

The Digital Transformation of Manufacturing Industries: Revolution or Evolution?

22 November, 2016

Opening Evening in the Munich Residenz

 **acatech**

NATIONAL ACADEMY OF
SCIENCE AND ENGINEERING



Industrie 4.0 in a Global Context Strategies for the Cooperation with International Partners

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DEUTSCHE AKADEMIE DER
TECHNIKWISSENSCHAFTEN

HEINZ NIXDORF INSTITUT
UNIVERSITÄT PADERBORN

WZL
RWTHAACHEN

 Datenverarbeitung
in der
Konstruktion

 TECHNISCHE
UNIVERSITÄT
DARMSTADT

 Deutsches
Forschungszentrum
für Künstliche
Intelligenz GmbH

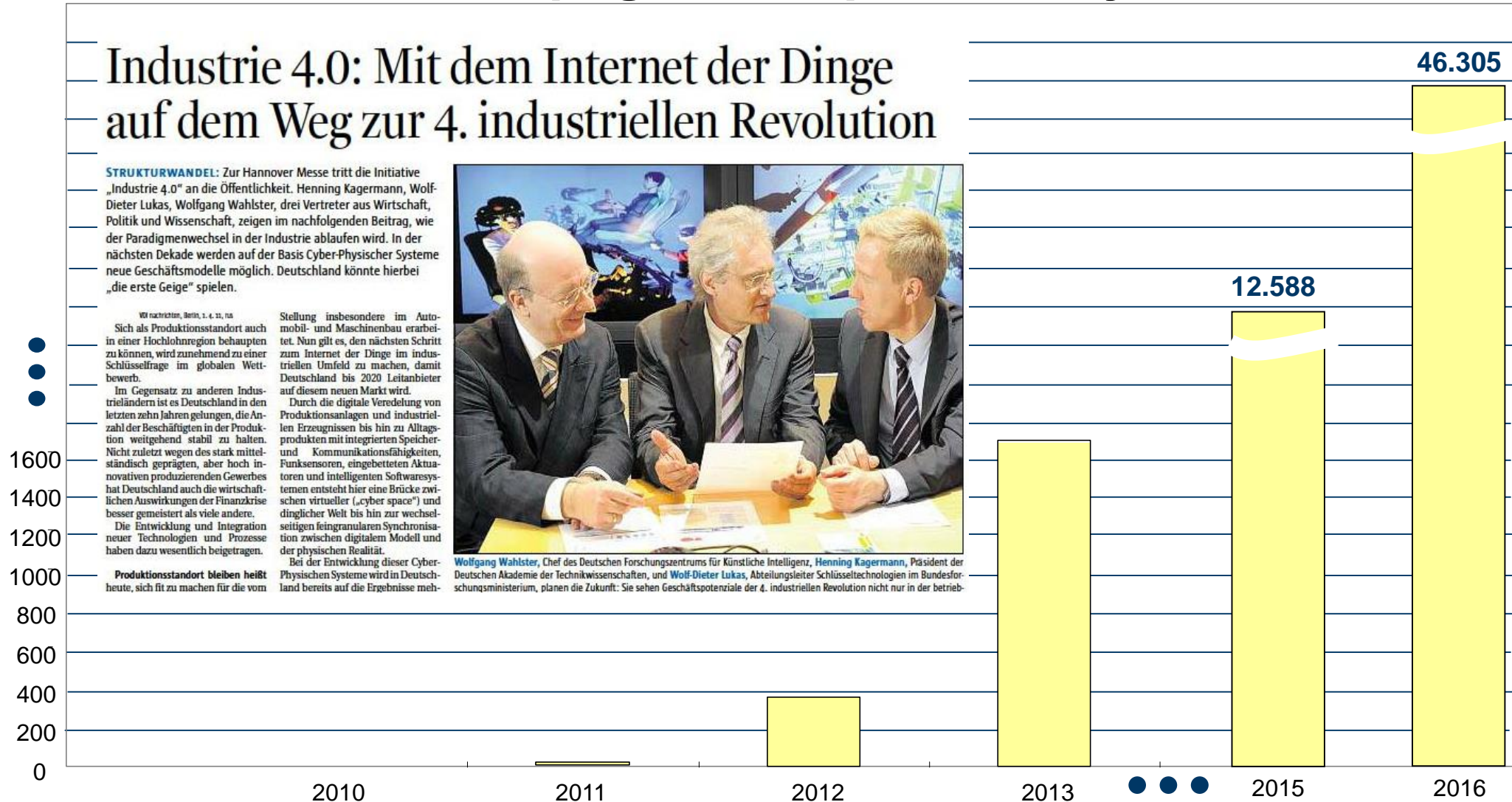
Project Design

Industrie 4.0 Global

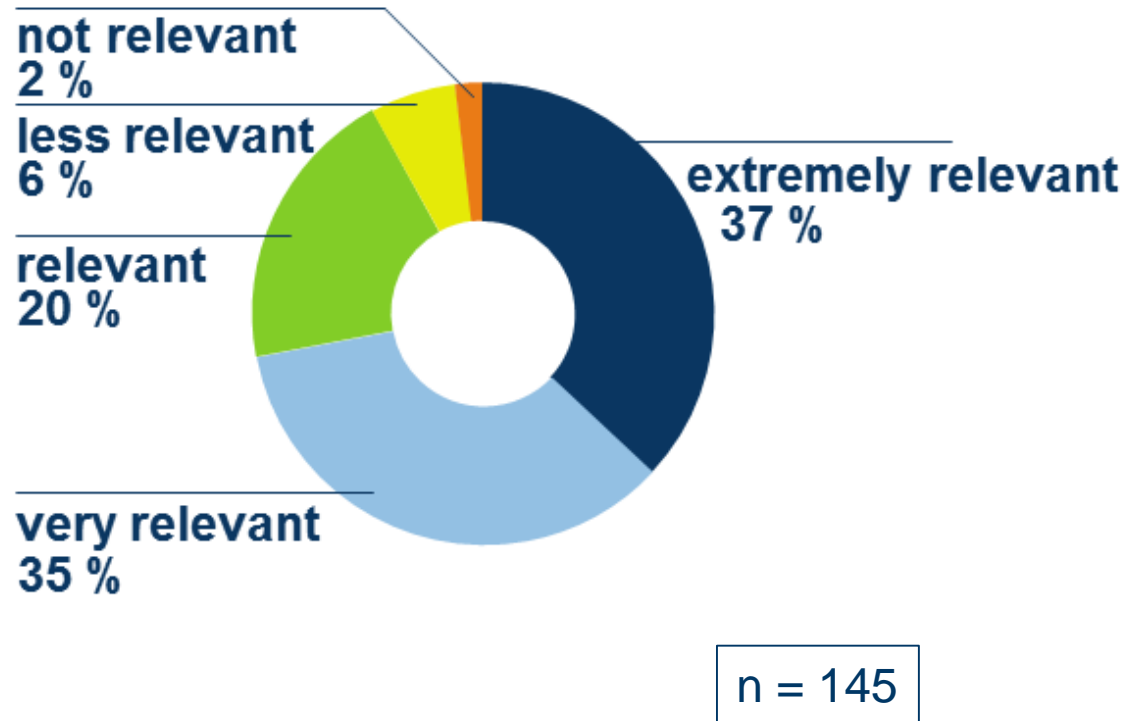
- **Objectives:** Opportunities and challenges of international cooperation in respect to the importance of Industrie 4.0-standards:
 - In-deph analysis of the **importance of standards**.
 - Development of **country profiles** for major Industrie 4.0-partner countries.
 - Providing advice for companies, politics & organizations on the **chances & challenges** of international cooperation within Industrie 4.0.
- **Important outcome:** Outline of major areas of cooperation within Industrie 4.0 & analysis of major partner countries.



