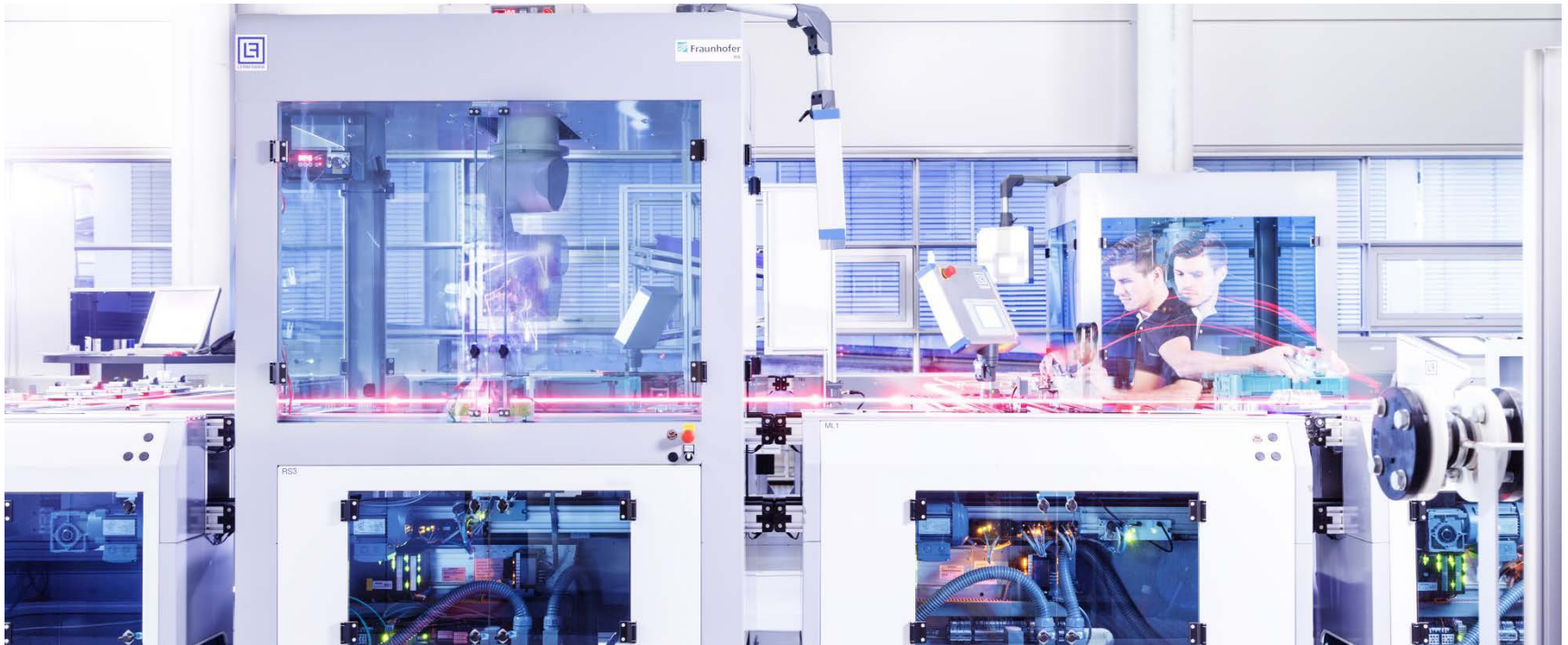


DIGITISING INDUSTRY – INDUSTRIE 4.0 IN GERMANY –

INESC TEC Forum "Factory of the Future: paths for the 21st century industry"
Dr. Günter Hörcher **20 October 2016**





