INDUSTRIAL DATA SPACE

Digital Sovereignty for Industry 4.0 and Smart Services

Prof. Dr. Boris Otto · Cambridge · February 1st, 2016

AGENDA

- Digitizing the Industrial Enterprise

- The Role of Data and the Industrial Data Space

- Outlook to Upcoming Activities

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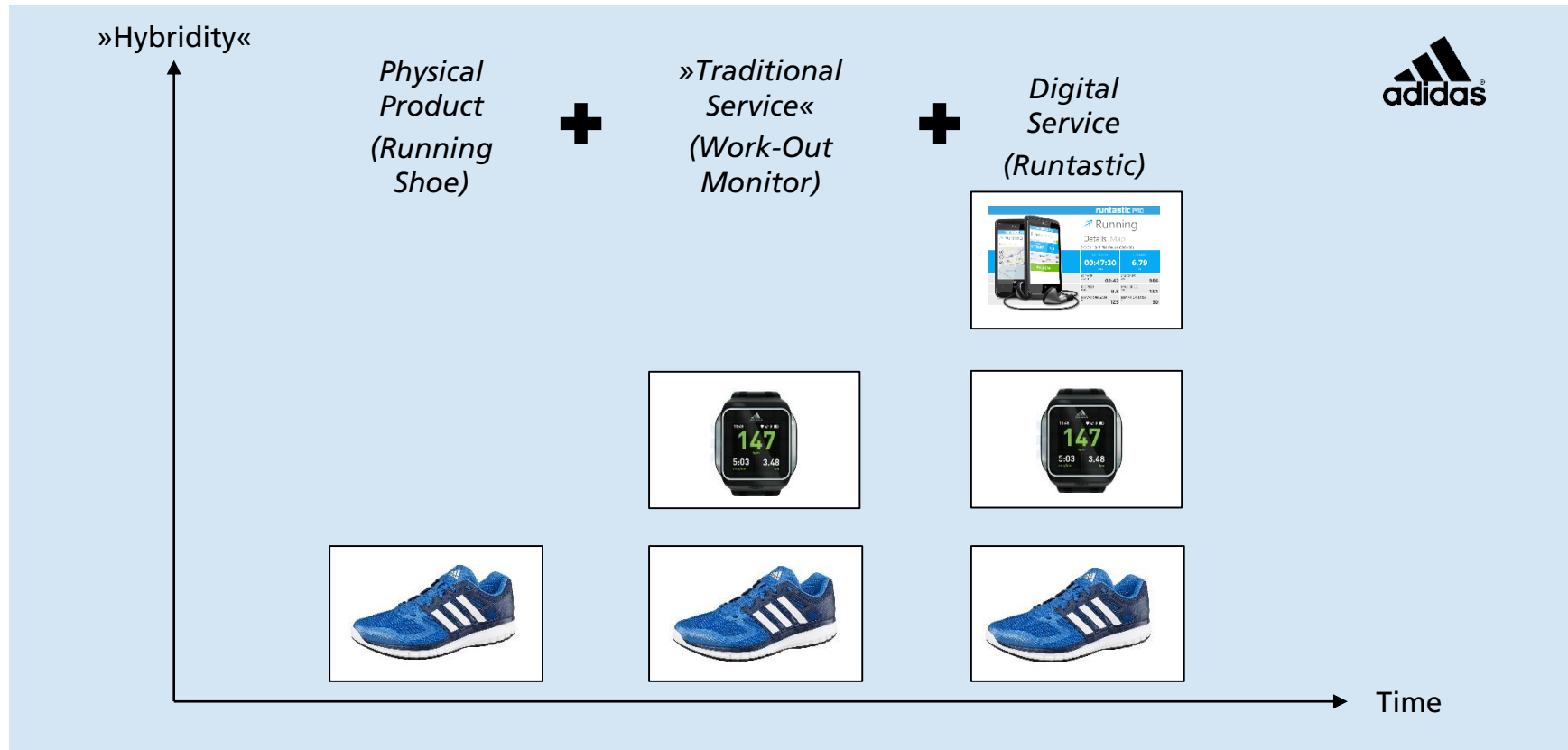# adidas combines digital services and lot size 1 production

Smart Service »Runtastic«

In-Store Production

Successful value propositions are becoming increasingly »hybrid«—as the example of adidas shows

»Hybridity«

Physical Product (Running Shoe)

+

»Traditional Service« (Work-Out Monitor)