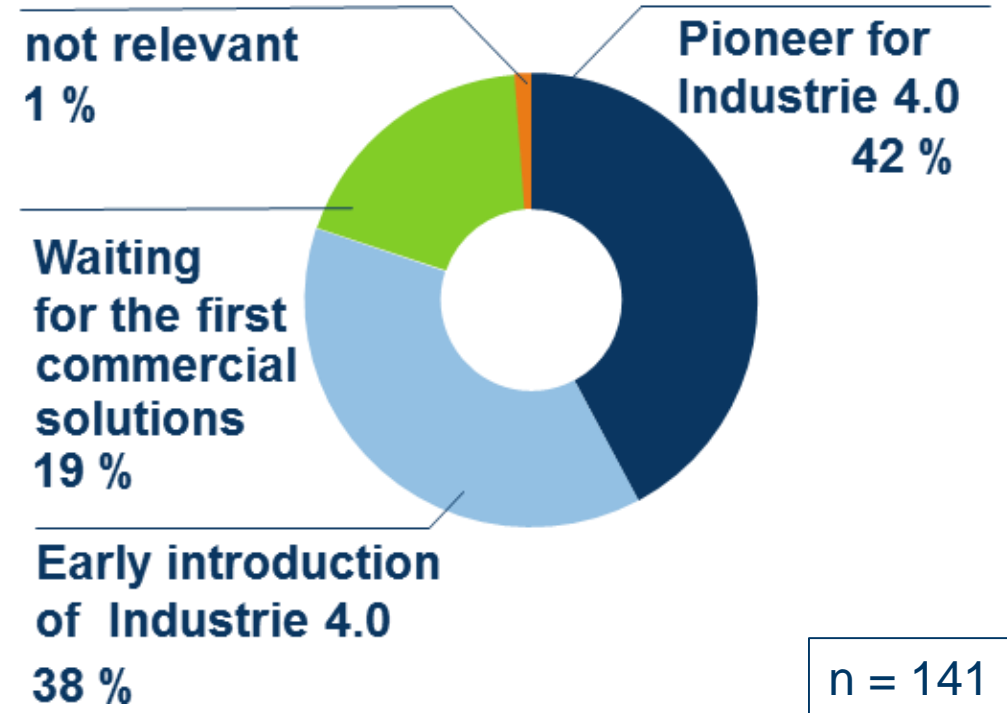
After Our Initial Publication in April 2011 the German Term „Industrie 4.0“ was Propagated Exponentially Worldwide



The Importance of Industrie 4.0 and Open Standards



The importance of Industrie 4.0 for my company



The importance of open standards for Industrie 4.0

Industrie 4.0 as a Megatrend in the US

Proclamation

City of Cincinnati

Be It Proclaimed:

Whereas, Dr. Jay Lee, Dept of Mechanical and Materials Engineering of the University of Cincinnati and the IMS Center have been at the forefront of the Industry 4.0 global revolution in manufacturing technology; and

Whereas, Dr. Jay Lee, Dept of Mechanical and Materials Engineering of the University of Cincinnati and the IMS Center/Industry 4.0 will enhance Cincinnati's stature as a city that provides global leadership in technology; and

Whereas, Dr. Jay Lee, Dept of Mechanical and Materials Engineering of the University of Cincinnati and the IMS Center/Industry 4.0 will help Cincinnati regain its former glory as a city riding the wave of new manufacturing revolutions; and

Whereas, Dr. Jay Lee, Dept of Mechanical and Materials Engineering of the University of Cincinnati and the IMS Center/Industry 4.0 and their work helping manufacturers increase their productivity, and therefore, create new wealth in investment capital and jobs for the Cincinnati region.

Now, Therefore, I, John Cranley,

*Mayor of the City of Cincinnati do hereby proclaim December 1, 2014
As*

"Cincinnati to be the Industry 4.0 Demonstration City"

in Cincinnati.



IN WITNESS WHEREOF, I have hereunto set my hand and caused this seal of the City of Cincinnati to be affixed this first day of December in the year Two Thousand and Fourteen.

*John Cranley, Mayor
City of Cincinnati*

Patrick Rülke
Industry 4.0 Liaison
Operational Excellence

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New Joint Innovation Laboratory MRK4.0 for Human-Robot Collaboration in Industrie 4.0



Czech PM Bohuslav Sobotka and Chancellor Dr. Angela Merkel at the signing ceremony with Prof. Marik and Prof. Wahlster in Prague



Investment Grant for Equipment
Lightweight Robots and Wearables 1 Mio. €
Living Lab for Support of Small and Medium Enterprises



SPONSORED BY THE

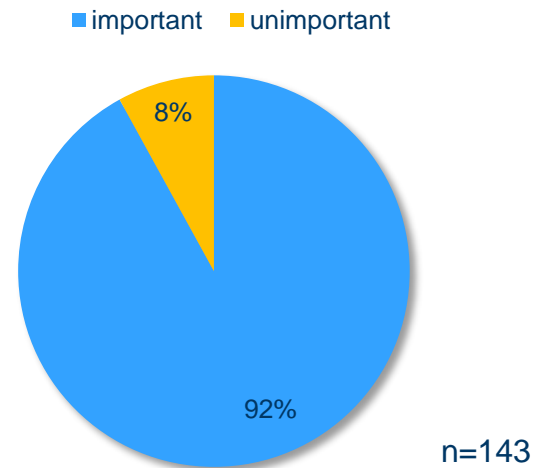
Federal Ministry of Education and Research



