

Digital Transformation – Opportunities & Challenges

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TU Kaiserslautern &
Fraunhofer IESE &
Science Alliance Kaiserslautern
Kaiserslautern, Germany



Agenda

- Fraunhofer Applied Research Organization
- Mega-Trend „Digital Transformation“
- Examples
 - Today
 - Future
- Opportunities
- Challenges
- Takeaways

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Fraunhofer-Gesellschaft, the largest organization for applied research & technology transfer in Europe

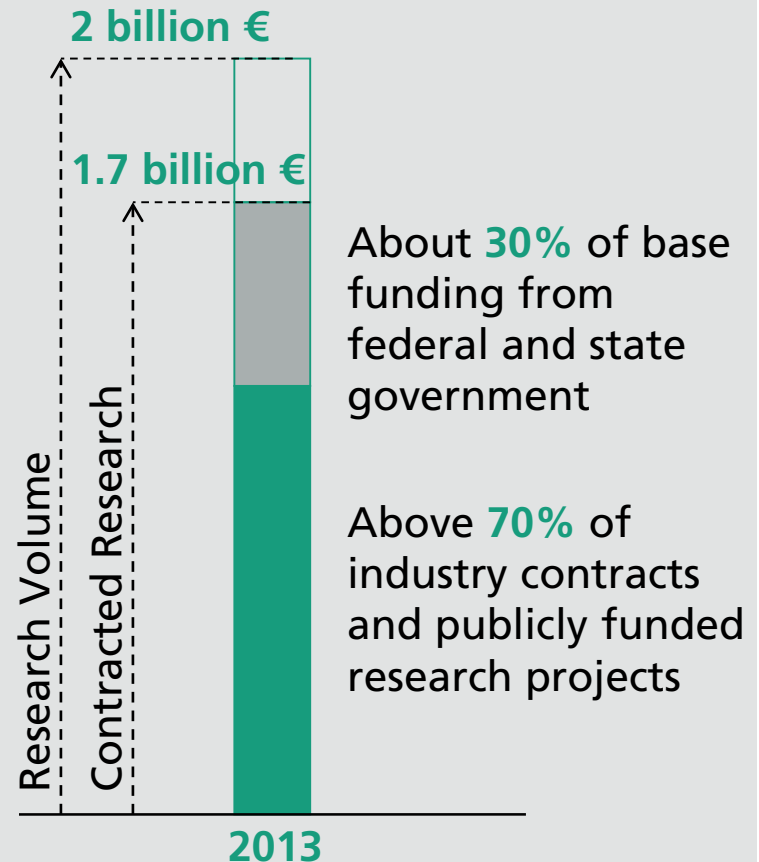
Applied Research for Economy and Society