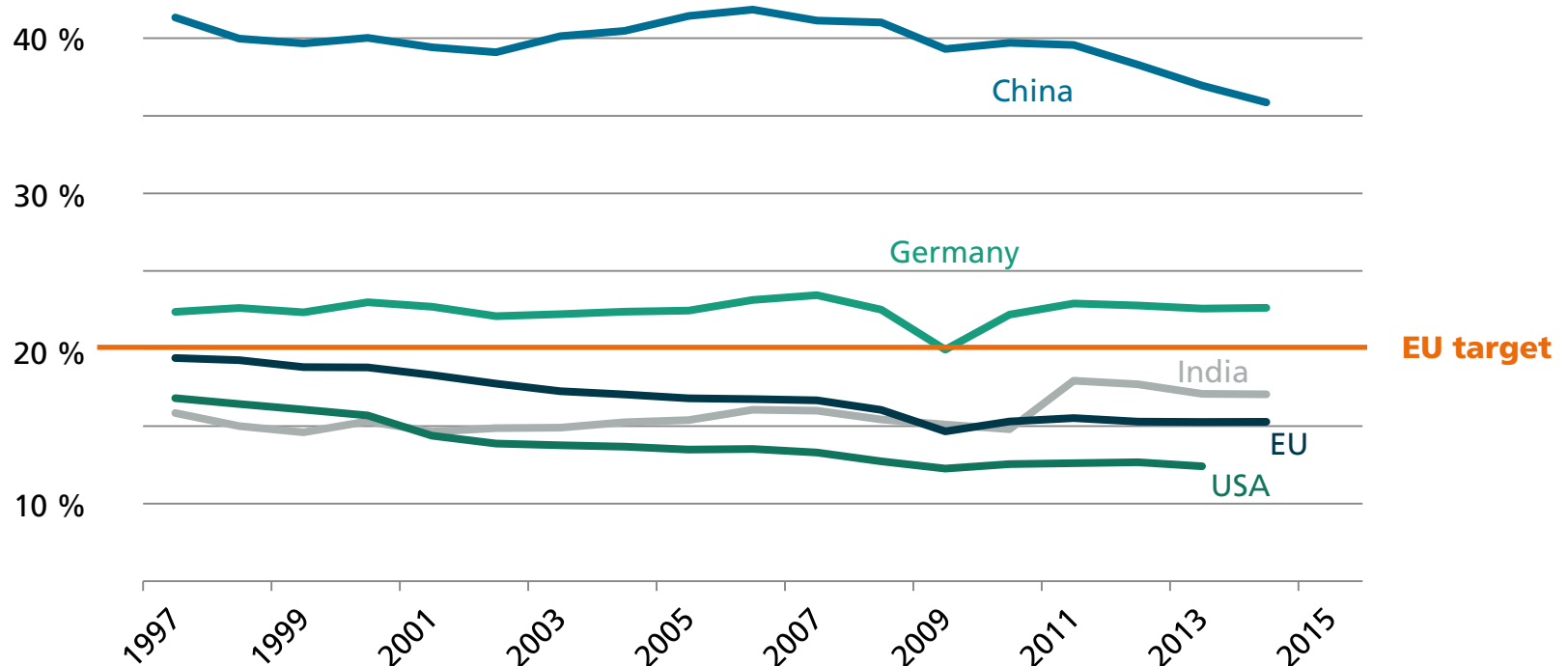
Digital Transformation

- Assessment: international position of Germany

Re-Industrialisation in Europa still pending

Germany supports its industrial core

Share of the manufacturing industry within the entire gross value added [%]

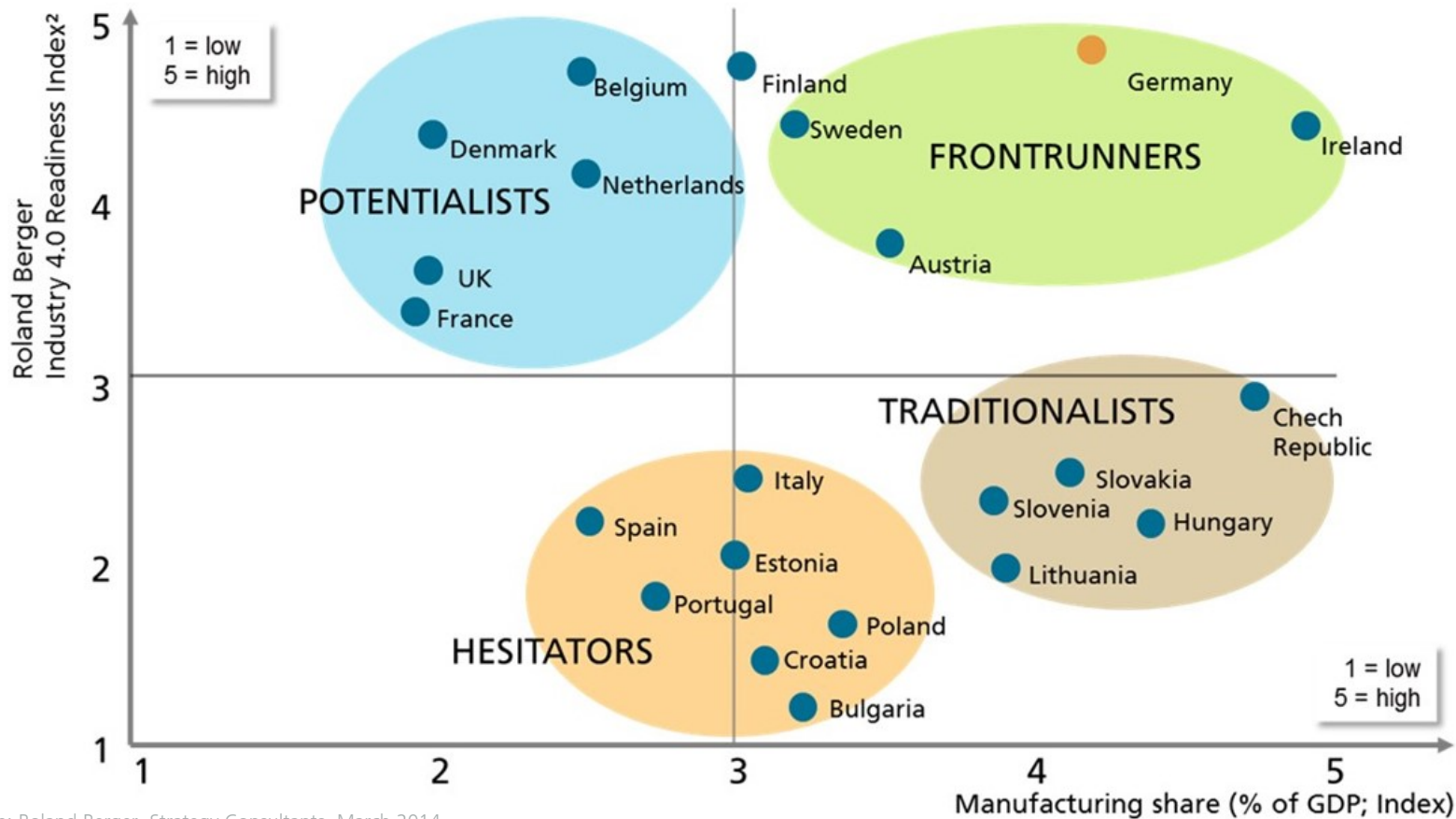


*Sofern nicht anders ausgewiesen, werden die Begriffe Industrie und Verarbeitendes Gewerbe synonym verwendet.