+
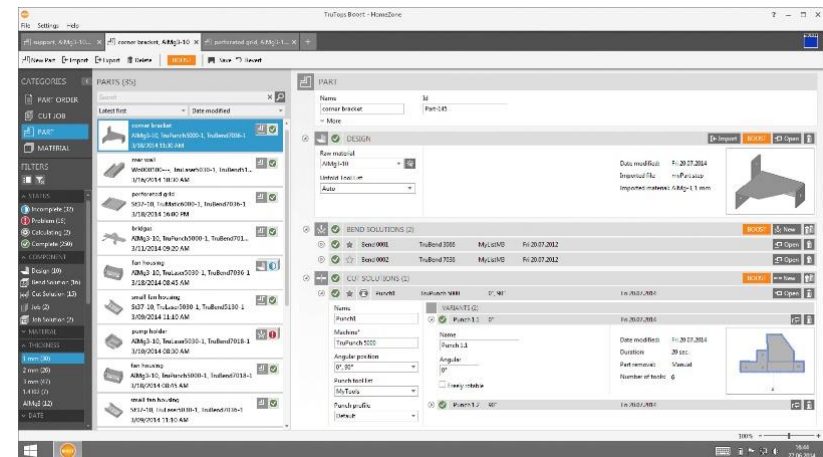
Digital Service (Runtastic)

Time

Tool machine manufacturer TRUMPF wants to offer an AppStore around metal sheet processing

Tool Machine as Physical Asset

Digital Value-Added Service

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Digital products follow a platform architecture logic

Digital Business Architecture

SMART SERVICES

SMART DATA

SMART PRODUCTS
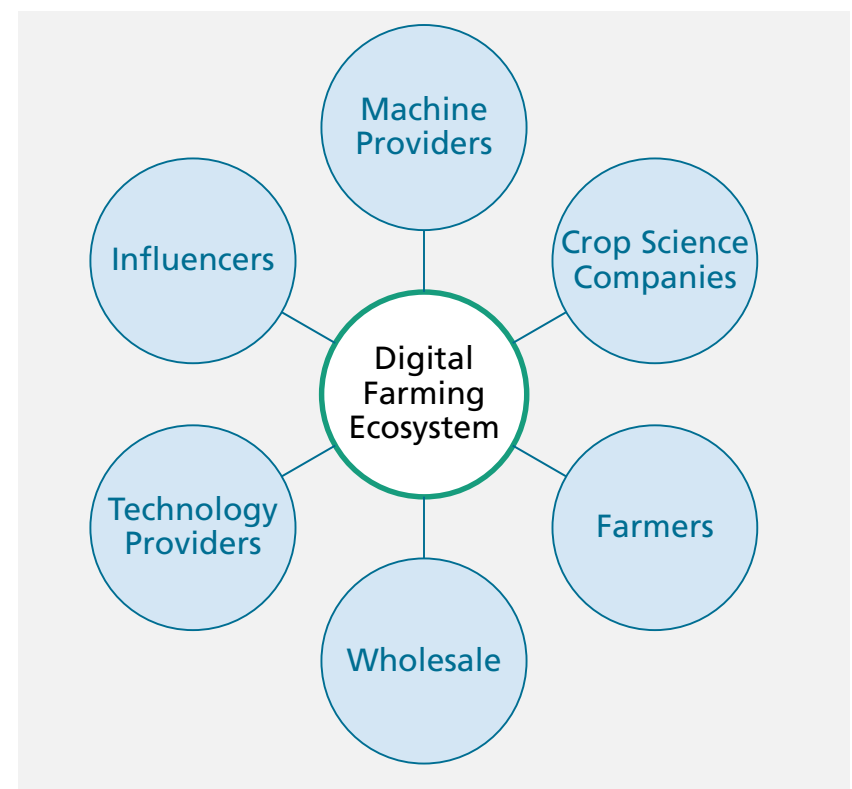
SMART SPACES

Principles of the Digital Economy

- Services can be separated from physical platforms
- Architectural layers are de-coupled
- Products turn to platforms—and vice-versa
- Ecosystems form around platforms
- Innovation happens in co-opetition modes

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Agricultural machinery manufacturers are driving comprehensive digital farming solutions

Precision Farming

Value Creation in Ecosystems

- Machine Providers
- Crop Science Companies
- Influencers
- Digital Farming Ecosystem
- Farmers
- Technology Providers
- Wholesale

