# From Industrie 4.0 to Data-driven Business Ecosystems

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### Megatrend Digitization: 'The second Wave'



#### New aspects

- SmartX All objects digitally enhanced
- Internet of Things ubiquitous connectivity
- Autonomous systems
  - 'Sense': Cheap sensors, big data
  - 'Plan': AI, Smart Data
  - 'Act': Robotics, 3D-Printing
  - 'Learn': Deep learning





#### **Classics from the past**

- The user at the center
  - Hyper-personalization
  - Products and services
- IT-driven 'servitization'
  - 'Everything as a service'
- Platform economy
  - Changed market dynamics
  - Unlock underutilized assets
  - → 'share economy'

#### → Disruptive data-driven business model innovation and -transformation of society



#### **Germany's Digital Journey**





## The Vision for the 4th Industrial Revolution Benefits for Enterprises and Society

#### Economic

- 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
- Growth potential > 100 billion
  Euro until 2025



#### **Environmental**

- Energy- and resource-efficiency (up to -50%)
- Increased Sustainability (Circular Economy)
- Compatible with urban life = clean production comes back to the city centers



#### Social

- "Better Work": Work-lifebalance and appeal of work
- Autonomous systems support social inclusion
- Reshoring





## Paradigm Shift I: Industrie 4.0

Agile, Learning and Adaptable Factories

Smart Products:

Actively support production processes

#### Smart Operator:

Digital assistance systems support employees

Smart Machines:

Offer data and capabilities as smart services, negotiate independently

- Hybrid teams: Robots become co-workers
- → Increasing complexity:

Decentralized, connected autonomous systems





Smart Factories are part of future and connected smart infrastructures.



# Guideline for the 4th Industrial Revolution

Industrie 4.0 Maturity Index



## The Digital Transformation of the Industry Will Be Bi-modal Link of Existing Technology and Innovative Digital Methods

#### **Steer your business**

- Insights to strategic decisions
- Machine Learning, Artificial Intelligence

#### Mode 1 Optimize business

- Focus: Efficiency
- Established business models
- Traditional production methods

#### Mode 2 Differentiate business

- Focus: Innovation
- New digital business models
- Autonomous Cyber-Physical Systems & Smart Services

#### Data foundation: Digital shadow



## Smart Products in Use Platforms for New Business Models



#### Innovation:

- Additional business
- Increased customer loyalty
- New business models (machine-as-a-service)
- Optimization:
  - Processes
  - Products
  - Rapid innovation



## Paradigm Shift II: The Users at the Centre ...in their Respective Roles as Consumers, Citizens, Employees



- Smart Services:
  - Personalized and designed to fit the respective situation
  - Using Smart Data
  - → Providing superior **user experience**
  - → Providing superior value proposition
- Smart Services are created...
  - …'on demand'
  - …across different industries
  - ...in digital ecosystems



## Path from Traditional Manufacturing to Data-driven Business Ecosystems

		Optimizo 8	Expand & grow	Innovate & grow ecosystem
	Connect & act live	deliver efficiency	revenue	·
Business Model	Product & support services	Product & after-sales services	Product-as-a-service & value-added services	Data-driven & digital business
Business Driver	Product sales	Process optimization	Services growth	Ecosystem expansion
IoT skills	Embedded systems, augmented reality	Big data analytics, machine learning	Services management, Platform management	Ecosystem business development
Integration & technology	Vertical Integration (OT-IT), Machine Connectivity	Horizontal integration, design to delivery	Services platform, SLA management	Open data platform, business networks
Standards	Connectivity (e.g. OPC-UA)	Semantic standards	Interoperability of services	Cross-industry standards
	Optimized production		Smart services	Innovation business



#### **Data-driven Digital Business**

- Data economy:
  Data become independent resources
- Data sovereignty:

Data protection becomes know-how- and IP-protection

Data processing:
 A pow strategie dim

A new strategic dimension

- Data-driven business models are disruptive:
  "everything as a service"
- Digital ecosystems evolve around digital platforms

 $\rightarrow$  Platform markets have their own rules.