OECD 2016, BMWi 2014

Assessment of the Industry 4.0 Readiness

Germany as frontrunner has the best position in Europe



source: Roland Berger, Strategy Consultants, March 2014

²Adjusted for outliers Cyprus, Latvia, Luxemburg, Romania, Greece

Potential Economic Benefits by Industrie 4.0

Possible increase in Gross Value Added from 15% to 30% by 2025*

- Bitkom/IAO expects additional annual growth of 17% by 2025
- John Chambers, CEO Cisco: „... 2% of additional annual growth for the Germany economy...“**
- German businesses are planning to invest €40 billion over the next 5 years***

Wirtschaftsbereiche	Bruttowertschöpfung [Mrd. €]		Potenzial durch Industrie 4.0	Jährliche Steigerung	Steigerung [Mrd. €]
	2013	2025*	2013-25	2013-25	2013-25
Chemische Industrie	40,08	52,10	+30%	2,21%	12,02
Kraftwagen- und Kraftwagenteile	74,00	88,80	+20%	1,53%	14,80
Maschinen- und Anlagenbau	76,79	99,83	+30%	2,21%	23,04
Elektrische Ausrüstung	40,27	52,35	+30%	2,21%	12,08
Land- und Forstwirtschaft	18,55	21,33	+15%	1,17%	2,78
Informations- und Kommunikationstechnik	93,65	107,70	+15%	1,17%	14,05
Potenzial der 6 ausgewählten Branchen	343,34	422,11	+23%	1,74%	78,77
Beispielhafte Hochrechnung für die Gesamtbruttowertschöpfung in Deutschland	2.326,61	2.593,06**	+11,5%**	1,27%**	267,45**

* Bei den Hochrechnungen für 2025 wurde kein Wirtschaftswachstum berücksichtigt. Es handelt sich um eine reine Relativbetrachtung mit und ohne die Industrie 4.0-Potenziale für die sechs ausgewählten Branchen.

** Gesamtsumme enthält die Industrie 4.0-Potenziale für die sechs ausgewählten Branchen sowie die Hochrechnung der restlichen Branchen unter der Annahme, dass für diese ein Potenzial in Höhe von 50% des für die ausgewählten Branchen gilt.

sources: * Bitkom/IAO 2014, ** Sueddeutsche.de, *** PwC Studie 2014, wiwo.de

Industrie 4.0 Activities in Germany



German Platform Industrie 4.0

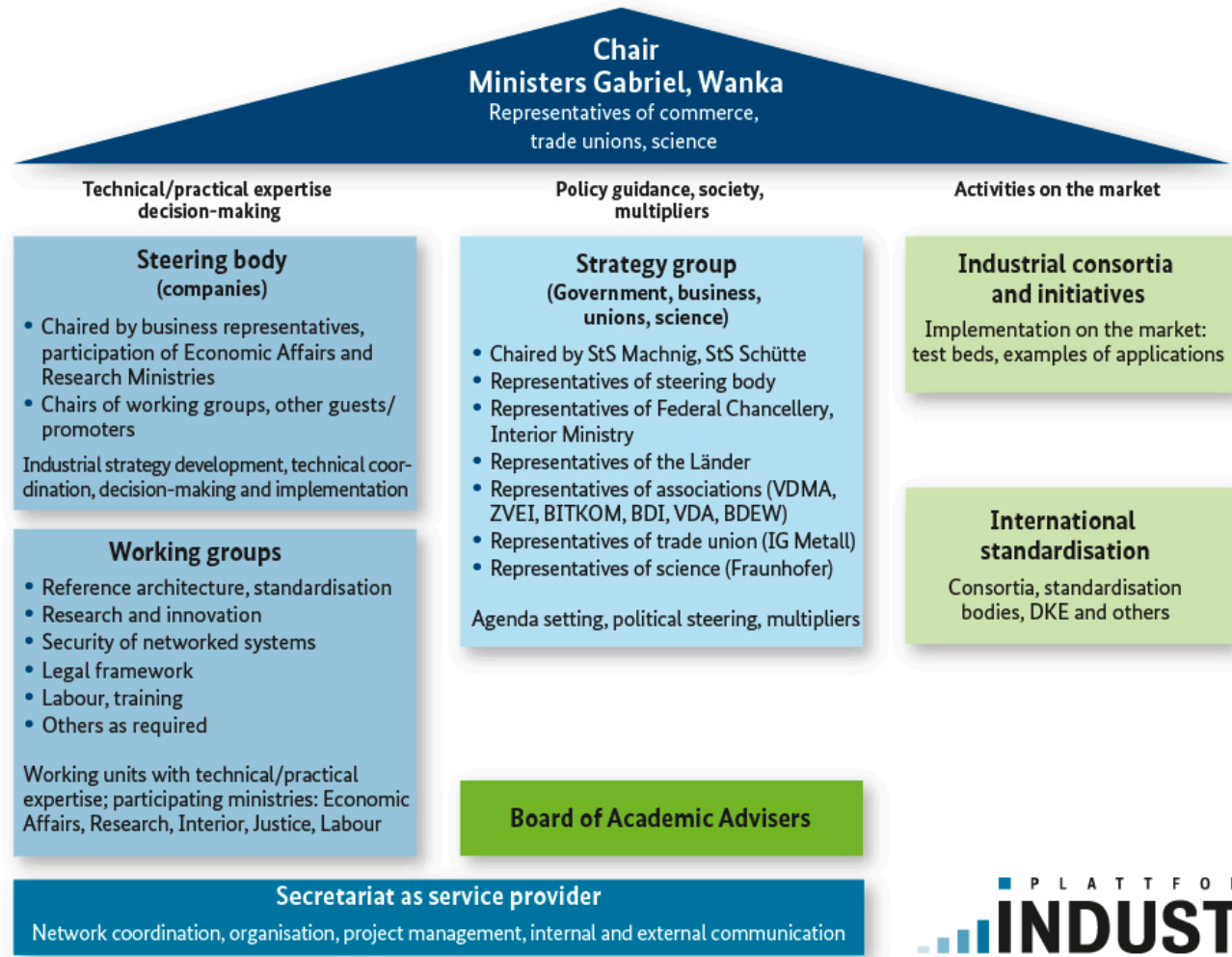
Securing and upgrading the international leading position of Germany in the manufacturing industry