About **27,000** employees

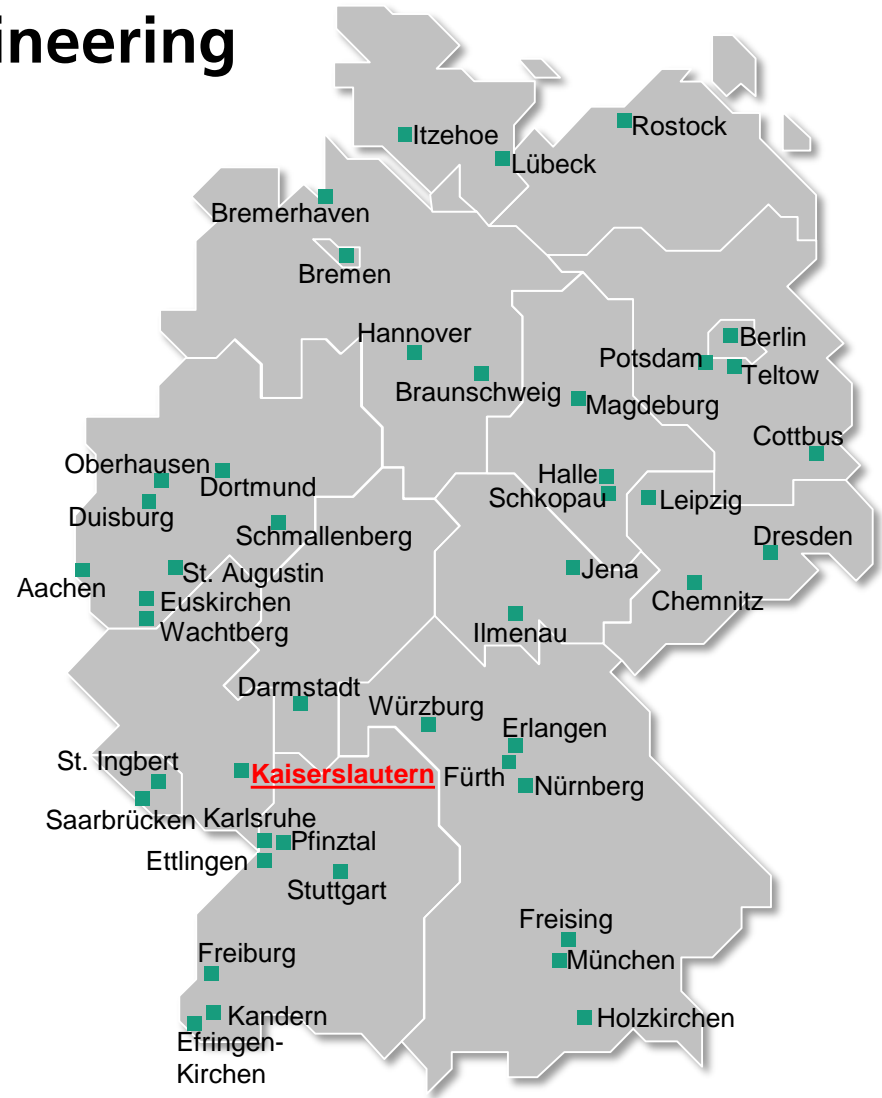


70 institutes and research institutions



Fraunhofer Institute for Experimental Software Engineering

- Founded in 1996
- Scaleable **software & systems engineering** with quality guarantees to support digital transformation
- Applied in automotive/mobility, industry 4.0, health, energy, etc.
- Over 200 (FTE) employees