Open standards & interoperability

Interoperable Solutions

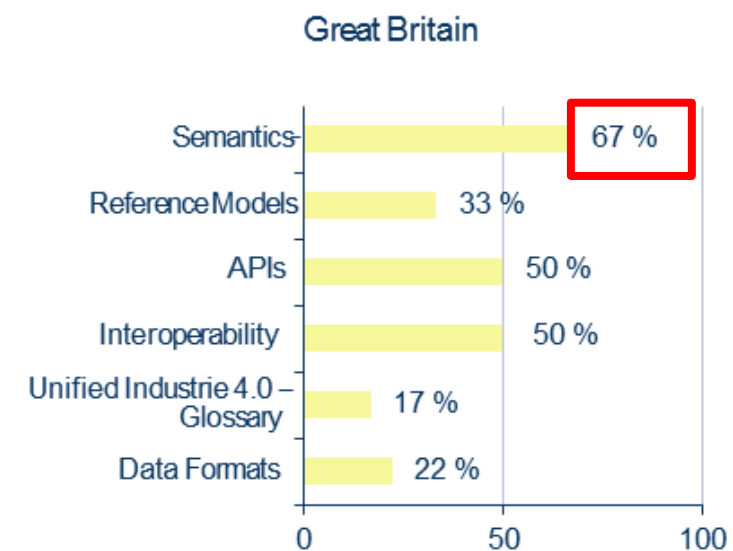
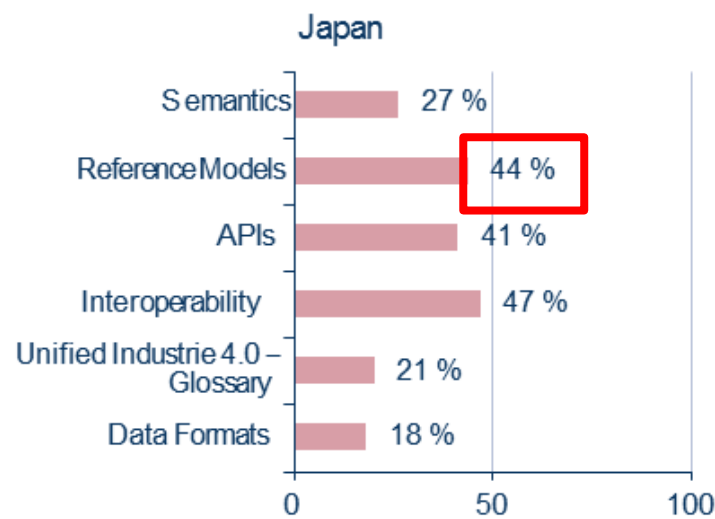
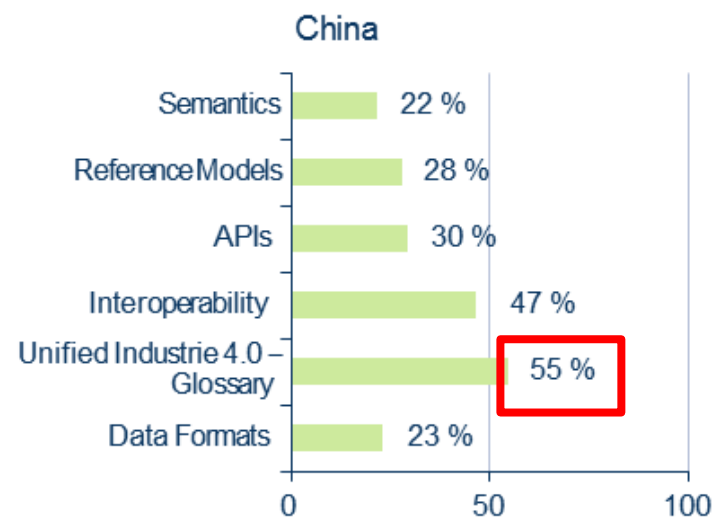
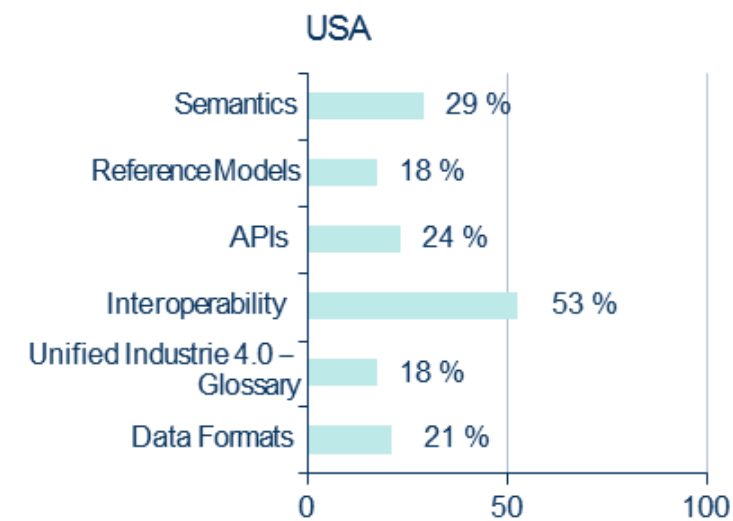
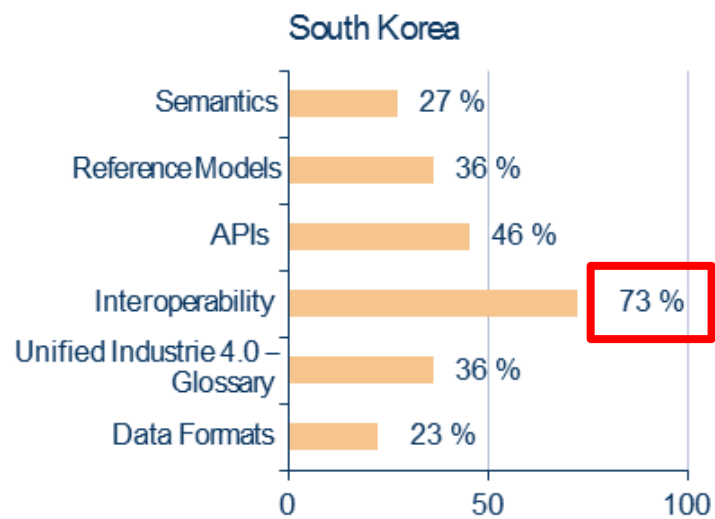
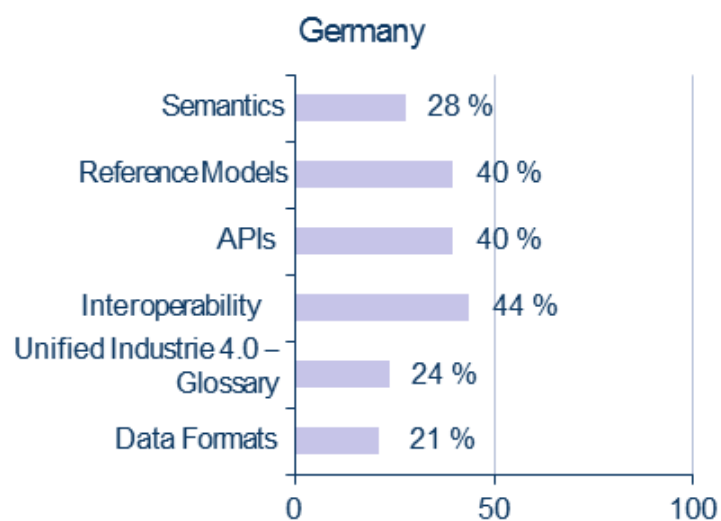
➤ Importance of open standards & interoperability:



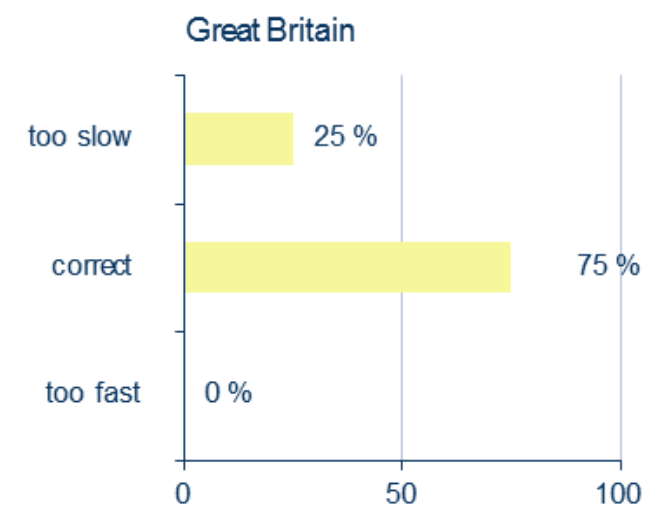
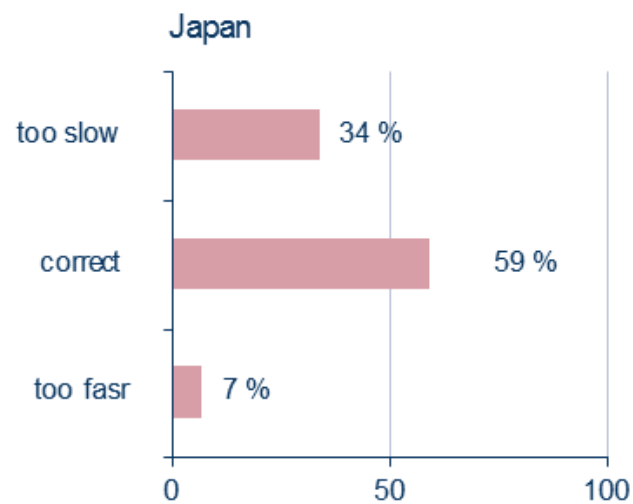
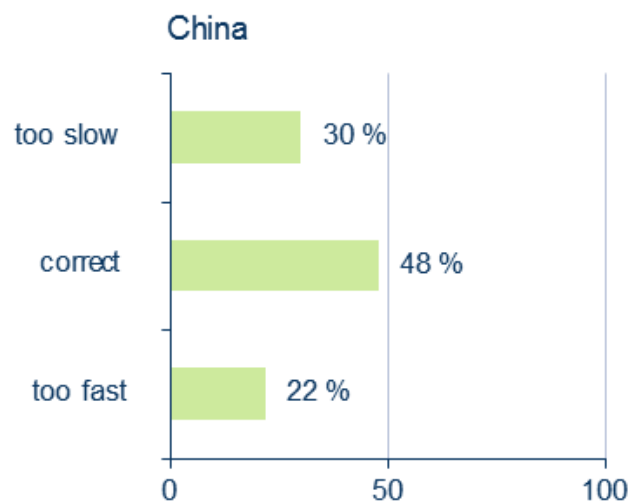
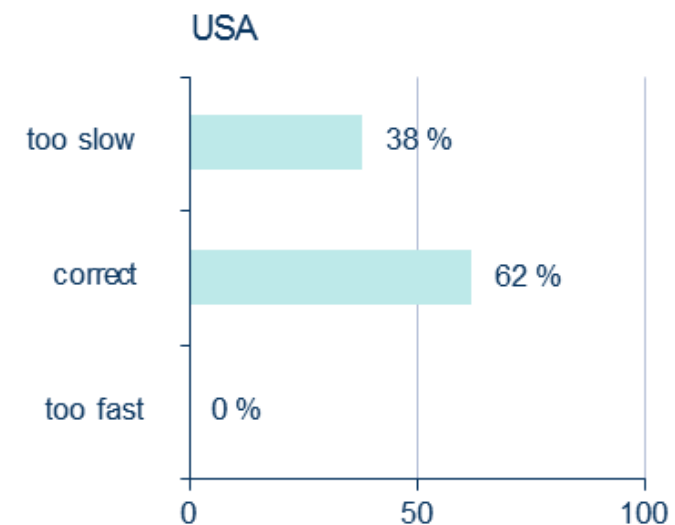
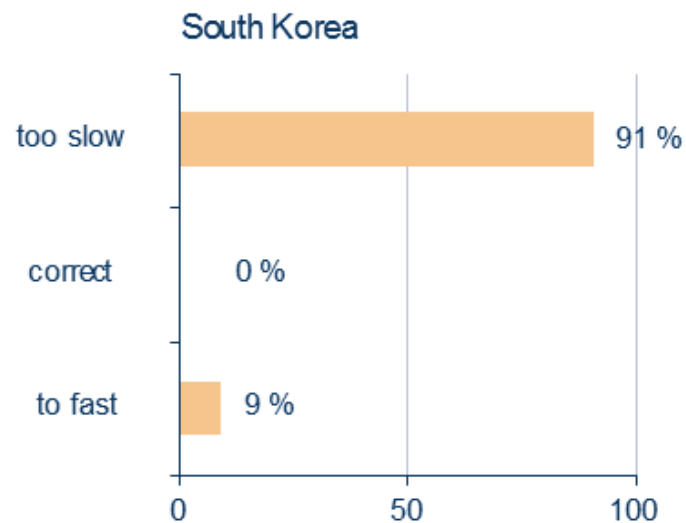
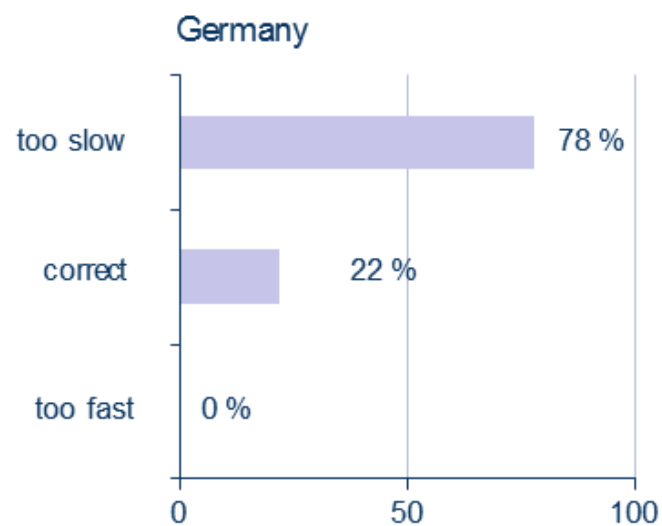
- Flexible and interoperable solutions between systems are essential > **extensibility of systems.**
- **Fast & cost-efficient** solutions for a broad customer base.
- **Reduction of R&D costs** and investment risks for SMEs.