- nationwide dialogue for the development of a harmonised understanding of Industrie 4.0
 - more than 55 companies
 - nine political organisations
 - six associations
 - one union
 - six representatives from science
- areas of activity
 - work 4.0
 - new security concepts for Industrie 4.0
 - common language for Industrie 4.0 technologies
 - legal framework for Industrie 4.0
 - Interdisciplinary collaboration as the basis for complex Industrie 4.0 technologies

source: plattform-i40.de



The Structure of the Platform Industrie 4.0



source: plattform-i40.de

■ P L A T T F O R M ■
INDUSTRIE4.0

Research Funding in Comparison

The race for access to customers has started



- Advanced manufacturing partnership (AMP): 50+ mio Dollar
- Cyber security R&D and standards: 45+ mio Dollar
- Cyber-physical systems: 40+ mio Dollar
- National network for production innovation (NNMI): 1 billion dollar
- Public-private partnerships, e.g. industrial internet consortium



- By 2015 1,2 trillion euro will be provided to reach the global technology leadership
- July 2014 founding of „China Internet and Industry Convergence Innovation Alliance“
- Target: promote digitalization of distribution and usage of ICT in production



- Funding of several initiatives for implementing the internet of things into production
- More than 9 billion euro are available

German Platform Industrie 4.0 and US Industrial Internet Consortium Cooperate

Joint road map ...

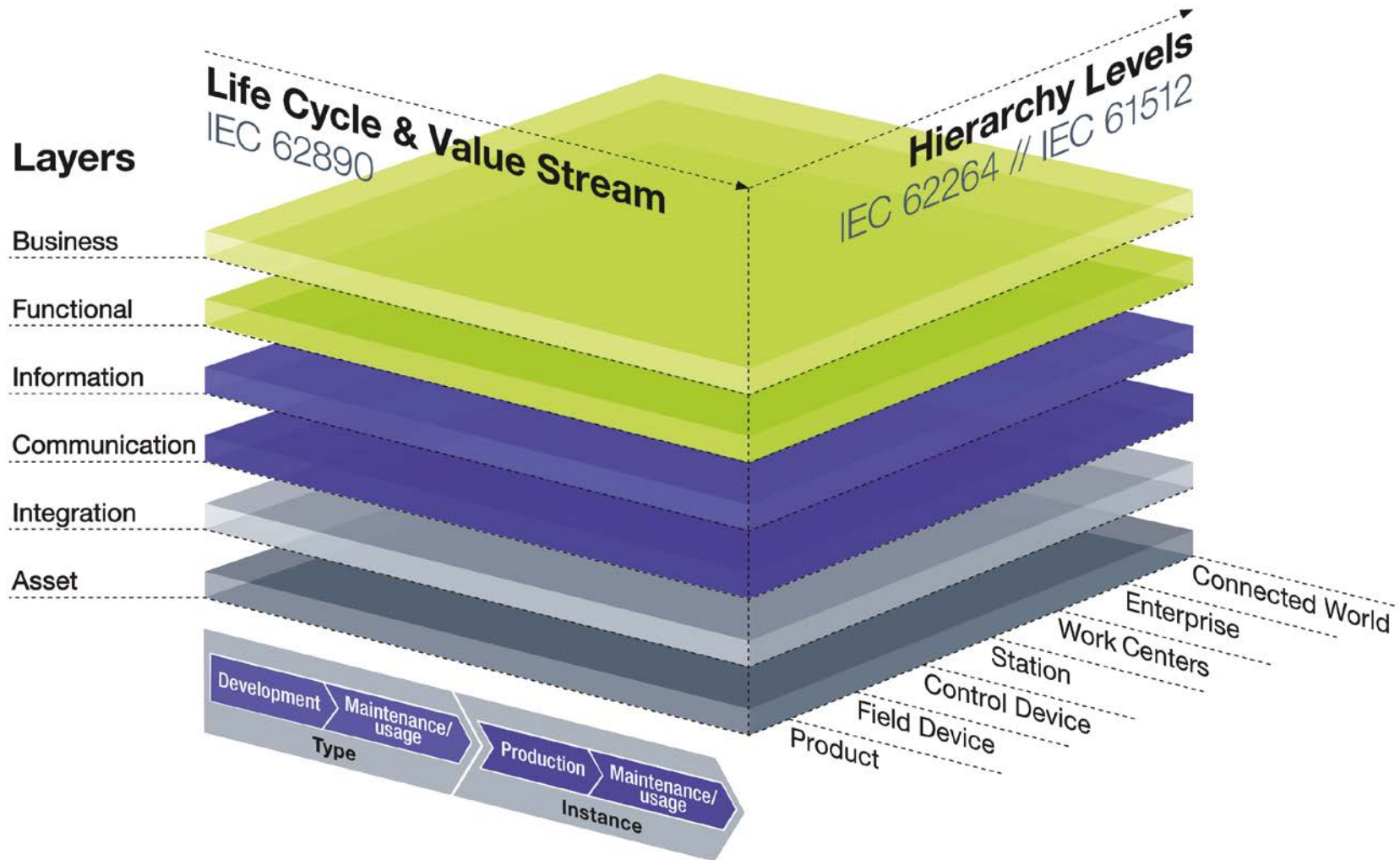
- for the achievement of an interoperability of the architecture models RAMI (reference architecture model for Industrie 4.0) and IIRA (Industrial Internet reference architecture)
- for joint initiatives in standardization and joint test environments