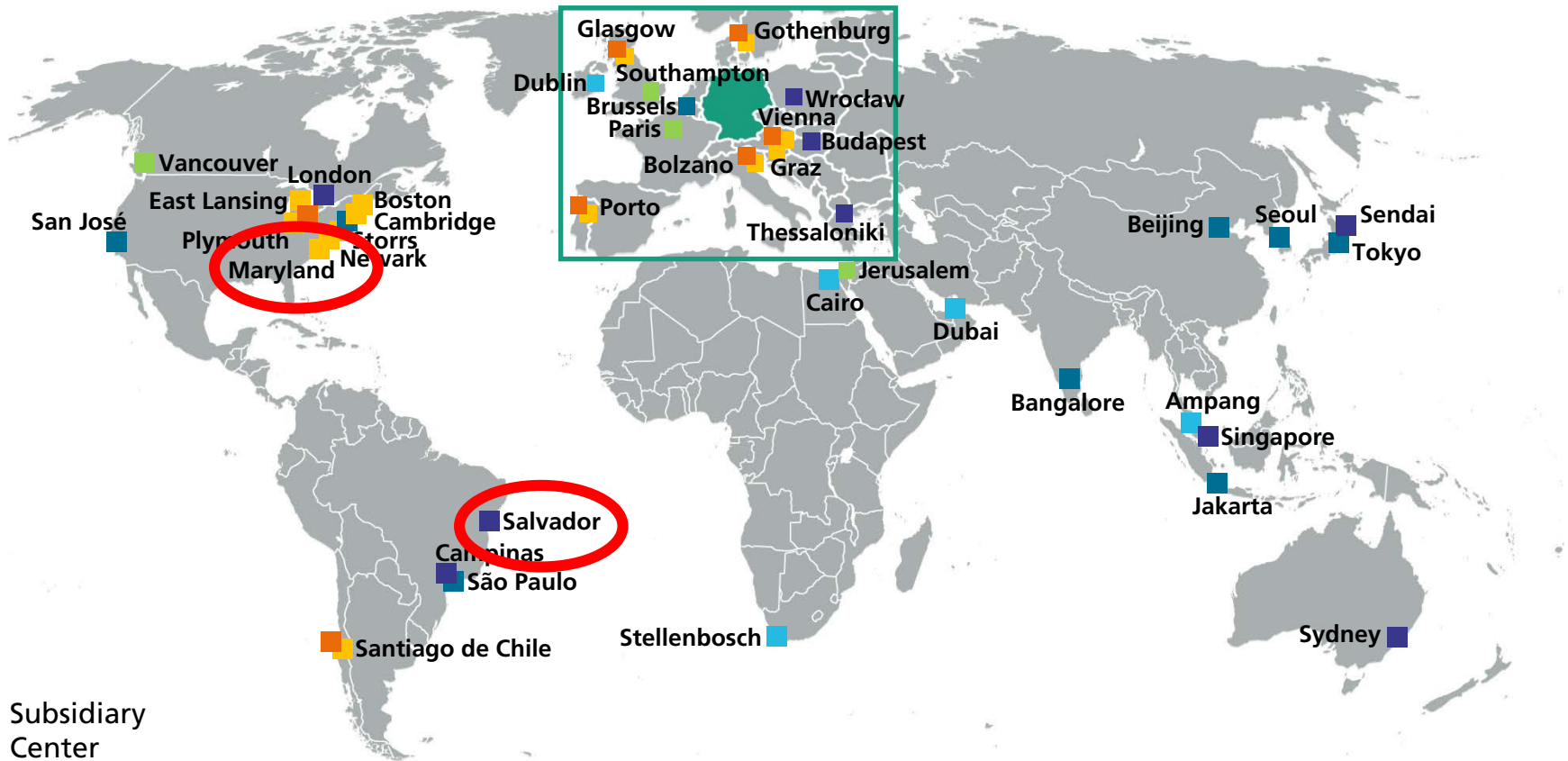
Science Alliance Kaiserslautern

(Leading German Competence Center in Digital Transformation)



- 2 Universities
- 10 Research Institutes in IT and Engineering, including
 - Max Planck (CS)
 - 3 x Fraunhofer (CS, Math, Physics)
 - German Center for AI
- App. 35 High-Tech Companies
- Leading National Research Centers in
 - Industry 4.0 („Smart Factory“)
 - Agriculture („Commercial Vehicle Alliance“)