- Reducing the risks of **technological lock-ins** on the **buyer side** of proprietary **silosolutions** (especially for SME); on the **supplier side**: Reducing the risk of developing products **not demanded** by the market.
- There will not be „**the one**“ Industrie 4.0 standard but **multiple standards** and interoperable solutions.

Main Topics for International Standardization



The Speed of Standardization



Country Profiles

Germany



- Strong **industrial basis & IT**
- Early recognition of the **disruptive potential**.
- Challenges in the **implementation** of the Industrie 4.0 strategy (SME, Security, data law).
- Most important stakeholder: **politics, companies, associations & unions**.
- **Data-driven business models** and digital ecosystems should **more be focus** in the future.

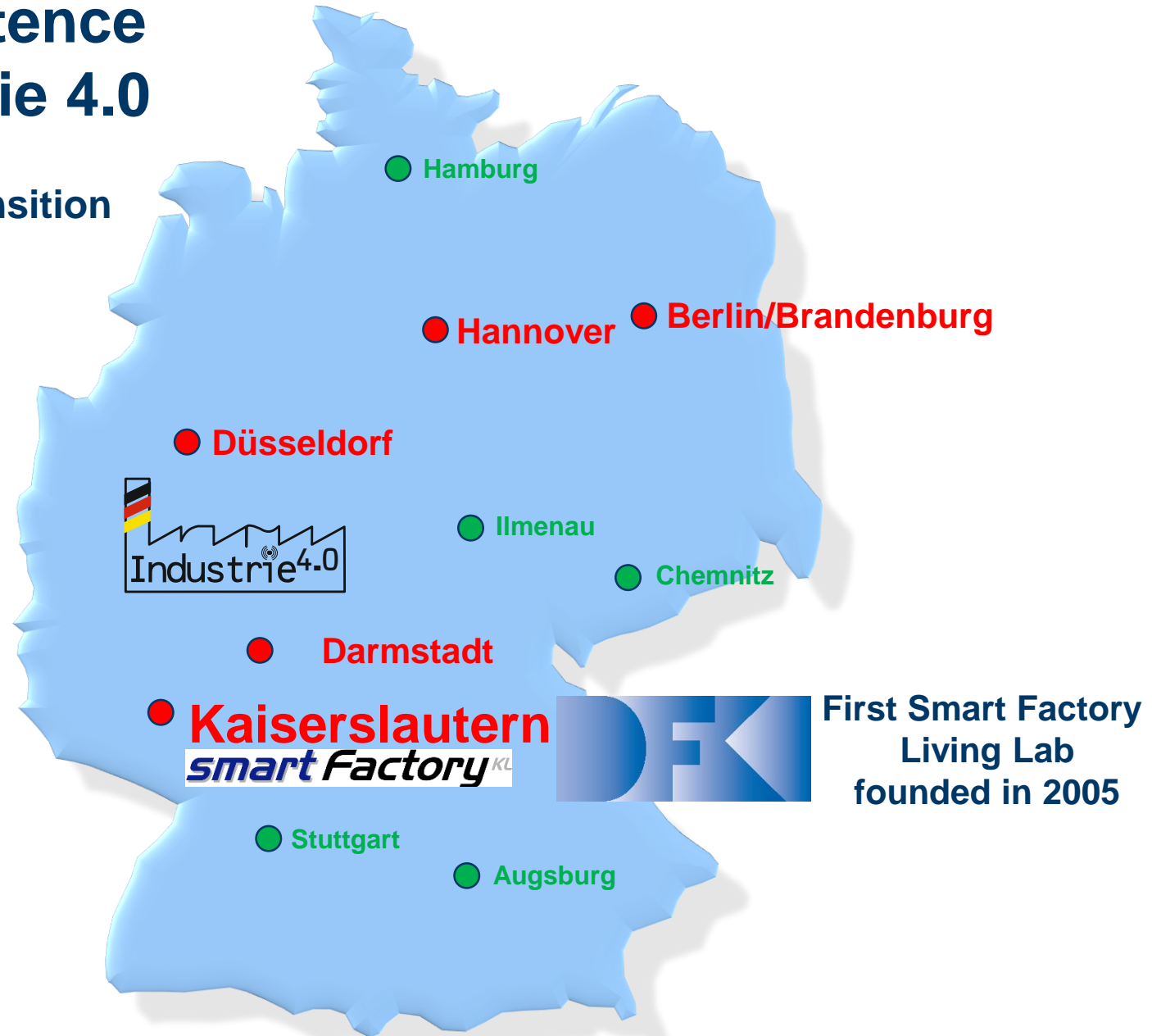
10 German Competence Centers for Industrie 4.0