The German Standardisation Roadmap Industrie 4.0

- was published in first edition in November 2013, second edition in October 2015, development of third edition starts now
- describes the standardisation needs and the current situation
- lists the available standards and specifications already available for Industrie 4.0
- identifies and describes fields of activity
- gives recommendations
 - for the standardisation of Industrie 4.0 technologies
 - for the standardisation strategy (challenge »system of systems«)
- is a means of communication between the actors from automation technologies, ICT technologies and manufacturing technologies
- is a living document which is updated regularly

»Reference architecture model Industrie 4.0« (RAMI 4.0)



National Contact- and Coordination Center of the German Federal Ministry of Education and Research

Industrie 4.0 for SME

Goal

Accelerate and simplify the transfer of Industrie 4.0 technologies among application-oriented research institutes and SME to strengthen their competitiveness.

Focus

Component-, machine- and plant manufacturers

Support

Support of pilot projects for proving Industrie 4.0 products and components in Industrie 4.0 test beds

Focus: Industrie 4.0, Internet of Things (IoT), cyber-physical systems (CPS)



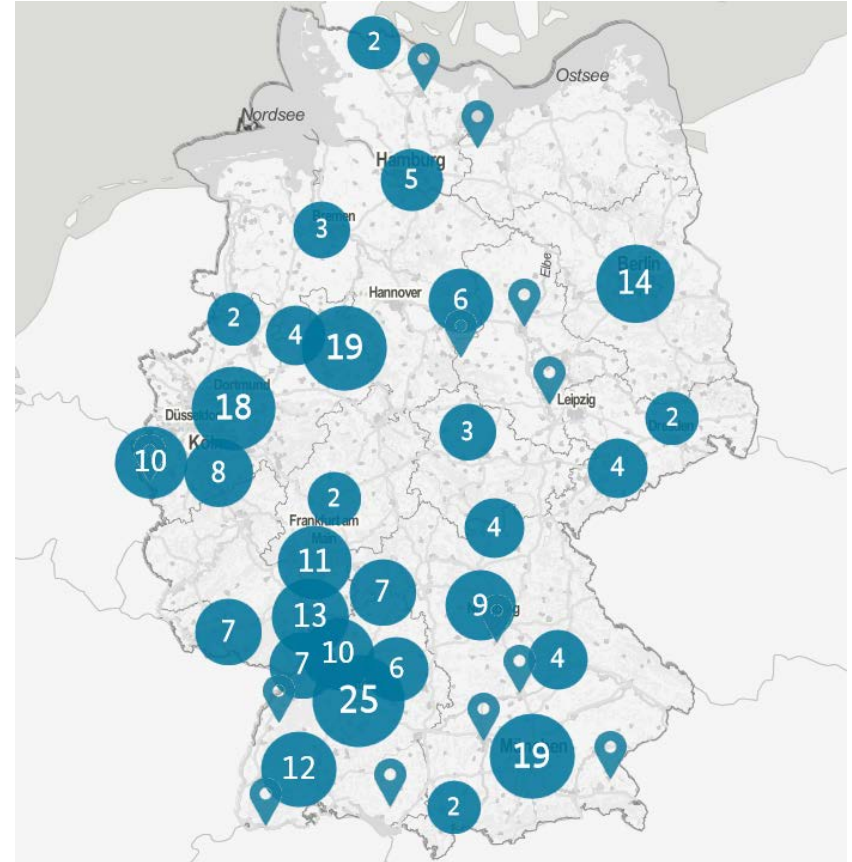
Mittelstand 4.0

Digital Production and Work Processes

- supported by the Federal Ministry for Economic Affairs and Energy
- helps SME and crafts enterprises with digitisation, networking and the practical use of Industrie 4.0
- competitiveness of enterprises should be strengthened and new business areas in the context of digitalization and Industry 4.0 should be developed
- nationwide programs are accessible:
 - four **Mittelstand 4.0 agencies** – Mittelstand 4.0 agency „**Cloud**“ (Stuttgart), „**Processes**“ (Dortmund), „**communication**“ (Berlin) and „**trade**“ (Cologne)
 - ten **Mittelstand 4.0 competence centres** Darmstadt, Kaiserslautern, Hannover, Berlin, Dortmund, Augsburg, Chemnitz, Hamburg, Ilmenau, Stuttgart
 - one **competence centre** „**Digitales Handwerk**“ (digital craft)