 - Energy („Fraunhofer Service Center: Cross Energy Management“)
 - Health („Fraunhofer Service Center: eHealth“)

Fraunhofer Subsidiaries and Centers worldwide



Subsidiary
Center
Project Center
ICON / Strategic Cooperation
Representative / Marketing Office
Senior Advisor

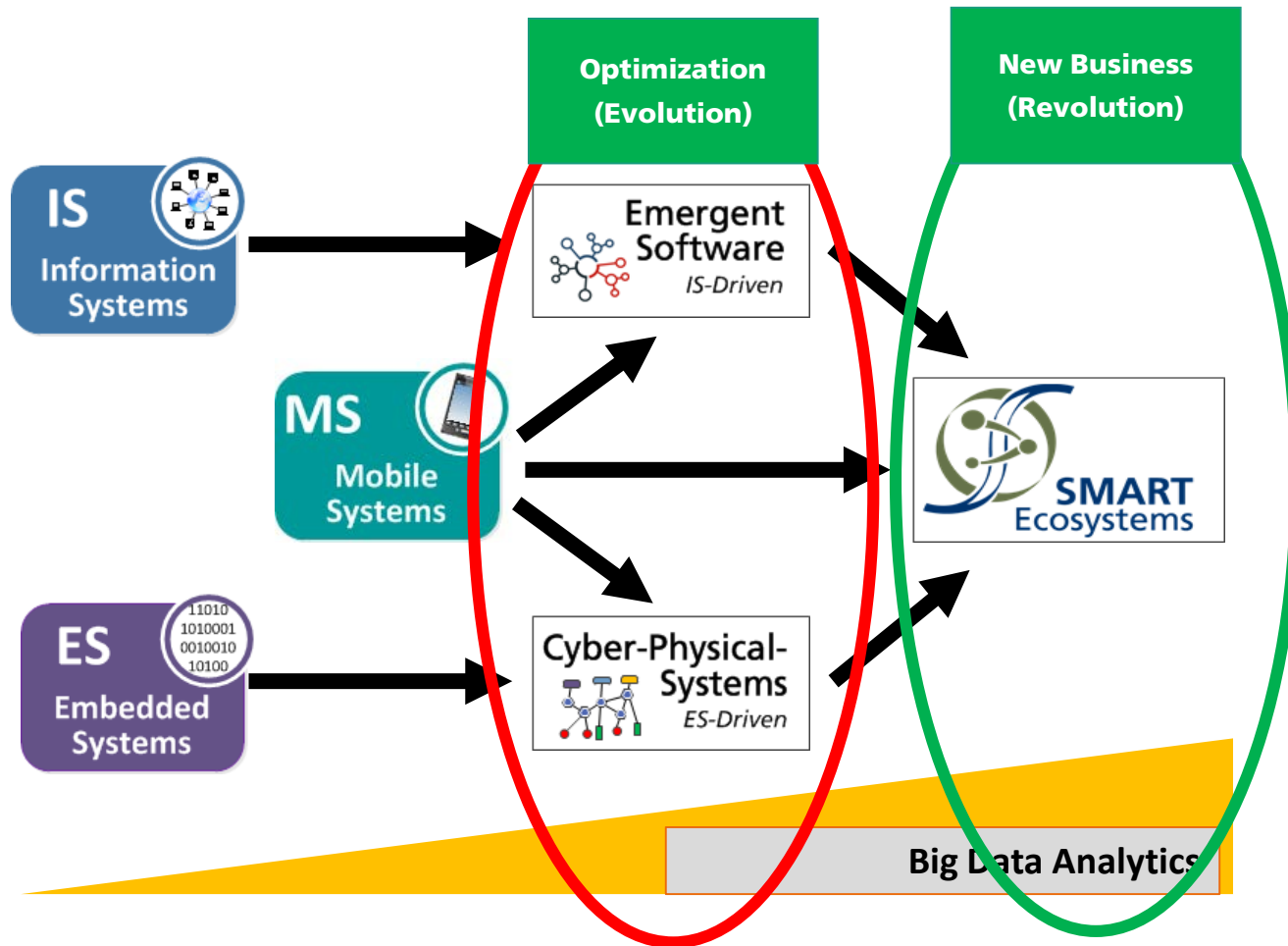
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Mega-Trend „Digital Transformation“