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The »Smart Service Welt« is a response to changing customer needs
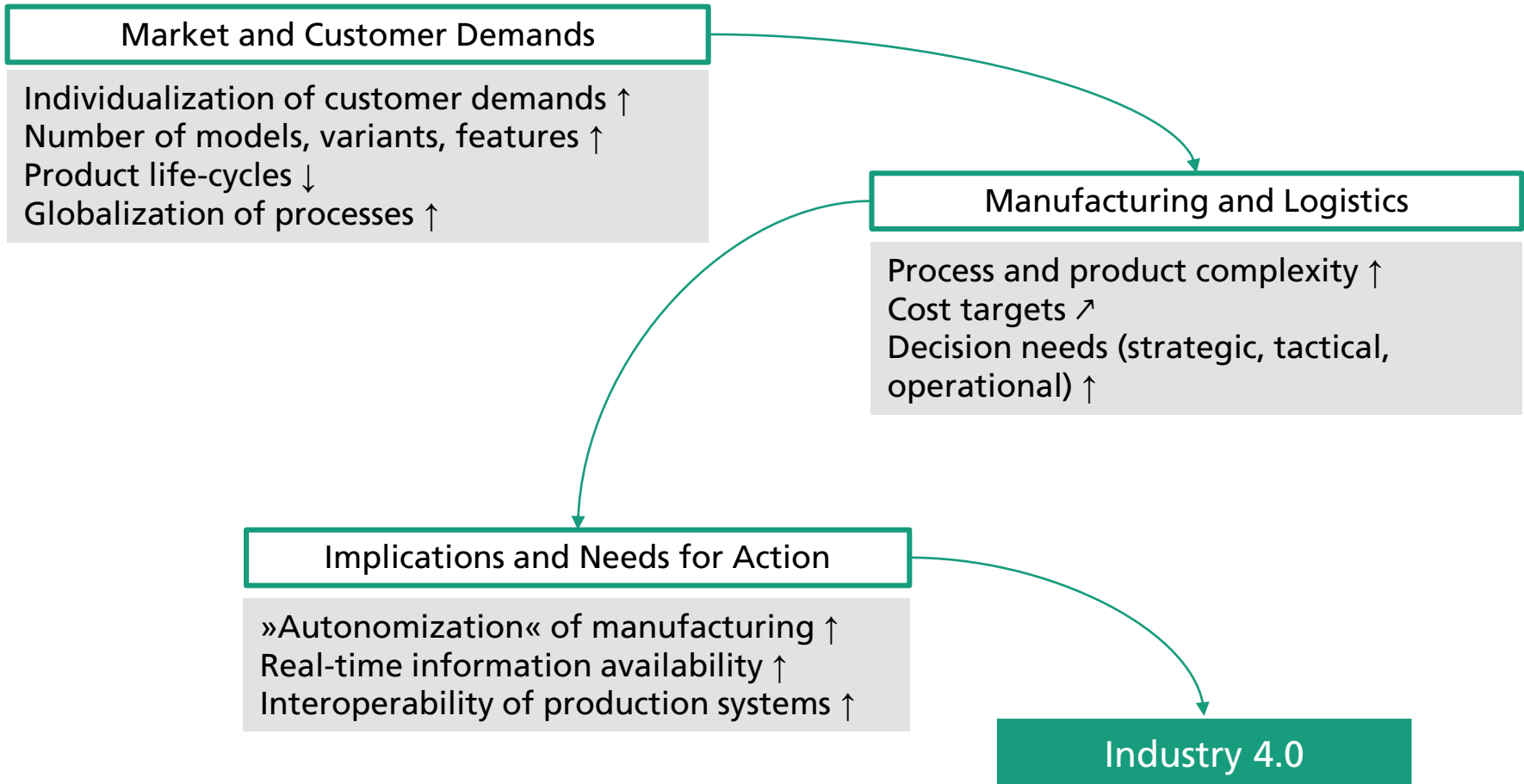
End-to-End Customer Process

Information Transparency

Individualization

Ubiquity of Service Consumption

Thus, Industry 4.0 is a means to an end, not an end in itself—as the example of Audi shows

Market and Customer Demands

Individualization of customer demands ↑
Number of models, variants, features ↑
Product life-cycles ↓
Globalization of processes ↑

Manufacturing and Logistics

Process and product complexity ↑
Cost targets ↗
Decision needs (strategic, tactical, operational) ↑

Implications and Needs for Action

»Autonomization« of manufacturing ↑
Real-time information availability ↑
Interoperability of production systems ↑