Industrie 4.0 is already in practice

- 251 application examples in Germany are already registered on Platform Industrie 4.0.
- 75 of those are in Baden-Württemberg
- Application examples in the region of Stuttgart:
 - **Arena 2036:** Research campus for the next generation of automobiles, University of Stuttgart
 - **Festo Lernfabrik:** Flexible assembly lines, Ostfildern
 - **SEW Eurodrive Smart Factory:** Concepts for tasks in logistics, assembly and production, Bruchsal



source: plattform-i40.de

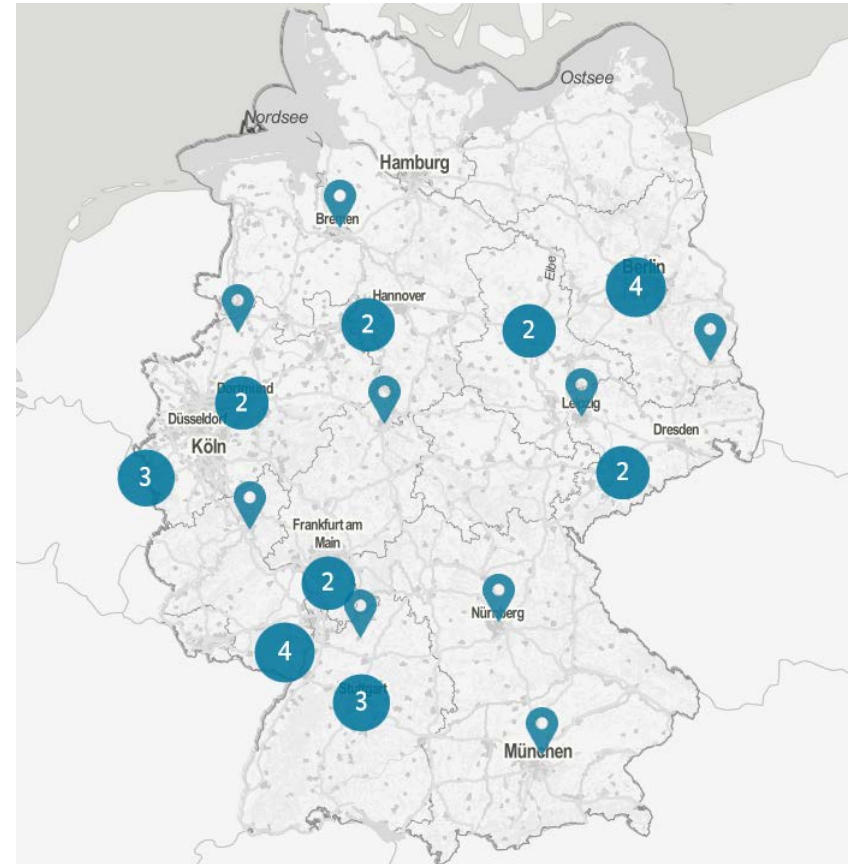
Test beds

As entry assistance for SME

There are 33 test and competence centers in Germany.

Six of those are in Baden-Wuerttemberg.

- **Application Center Industrie 4.0**
at Fraunhofer IPA, Stuttgart
- **Digital Engineering Lab**
at Fraunhofer IAO, Stuttgart
- **Smart Data Innovation Lab** at
Karlsruhe Institute of Technology, Karlsruhe
- **FZI Living Lab smartAutomation/
Service Robotics**, Fellbach
- **Demo-Center Virtual Engineering**,
Research Center for Information Technology
at Karlsruhe Institute of Technology,
Karlsruhe



source: plattform-i40.de, bmbf.de

A person in a light blue suit is holding a laptop. The image is heavily layered with digital and network motifs. A complex network of black dots connected by thin lines is overlaid across the entire scene. In the background, there are faint, blue-tinted images of server racks and a globe. The overall color palette is dominated by light blues and greys, with the text in a contrasting teal-green.

Lighthouse Projects in Germany

Robots will be mobile, flexible and safe

Example: SEW Eurodrive – freely navigating DTS (carries the robot for bin picking)