- **Digital technologies** enter all areas of business, private and public life (iPhone is main access device)
- **Key enablers** are
 - Omni-present **ad-hoc communication technologies** (with internet as backbone)
 - **Micro-sensors** to capture masses of data
- **Key synergizing characteristics** are
 - **Interconnected things** (physical, digital, human)
 - Buzzword: Internet of things (IoT)
 - Value generation via **(big) data analytics**

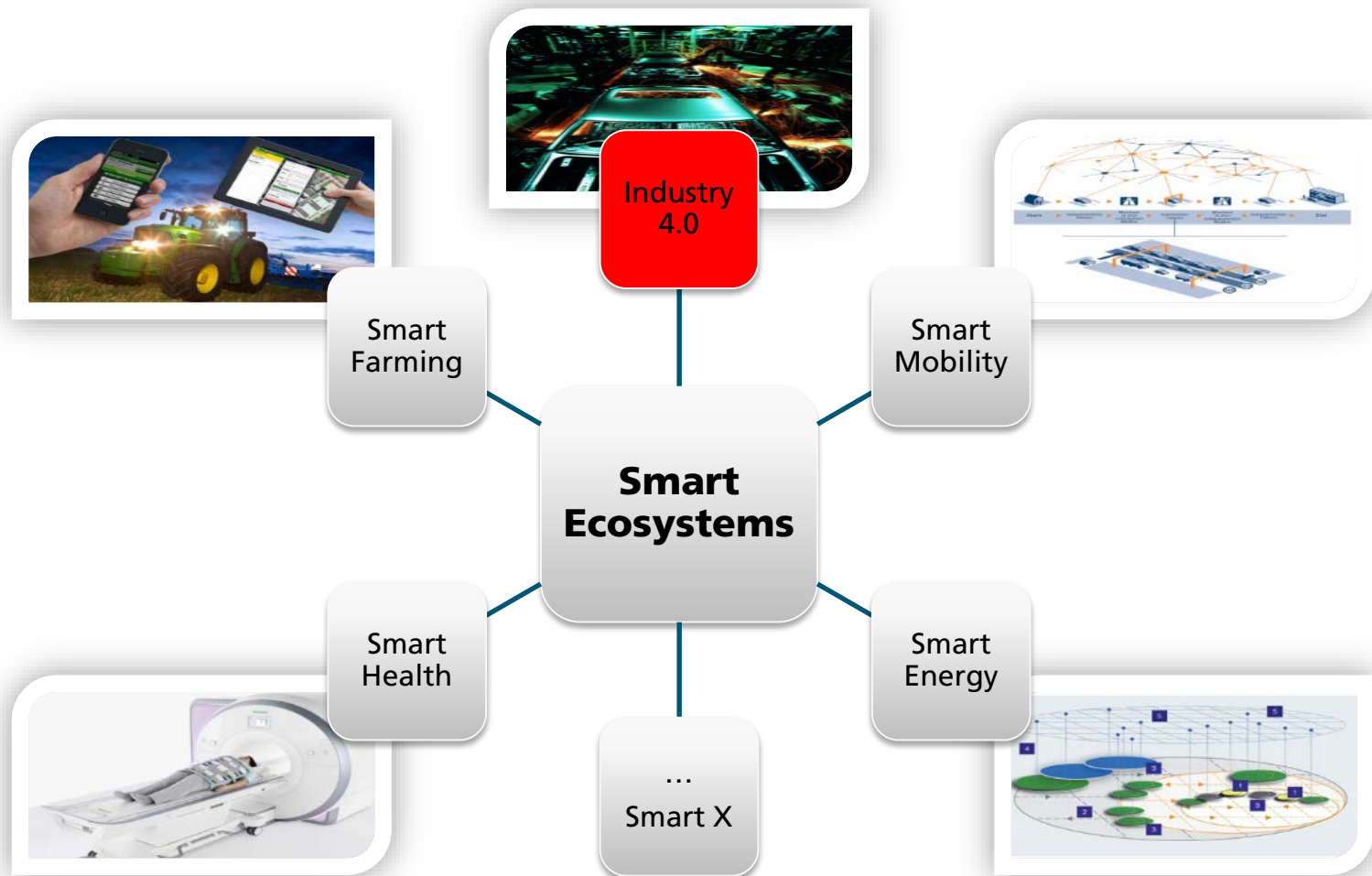
Digital Transformation – Evolution vs. Revolution?



Evolution represents normal innovation (competitive advantage); Revolution enables new revenues & jobs!

Smart Ecosystems

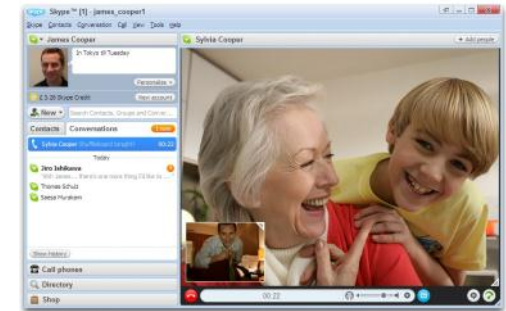
A Trend across Domains



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Digitalization: A Driver in Private Life



Digitalization as Driver for Business Life: Integration Enables Innovation!