## The Race for Data is in Full Swing





# Data-Sovereignty and Secure Data Supply Chains Example Automotive (↔ B2B, ↔ B2C)





## **Digital Platforms: Self-reinforcing Growth Engines**

#### Multi-sided markets with network effects

- With more users, the platform becomes more attractive to potential new users (e.g. social networks)
- The more users on side of the platform, the more attractive the platform becomes for users of the other side (e.g. smartphones)
- Dynamic digital ecosystems are critical to success
  - Provide complementary data, services, products and competencies
  - New growth opportunities for SMEs and Startups
- Cloud-based: Fast scaling on a global level with low investments
- → Platform enterprises are more powerful than traditional enterprises.



## Platform Governance

New Regulatory Challenges

- Tendency towards concentration:
  - Network effects and economies of scale
- Avoid lock-in effects:
  - Interoperability und portability
  - Problem: Hampers differentiation of platforms
- Platform neutrality:
  - No preference for the platform operator's offers
  - Problem: Who assesses neutrality and how?
- Trustworthiness:
  - Win-win-situation for all partners in the ecosystem vs. occupation of the customer interface





## How are Smart Services created? In Dynamic Digital Ecosystems on Digital Platforms



#### **Actives users:**

- Co-creation
- Recommendations and ratings

#### **Smart Service-providers:**

- Superior user experience (Augmented Reality)
- Attractive business models

#### **Platform operator:**

- Data fusion and -processing → Smart Data
- Trustworthy distribution of data; cloud services

#### Manufacturer of digitally enhanced products:

■ Efficient generation of data → **Big Data** 



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Source: acatech (2017), Wegweiser Smart Service Welt

## **Different Business Concepts**





## **Different Business Concepts**





## Smart Condition Monitoring Services All Gämmerler Machines on Siemens Platform



Source: acatech (2017), Wegweiser Smart Service Welt

#### Smart Service:

- Avoid unexpected production losses
- Monetization:
  - Pay-per-use
- Growth potential:
  - Gämmerler: Expanding the ecosystem, additional business
  - Siemens: Additional manufacturers, innovative platform services



## **Different Business Concepts**

All products of one manufacturer

#### All machines of one production line



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All suppliers and consumers of one product type

**4.** All data sources for one business activity





## The Administration Shell and RAMI 4.0 as Lingua Franca





## **RAMI 4.0: Reference Architecture Model Industrie 4.0**



Development, Production/Sales, Service

#### $\rightarrow$ A Solution Space with a Coordinate System for Industrie 4.0.



## **Different Business Concepts**







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## 3 A Network to Bring Together Business Partners II SAP Asset Intelligence Network



Source: acatech (2017), Wegweiser Smart Service Welt

- Smart Service:
  - Data fusion
  - Secure access to same and latest data for all partners in the ecosystem
- Monetization:
  - Pay-per-use, pay-per-service
- Growth potential:
  - Integration of other product categories and related ecosystems
  - Additional Smart Services



## **Different Business Concepts**







#### **Extension of the Database**

Hitachi Europe's Ecosystem for Smart Energy Services



Source: acatech (2017), Wegweiser Smart Service Welt

#### Smart Service:

- Optimization of energy trading
- Monetization:
  - Profit sharing
  - Software-as-a-service
- Growth potential:
  - Expansion of the ecosystem for comprehensive energy management
- Integration of diverse data sources



## New Opportunities with Artificial Intelligence Self-learning Smart Service Architectures





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Source: acatech (2017), Wegweiser Smart Service Welt

## Machine Learning from Big Data Deep Learning with Neural Networks



Connection patterns

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## From Automation to Autonomous Systems (AS)

#### Strategic Project III "Autonomous Systems" (since 2015)





- AS achieve predefined goals independently
  - Without human intervention or detailed programming
  - Adapt to changing circumstances
- AS can help us find solutions for a range of social and economic challenges
- New societal, legal and ethical challenges
  - → Gradual and experienced-based introduction via use cases
  - → Supported by an early and long-term public dialogue



# Thank you very much for your attention.