Industry 4.0

Industry 4.0 enables smart manufacturing through cyber-physical systems and decentralized control
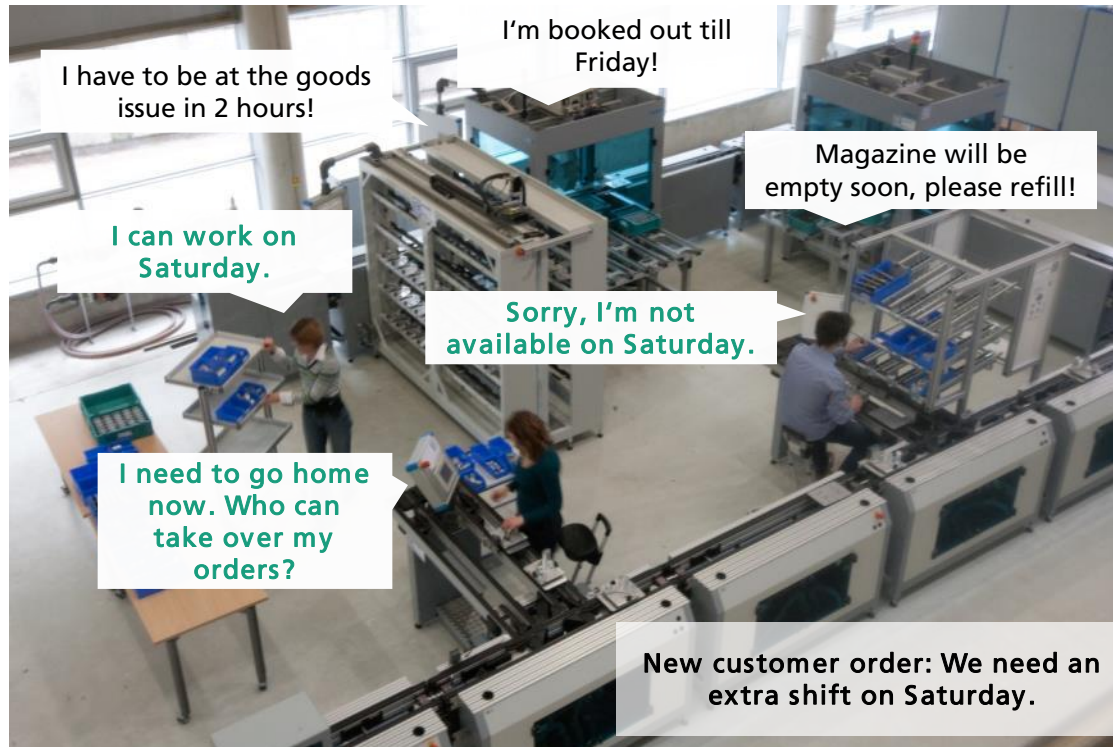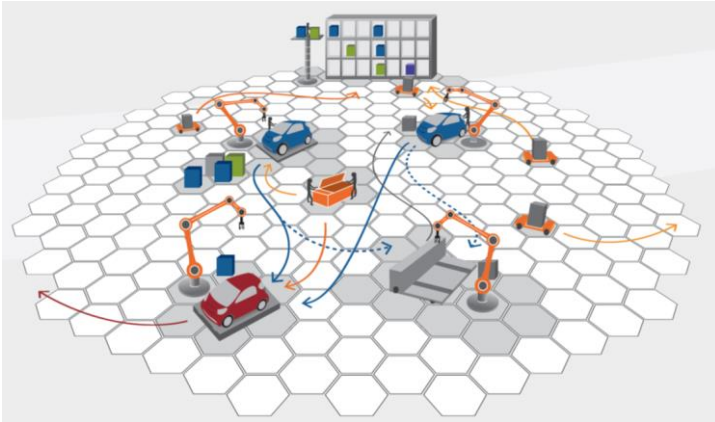

Solution Components

- Cyber-physical systems
- Self-configuration
- Virtual representation
- Context-aware information management

Benefits

- Increased flexibility and agility
- Coping with complexity

Industry 4.0 enables smart manufacturing in electric car production

Solution Components

- All objects and items are interconnected
- Assembly parts find their way on their own through production
- Redundant manufacturing capacities are autonomously distributing work loads among each other
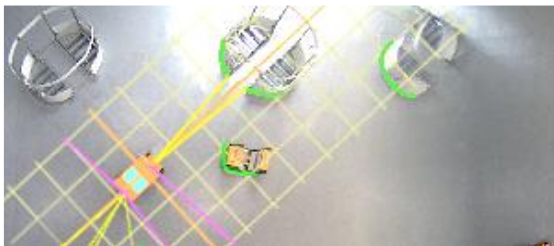
Benefits

- No central control systems required
- Dynamic system reaction in case of exceptions
- High scalability of all production processes

Federal Ministry
for Economic Affairs
and Energy

Supported by

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Industry 4.0 enables smart intralogistics

- Small autonomous transport units (shuttles) replace inflexible conveyor technology

- Cellular transport systems (CTS) follow self-control principle

- CTS uses swarm intelligence for handling complex transport tasks.

- Autonomous transport management

- Increase of:

  - Changeability

  - Scalability and Flexibility

- Logistics performance where it is required!