Helping SME's during the transition phase to Industrie 4.0

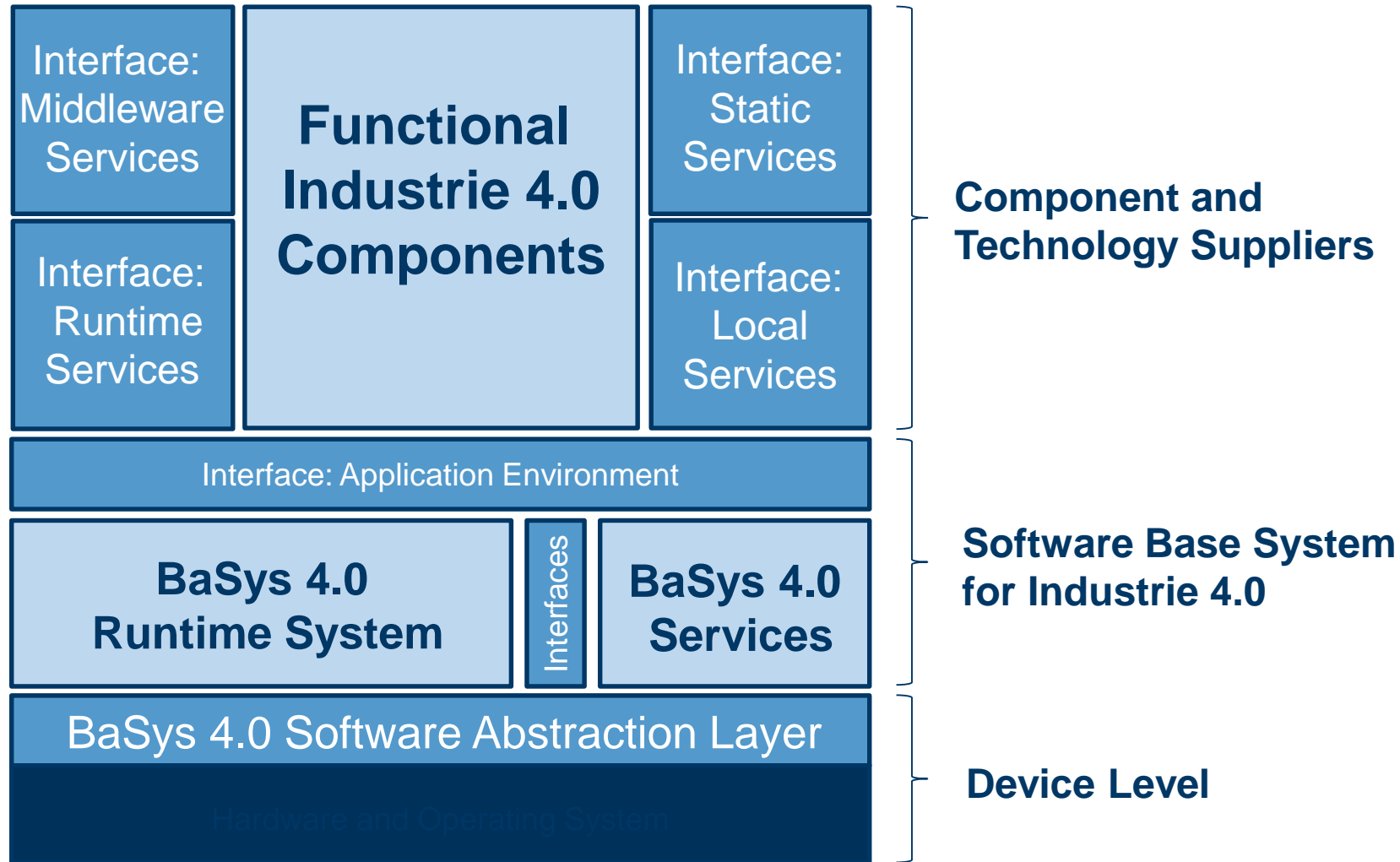


**Core Centers selected
In First Round in 2015**

**Secondary Centers
selected in 2016**

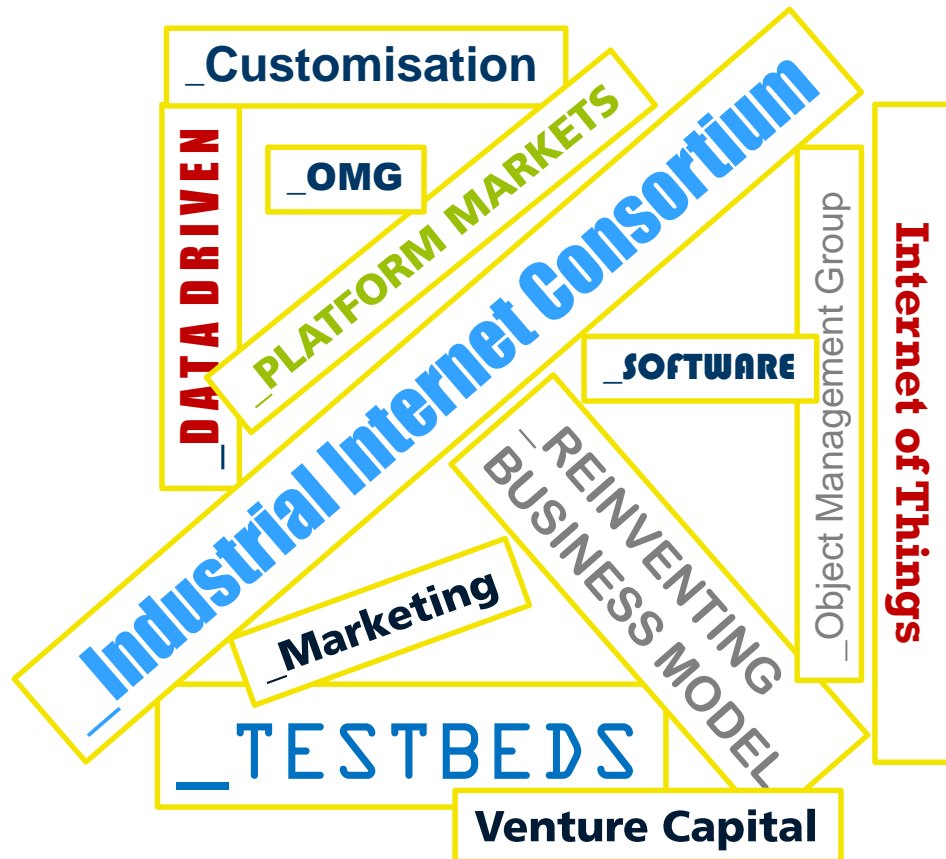


BaSys: an open system architecture for Industrie 4.0 like AUTOSAR for vehicle manufacturers



Country Profiles

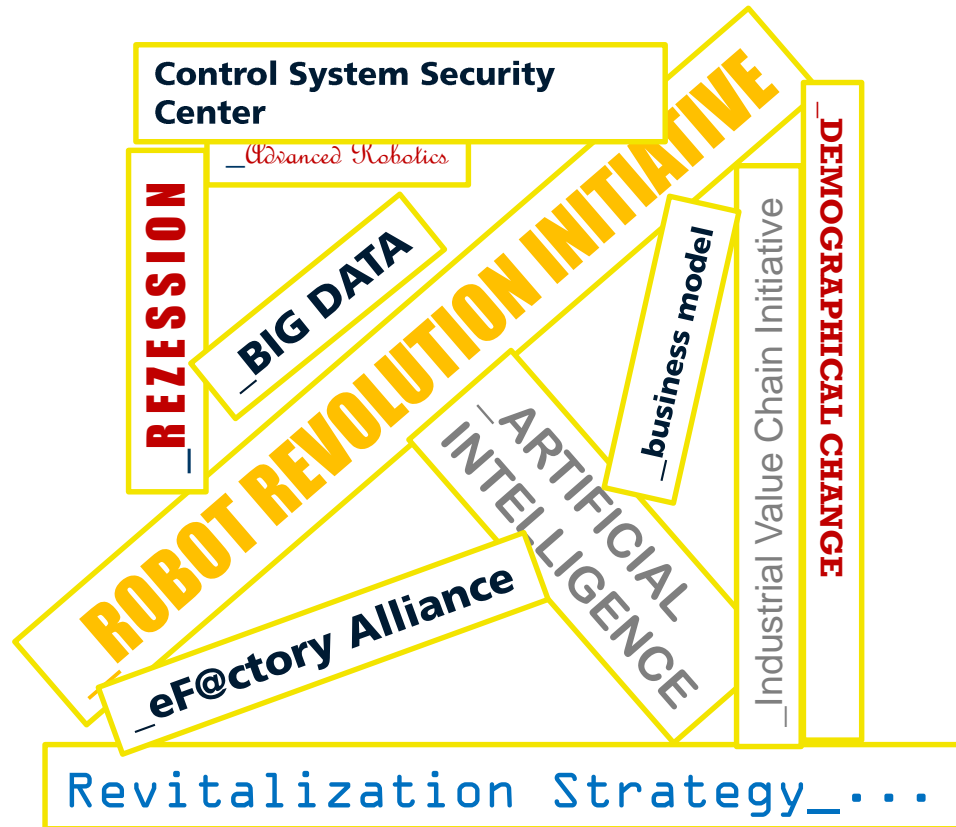
USA



- Strong focus on **data-driven business models**.
- Strong **private associations & organisations** (e.g. IIC).
- **VC-driven** Industrie 4.0 start-ups.
- Strong interests from **Internet- & Software-companies** on Industrie 4.0.