source: IPA

All Objects in a Factory will be Mobile as Far as Possible

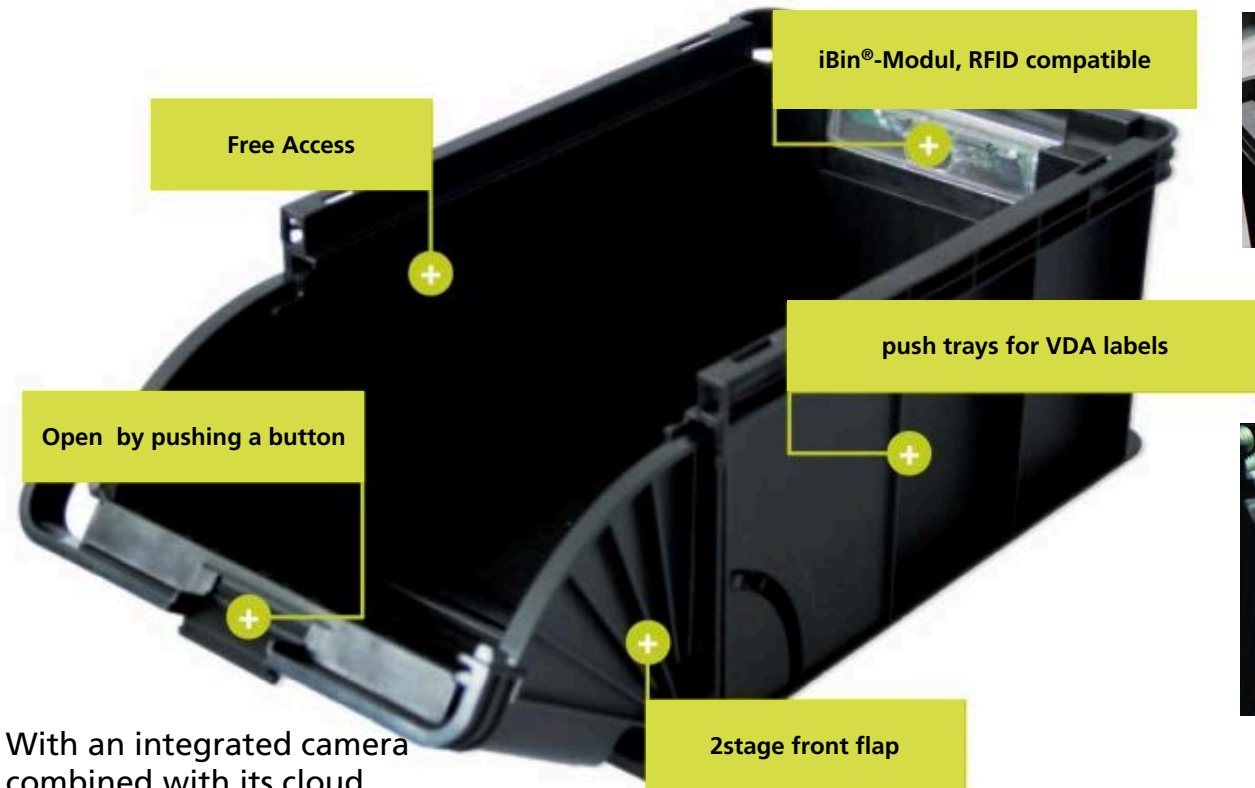
Example: Audi R8 – freely navigating AGV (navigation as a service)



source: audi-mediaservices.com

All Objects in a Factory will be Smart

iBin – Intelligent bins order their filling autonomously



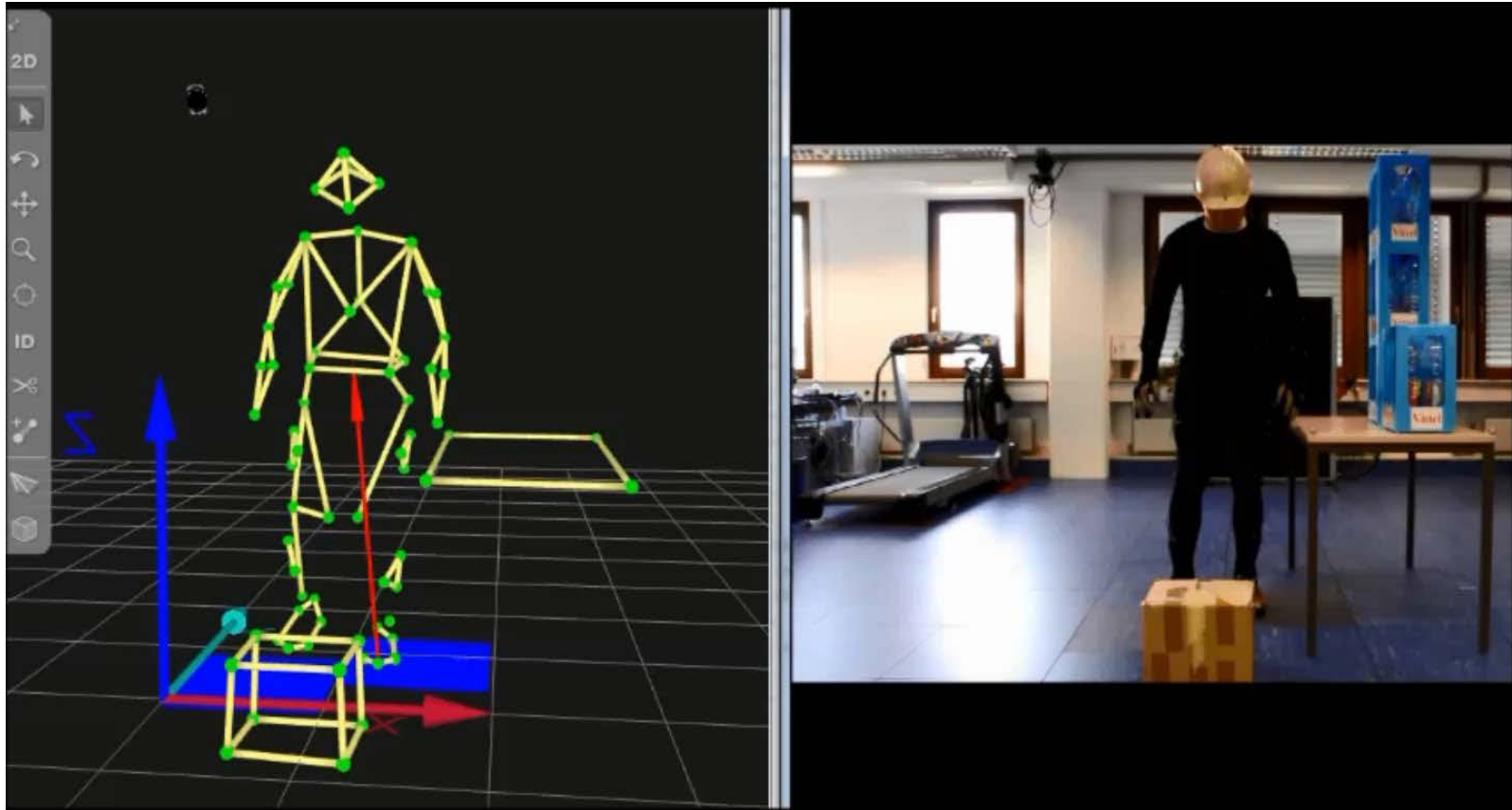
With an integrated camera combined with its cloud, iBin counts the parts enclosed in it.