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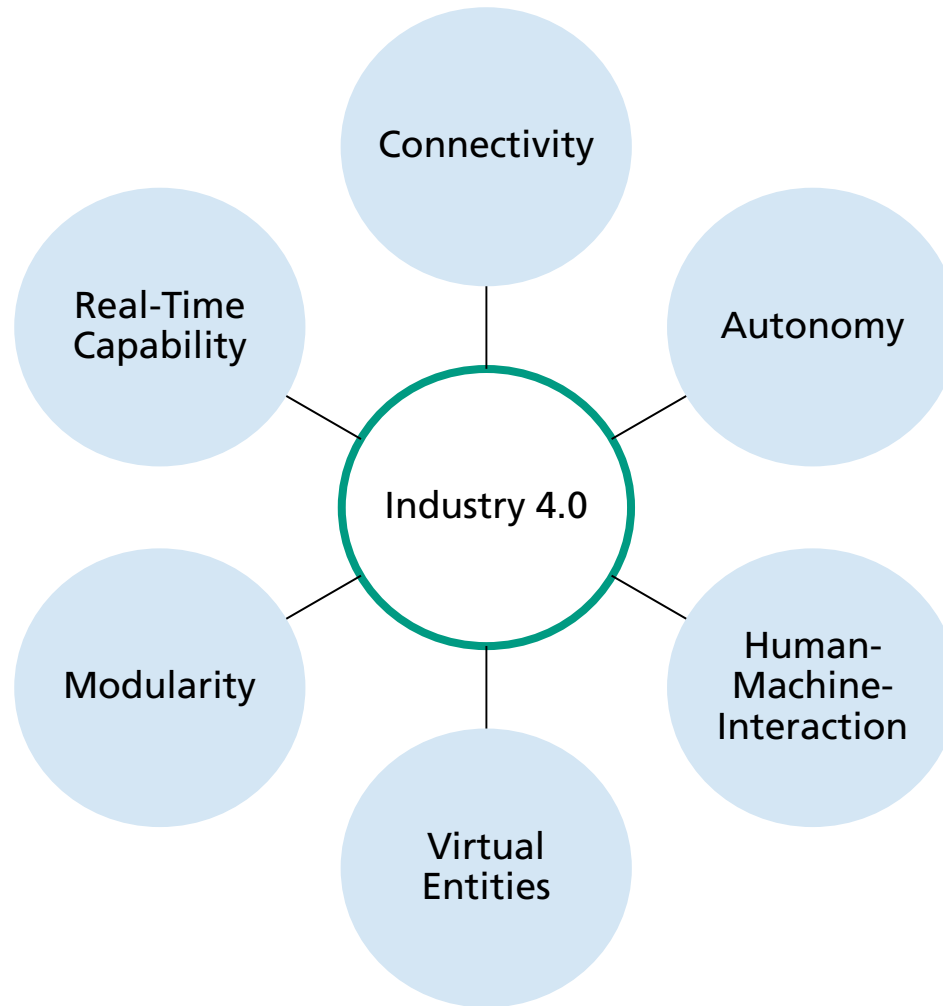# Industry 4.0 increases and efficiency in the warehouse
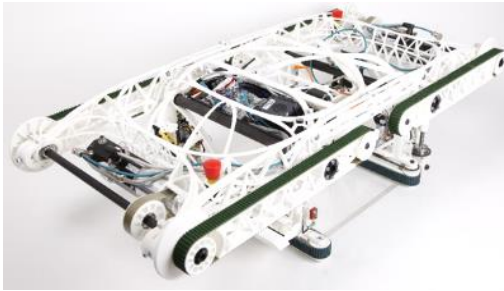
Solution Components

- Autonomous navigation in the shelf
- No lift needed
- Flexible deployment of rack racers
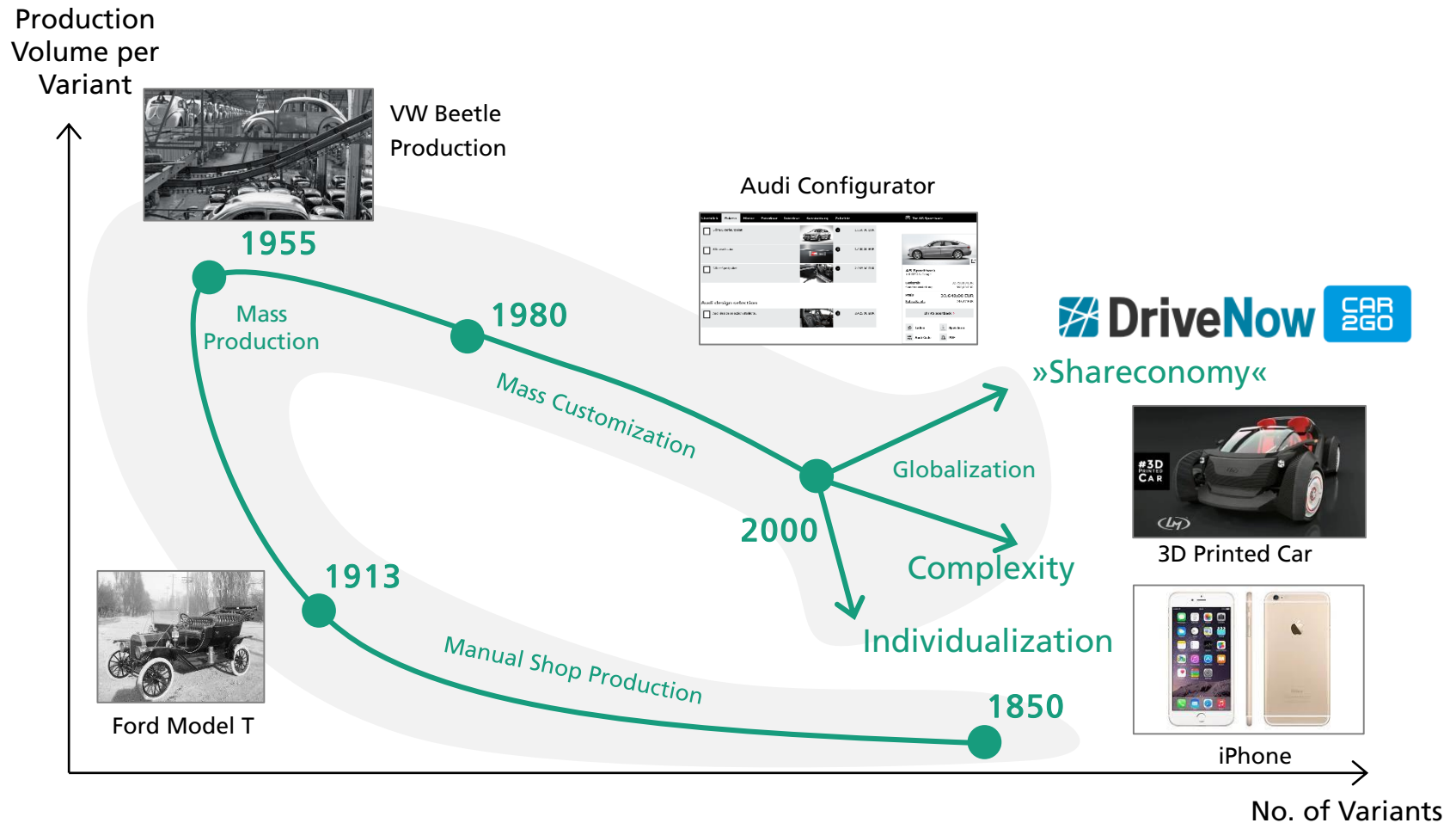- 85 percent 3D printed components