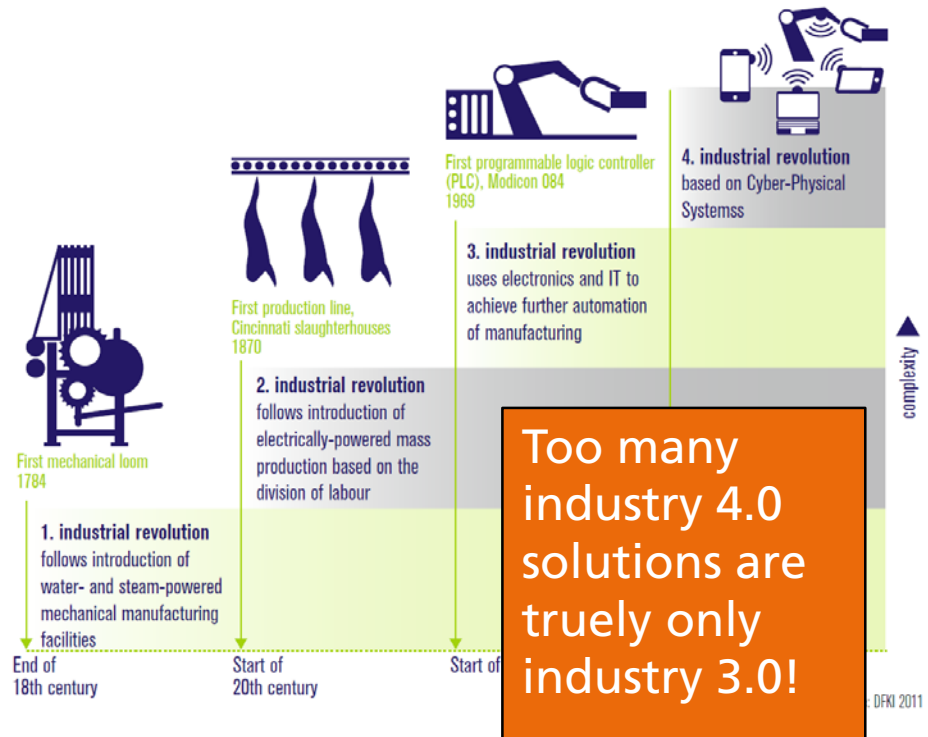


... in Information Systems as well as in Embedded Systems

Wide-spread usage in logistics, traffic management, smart farming,
driver assistance systems, etc.!

The Fourth Industrial Revolution

- Industry 4.0 is more than automation:
- Individual products at the cost of mass products
- Massive integration of data into technical systems of systems
- Self-organisation and reorganisation
- Self-optimisation: Autonomy
- Self-diagnostics: Safety!



Instead of static solutions designed during development time, we move to dynamic solutions that adapt and optimize autonomously during run-time.

Individual Products; Batch Size = 1

- The product configures the production line, which is assembled from interoperable production cells
 - Research: Smartfactory @ DFKI/Kaiserslautern
 - Practice: BoschRexroth, Wittenstein



Image: SmartFactory^{KL}



Image: Industry 4.0 production of electro/hydraulic tractor valves in Homburg, Germany (BoschRexroth)

Germany is investing heavily in digitalized production (Industry 4.0)

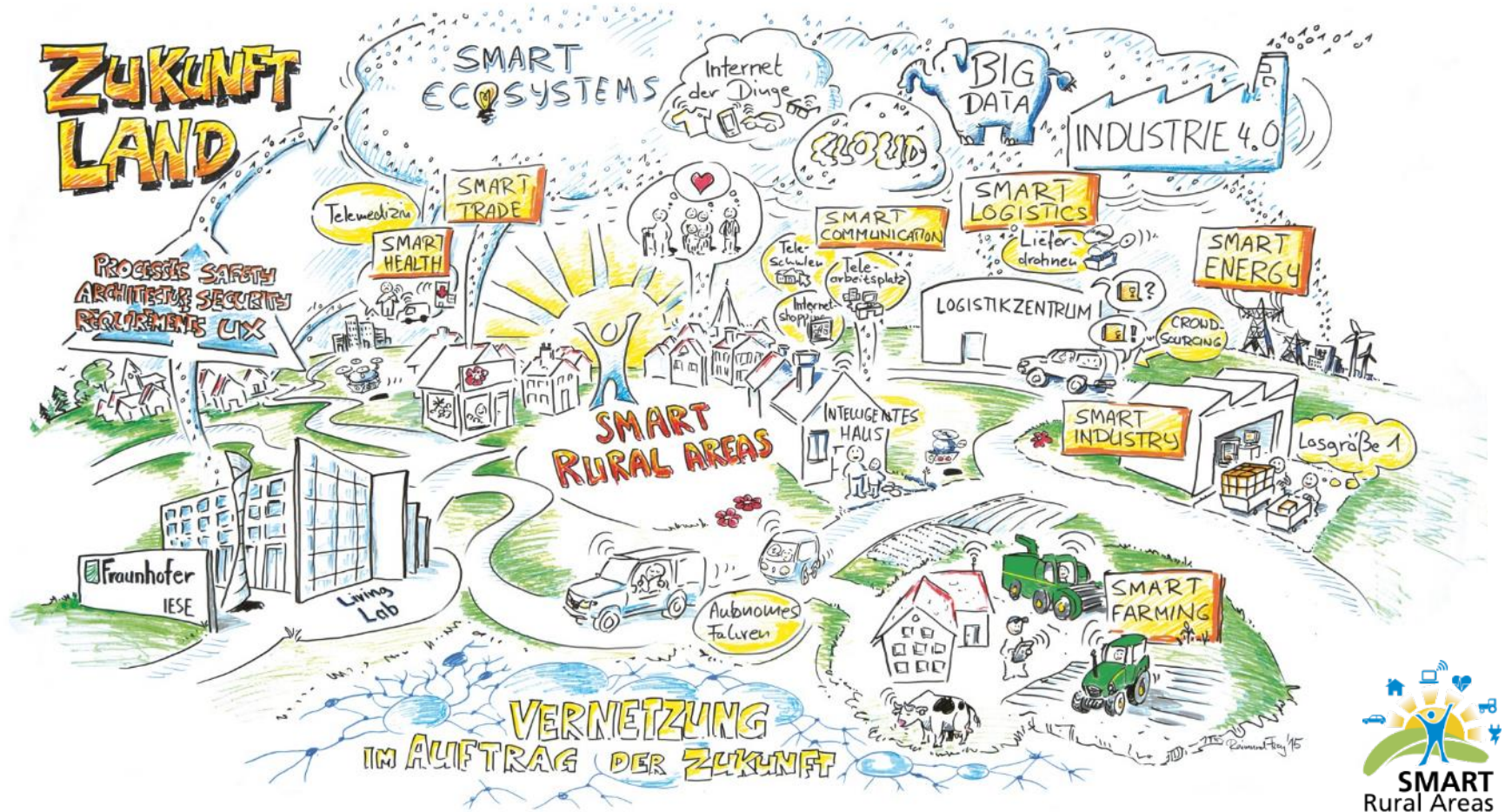
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Future Examples (More of the same!)