Country Profiles

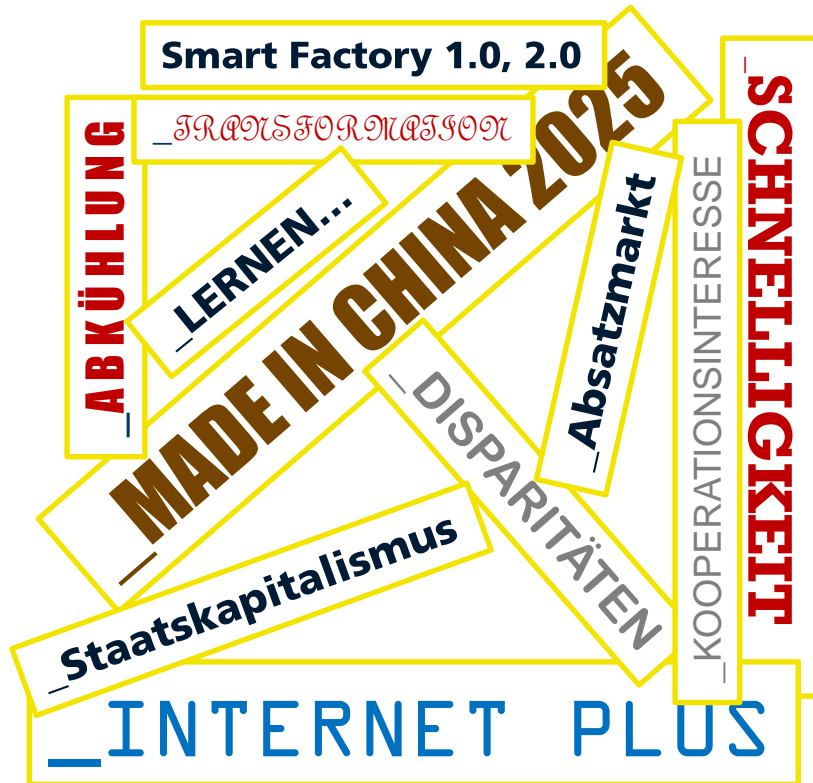
Japan



- Strong **national standardization** for the Japanese industry via the Japanese Industrial Standards Committee (counterpart to DIN).
- Tights relations to ISO, ITU, IEC & **international Consortia** (e.g. W3C).
- Japanese companies are advanced regarding the **implementation of Industrie 4.0.**

Country Profiles

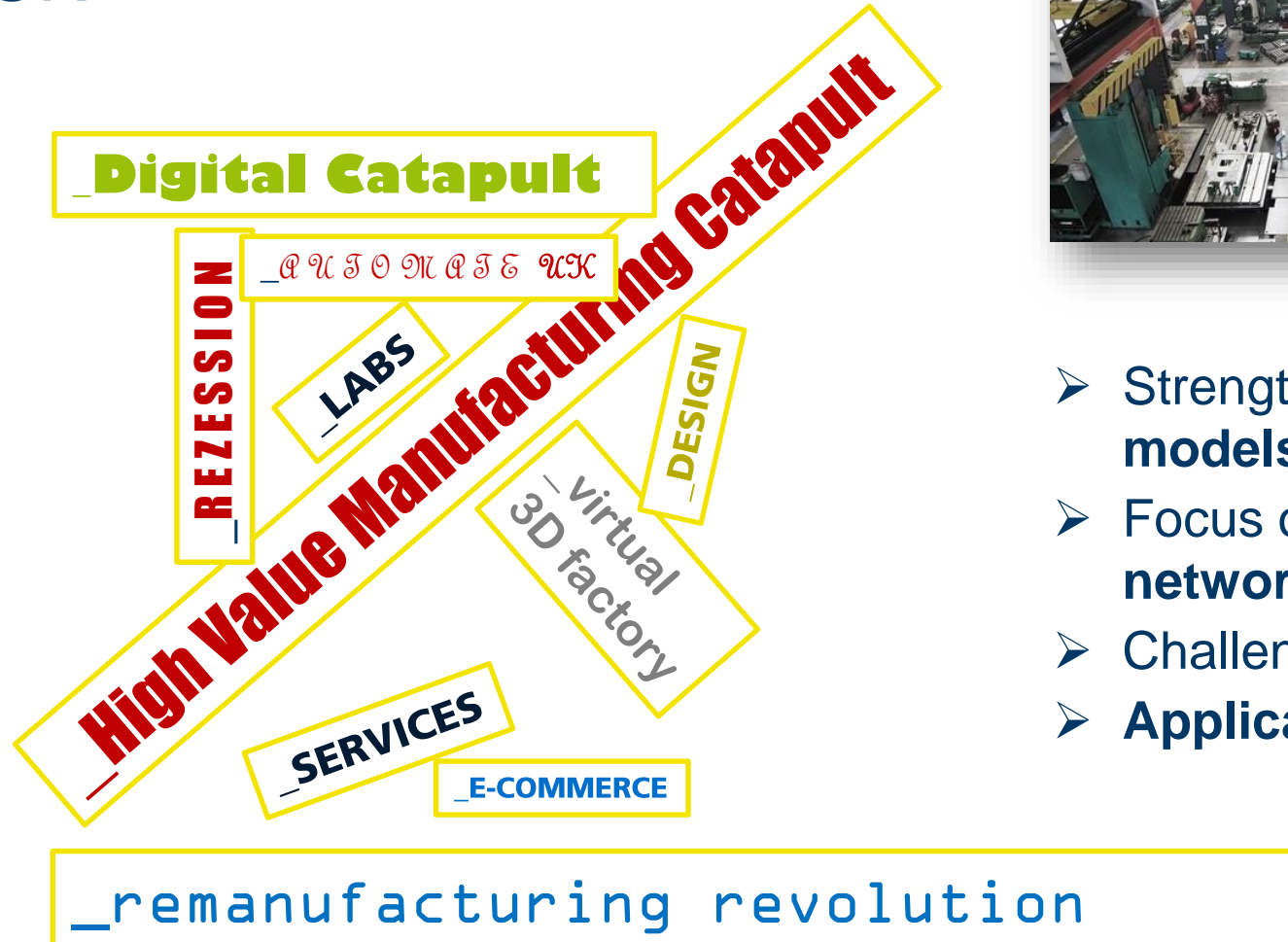
China



- Goal of „**Made in China 2025**“: Economic transformation and international **supplier** of Industrie 4.0-solutions.
- **Disparities** between **large, international corporations** & government-owned **SME**.
- High interest in international cooperation & **technology transfer**.