Benefits

- Functional and cost advantages compared to state-of-the-art
- Increased flexibility of storage systems
- Reduced fixed costs
- No bottleneck through lift, thus reduced storage cycle times

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Industry 4.0 is a design principle for the industrial enterprise of the future

Connectivity

Autonomy

Real-Time Capability

Industry 4.0

Human-Machine-Interaction

Modularity

Virtual Entities

As a consequence production and supply chain complexity is dramatically increasing

Production Volume per Variant

VW Beetle Production

1955

Mass Production

1980

Audi Configurator

Mass Customization

»Shareconomy«

Globalization

2000

Complexity

3D Printed Car

1913

Individualization

Manual Shop Production

1850

Ford Model T

iPhone

No. of Variants

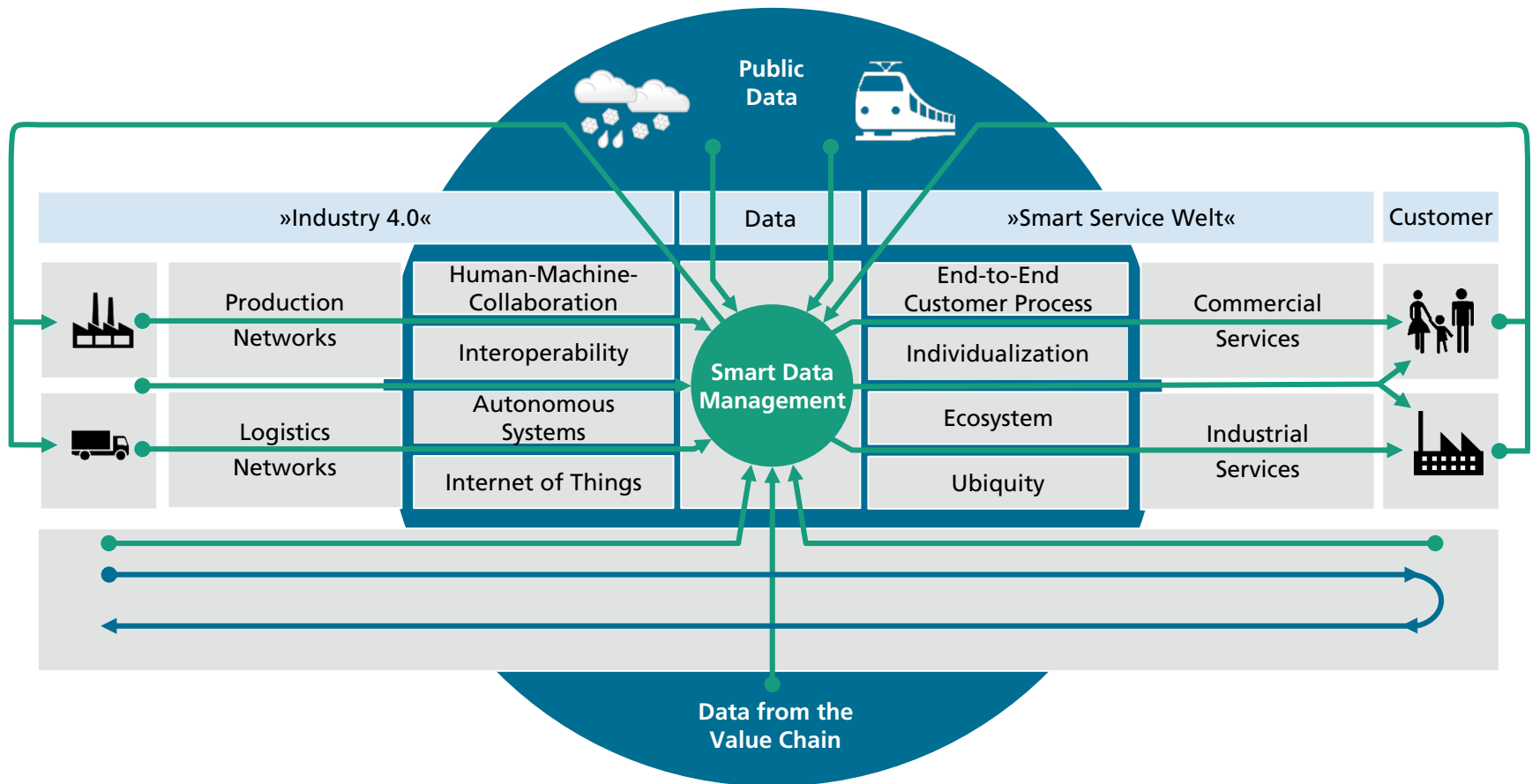# AGENDA