source: Fraunhofer IML, Prof. Dr. Michael ten Hompel



All Entities of a Factory have a Digital Shadow

Example: Motion Capturing for feed-back of real processes into planning models



Business Ecosystems

„Farmnet 365“ – an agricultural machinery initiative



■ Online Tracking

Real time access to farm information
any time from anywhere

■ Traceability

Digital, automated and
complete documentation

■ Transparency

Integration of
all farm processes

■ Efficiency

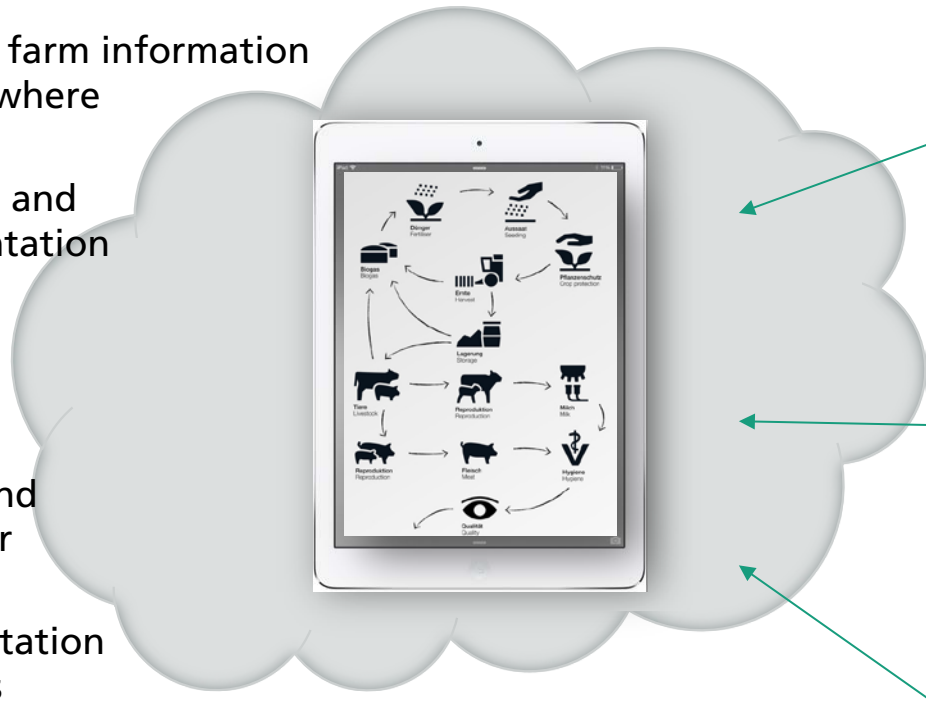
Decision support and
knowledge transfer

■ Quality

Tracking, documentation
and early warnings

■ Analytics

Prediction, Big Data processing



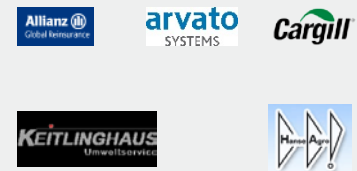
Machines



Equipment



Content



source: farmnet



Industrie 4.0 Activities in Baden-Württemberg

4.0

A large white 3D '4.0' sign is positioned in the center of the frame, resting on a metal rail of an industrial assembly line. The background shows a blurred factory environment with various mechanical components and lighting. The sign is the focal point, symbolizing Industry 4.0.

Baden-Württemberg Uses the Chances

Allianz Industrie 4.0

- Network initiated and funded by the state of Baden-Württemberg
- Aim: pool resources and know-how from production, information and communication technology in order to assist companies in their digital transformation process
- Topics
 - Cyber-physical systems
 - IT-systems, interlinking and business models
 - Production planning and -control
- Partners: Arena 2036 e. V., VDI, VDMA, Fraunhofer IPA, IG Metall BW, Manufuture BW e.V., Leichtbau BW GmbH



ARENA2036 – Stuttgart Research Campus

Active Research Environment for the Next Generation of Automobiles



Future Project Virtual Fort Knox

Security and transparency builds trust

Safe, federative platform for service-oriented applications (Apps) for mechanical and plant engineering

Funded by:



Future is our product
Sustainable. Personalized. Smart.



Dr Günter Hörcher
Research Strategy

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