Country Profiles

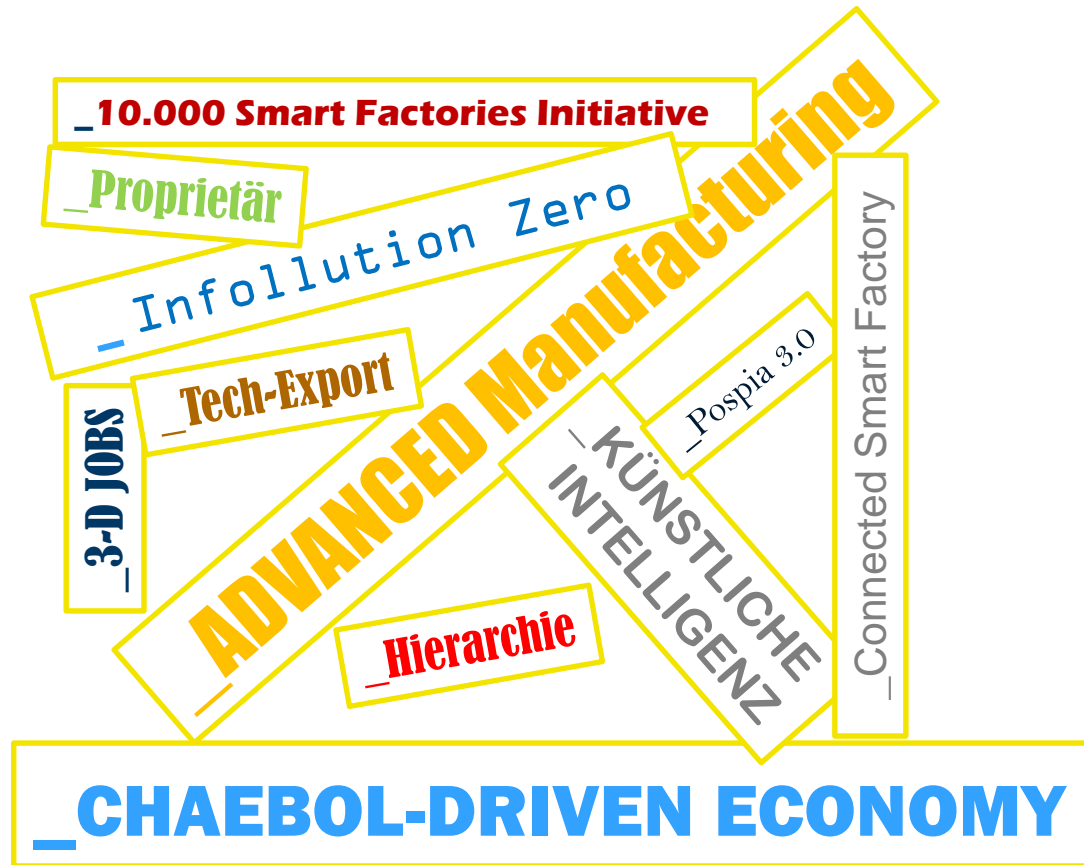
UK



- Strengths in **smart services & new business models**.
- Focus on **automation & integration of networks**.
- Challenges in the **re-industrialization** process.
- **Application-oriented** research (Catapult).

Country Profiles

South Korea

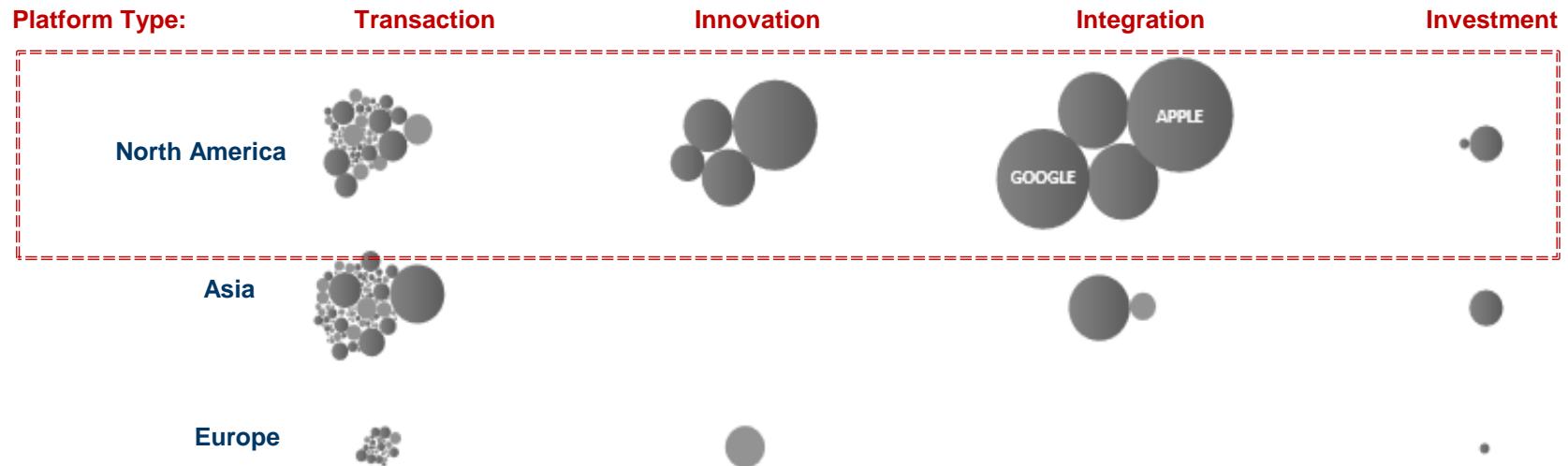


- Dominance of **Chaebols** & relatively low autonomy of SME.
- Government Goal: 10.000 „Smart Factories“ & **higher efficiency in production** among SME.
- **Import** of Industrie 4.0 solutions and **export** of high quality products.
- Strengths in **IT-infrastructure**.

Chances & Challenges

International Challenges

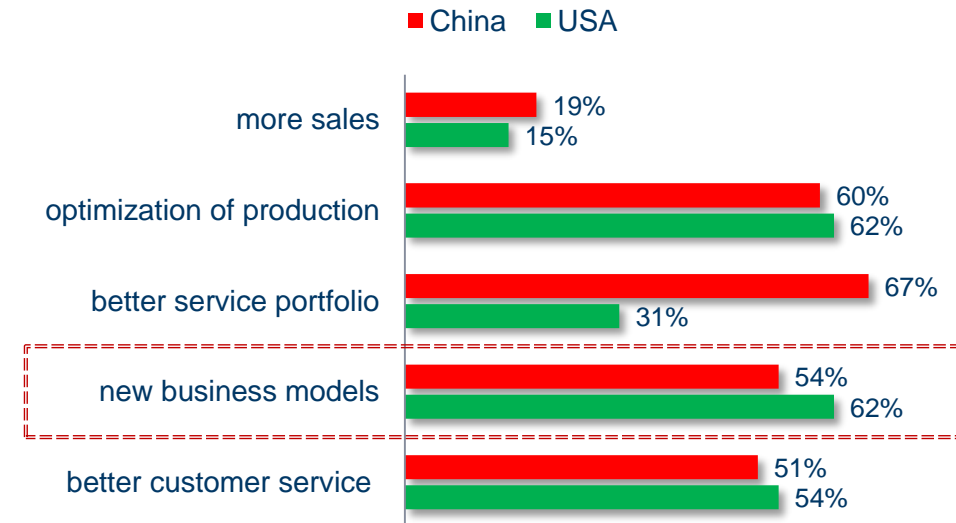
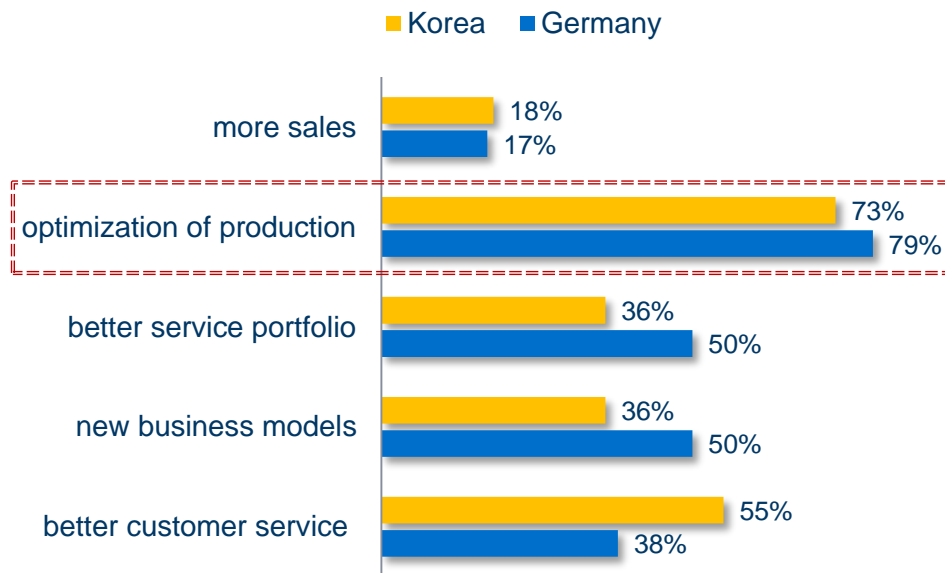
- **USA:** Innovative Silicon Valley start-ups, venture capitalists, internet-corporations focus on Industrie 4.0.
- **China:** Contextual connection between new business models and intelligent integration “China2025” and “InternetPlus”.
- Major **challenges** for **Germany & Korea:** Building-up in-depth IT-competencies & overcome shortfall of innovative business models
- Large domestic markets + critical masses = **strong ecosystems.**