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- The Role of Data and the Industrial Data Space

- Outlook to Upcoming Activities

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Data has evolved from a byproduct of operations to a strategic resource

Value-added

Data as byproduct of processes

Data as process enabler

Data as product enabler

Data as a product itself

Time
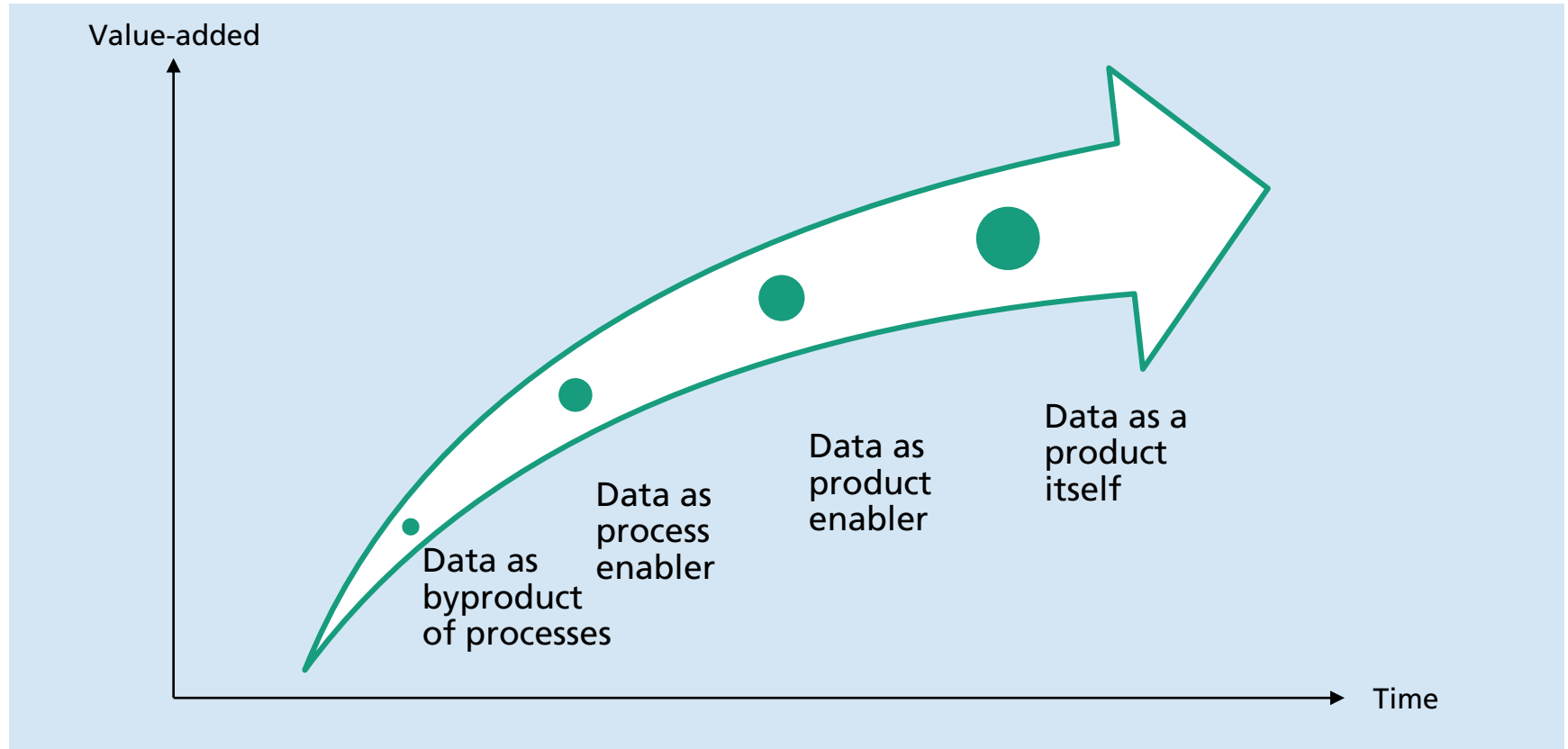
Data is the strategic resource to link »Industry 4.0« and »Smart Service Welt«

Public Data

| »Industry 4.0« | Data | »Smart Service Welt« | Customer |

Production Networks

Human-Machine-Collaboration

Interoperability

Autonomous Systems

Internet of Things

Logistics Networks

Smart Data Management

End-to-End Customer Process

Individualization

Ecosystem

Ubiquity

Commercial Services

Industrial Services

Data from the Value Chain

Legend: ●——→ Information flow ●——→ Material flow.