- Cross energy management systems
 - Fraunhofer leads large consortium on „Cross-Energy-Management“
- Mobility management systems
 - Intelligent guidance systems (fully connected)
- Automated Driving
 - To guide in boaring & critical systems
- Integrated health systems (hospital, doctor's office, home)
 - Telemonitoring, tele-medicine, ...

Our Main Theme in 2015 – Smart Rural Areas



Smart networking between mobility, logistics, energy, health, communication, safety and security "only" for cities?

This project is currently being replicated in many states in Germany & USA!

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Opportunities

- (Continued automation → Stay / become competitive)
- Commercial opportunities
 - Establish new streams of revenues and jobs
 - could function as spinoff enabler
 - Software = machine; data = fuel!
- Societal opportunities
 - Partial solution to the lack of highly qualified personnel
 - Guidance via virtual & augmented reality
 - Cost reduction of public infrastructures
 - Health, energy, education, ...

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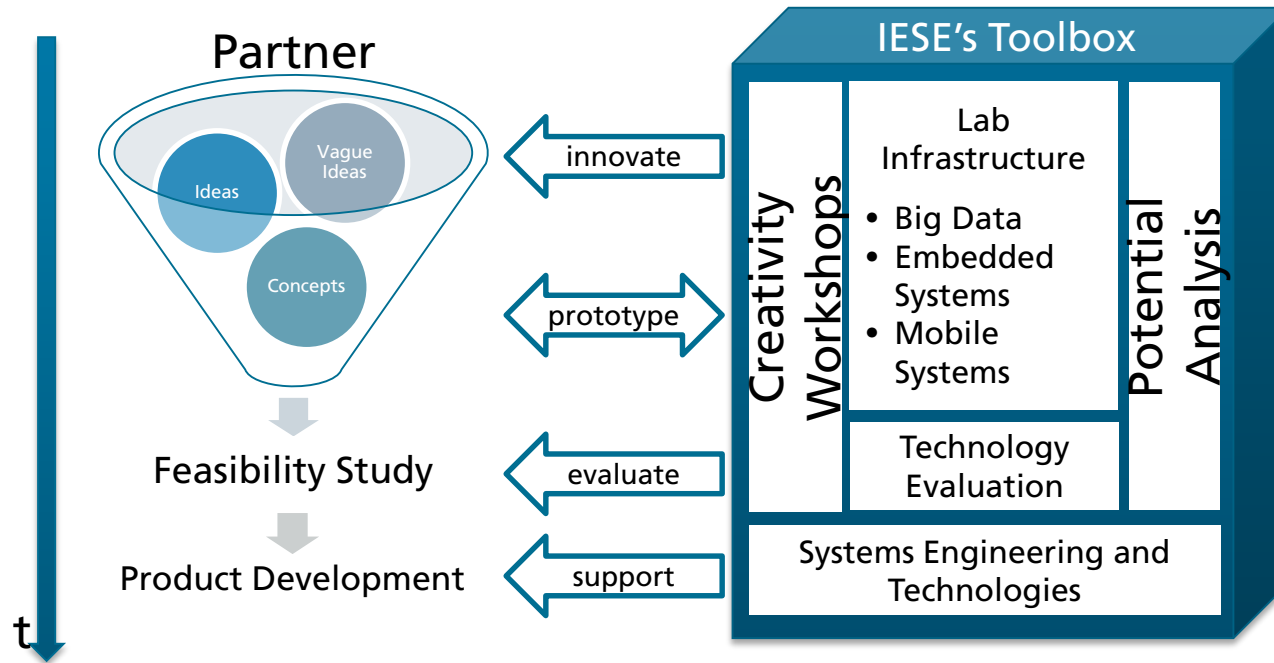
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Challenges