Chances & Challenges

Specific Chances of Industrie 4.0

- **Germany & South Korea:** Focus on intelligent and smart factories & production efficiency > strengthening of national production sites (resourcing)!
- **USA & China:** Strong focus on new business models, platform economics & intelligent products.



n=143

Open standards & interoperability

Investment restraint

- Gap between **international corporations** & **national SME**, regarding resources, international networks and opportunities to join several international standard organisations.
- How to overcome the **penguin-effect** for SMEs?



Open standards & interoperability

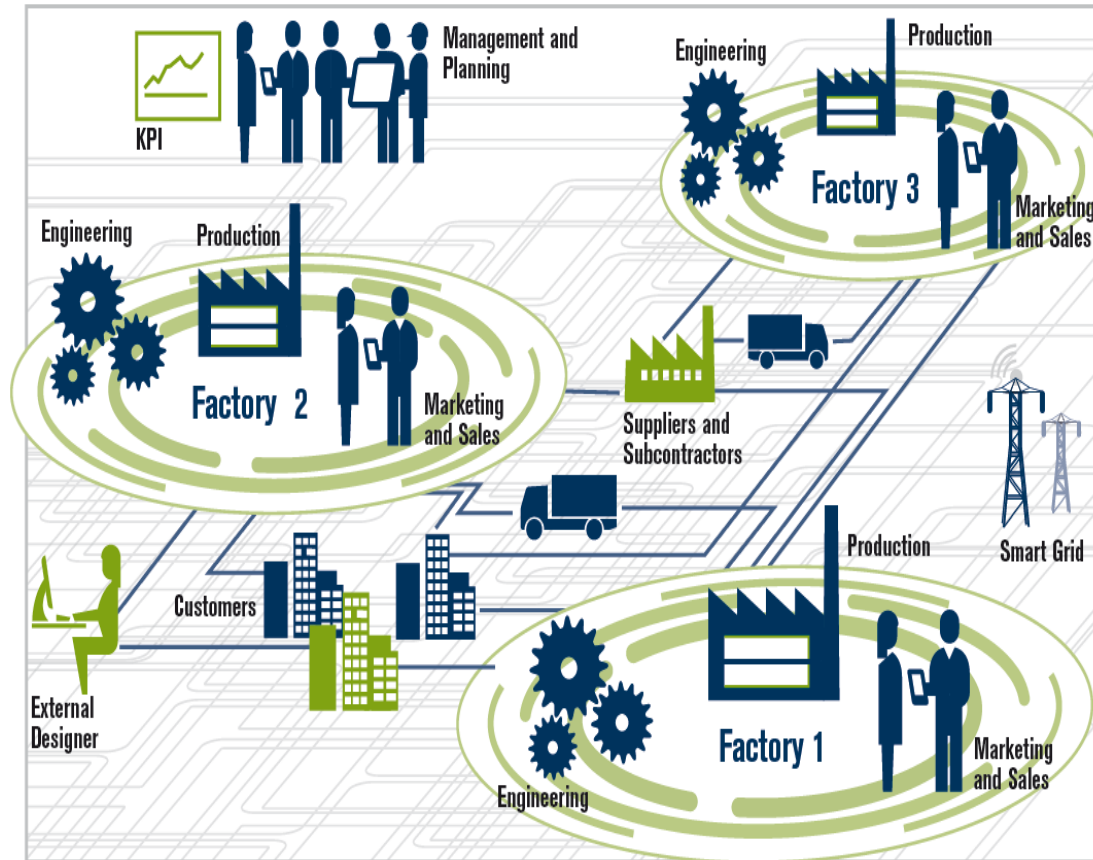
Complexity of the international standardization landscape

- **Complexity** of Industrie 4.0 is reflected by a high number of international stakeholders & **slow speed** of standardization activities due to lack of international coordination.
- **Well-coordinated & multi-stakeholder teamwork** across countries in order to build-up **trust & competencies** on integrated technological solutions.
- **Global cooperation** between organizations (e.g. Platform Industrie 4.0; IIC) in order to foster **speed & dynamics** of complex standardization processes.



What are the implications?

Rethink Value Chains



➤ Ad hoc value networks

- Dynamic reconfiguration in real time.
- Trusted data supply chain.
- Integration of shop floor and office floor.

What are the implications? Rethink the Job Market



What are the implications?

Rethink cooperation partners

- Focus on **testbeds** for the development of **prototypes, pragmatic solutions & innovation advantages** (Gap between **international corporations & national SME**).
- Focus on **industry specific integration platforms** for a broader impact & orchestration through international standardizing organizations.
- Cooperation on open-standards: Reducing the risks of **technological lock-ins** on the **buyer side** of proprietary **silosolutions** (especially for SME); on the **supplier side**: Reducing the risk of developing products **not demanded** by the market.
- **Global cooperation** between organizations (e.g. Plattform Industrie 4.0; IIC; OMG) in order to foster **speed & dynamics** of complex standardization processes.



What are the implications?

Rethink Business Models & Financing



- Disruption of traditional **supply chains, value creation & business models** due to Industrie 4.0.
- **Data sharing** across value networks & definition of **data security** standards are essential requirements for the development of successful Industrie 4.0 platforms & **data-driven business models**.
- **Digital ecosystems** are created around Industrie 4.0 shaper-platform & focus on **network-effects, lock-in-effects** and **domestic market size** as important factors for fast and global growth rates of Industrie 4.0 platforms.
- Different **forms of financing** beyond banking loans (e.g. venture capital, corporate venture, business angels) & **new competitors** from internet businesses, require new **forms of cooperation** within Industrie 4.0

Takeaways

Industrie 4.0 Country Profiles



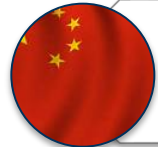
Strong brand Industrie 4.0
Strengths in the production sector

High level of training & qualification
Excellent international reputation



Strong focus on new business models
IT-start-ups in Industrie 4.0

Large domestic market
Driven by private organizations (e.g. IIC)



High-tech operating companies &
low-tech SME

Ambitious government programs (China 2025)
Fragile legal framework



Dominance of “Chaebols”
Know-how in consumer technologies

Focus on production efficiency
Strengths in IT-security



Strong production sector
Complex standardization landscape

Focus on new business models
Strengths in robotic & work science



Focus on reindustrialization
Strengths in smart services

Strong R&D sector & research transfer
Cooperation in “Catapult”-centers

Takeaways

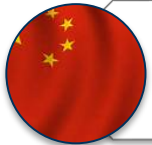
A Vision for international cooperation: Do's & Dont's



Strengthening the concept Industrie 4.0 & exploitation of a strong production sector



Keeping control of new business models & connecting to private organizations (e.g. IIC)



Multiplier for international standards & exploitation of the buyer's market potential



Exploiting the "Chaebol-system" & excellent IT-infrastructure



Cooperation in robotic & work science



Chances for cooperation in "Catapult"-centers & usage of the IT-service know-how

Beyond Industrie 4.0: Long-term Autonomy

Beyond Industrie 4.0



100%

30%

**Deep Learning for
Long-Term Autonomy**

Collaborative Robots

30%

Cyber-physical Production Technologies

20%

Web of Things

20%

Industrial Internet

> Thank you for your attention!