- Business
 - Business models that generate value ?
 - Challenge for SMEs (← Rapid Innovation Labs)
- Technical
 - (Software) Engineering of open, hybrid (embedded & information systems), and run-time adaptivity
- Social, ethical, legal, ...
 - Dealing with acceptance, ethical decision making of automated systems, responsibility, data privacy (← data usage control), ...

Risks are multi-dimensional and serious, but can be addressed !

Prototyping New Business Models in IESE's **Rapid Innovation Labs**



October 12, 2016

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Rapid Innovation Lab enables „creativity“ to find revolutionary business models, and reduces „risk“ by evaluating them rapidly before major invest!

Smart Ecosystems

Key Technical Challenges for Software & System Engineering

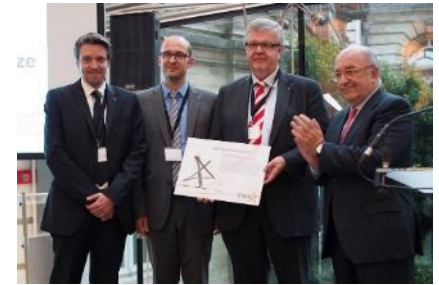


IND²UCE

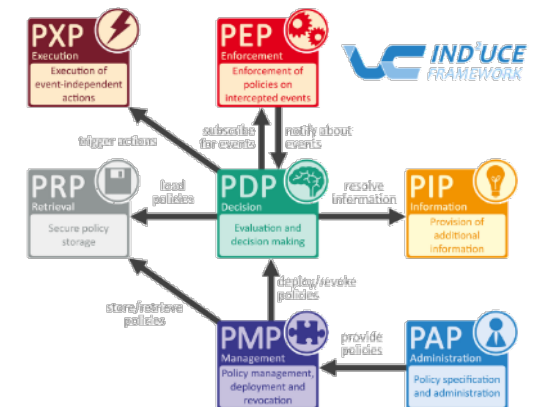
Data Privacy Framework



2014 Innovation Prize
Winner



- The IND²UCE Framework (INtegrated Distributed Data Usage Control Enforcement) provides all necessary components for implementing data usage control.
- Static access control & encryption are insufficient in smart ecosystems!
- Context-sensitive data usage policies support appropriate compromise between new business models and data privacy needs (e.g., data can only be used in a specific building, data must be deleted after 1 week, data can only be copied 3 times)
- Graphical selection of policies by end-user creates trust!
- The framework has been implemented in several environments and can be evaluated in the IESE Data Usage Control Lab



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The Induce approach addresses „data privacy“ in the appropriate way for smart ecosystems!

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TAKEAWAYS

- Industry 4.0 (and other domains of digital transformation) are **essential for global competitiveness**
- **Smart ecosystems** (instead of just automating existing things further) **are key**
- **Opportunities outweigh challenges/risks by far**
 - Opportunities: competitiveness, new revenues and jobs through new business models, overcoming demographic and geographical challenges
 - Challenges: finding the right business models, proper engineering, addressing also economic, social, ethical and legal aspects
- **EU needs to take a comprehensive approach**
 - Communication infrastructure everywhere (government)
 - Education addressing new challenges (government)
 - Identifying & implementing new business models (industry)
- **Fraunhofer offers cooperation across Europe**
 - **Rapid Innovation Labs (to identify proper business models and validate them rapidly)**
- **Engineering support (software & systems)**

Thank You!

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