The Industrial Data Space aims at a »Network of Trusted Data«

Decentralization
Federated Architecture

Sovereignty
Data and Services

Trustworthiness
Certified Members

Security
Data Exchange

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DATA SPACE

Openness
Neutral and User-Driven

Governance
Common Rules of the Game

Scalability
Network Effects

Ecosystem
Platform and Services

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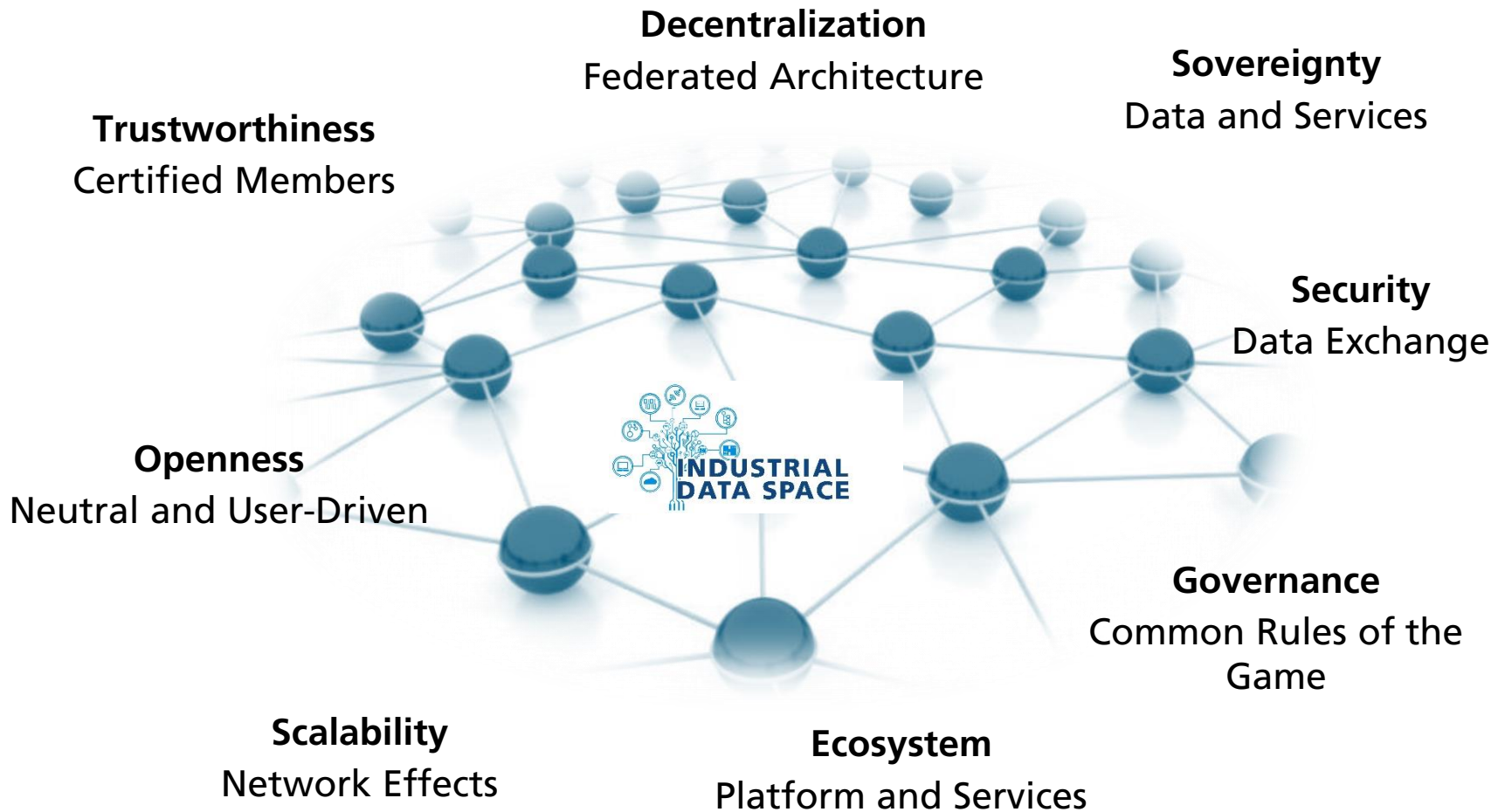
The overall Industrial Data Space architecture takes four different viewpoints
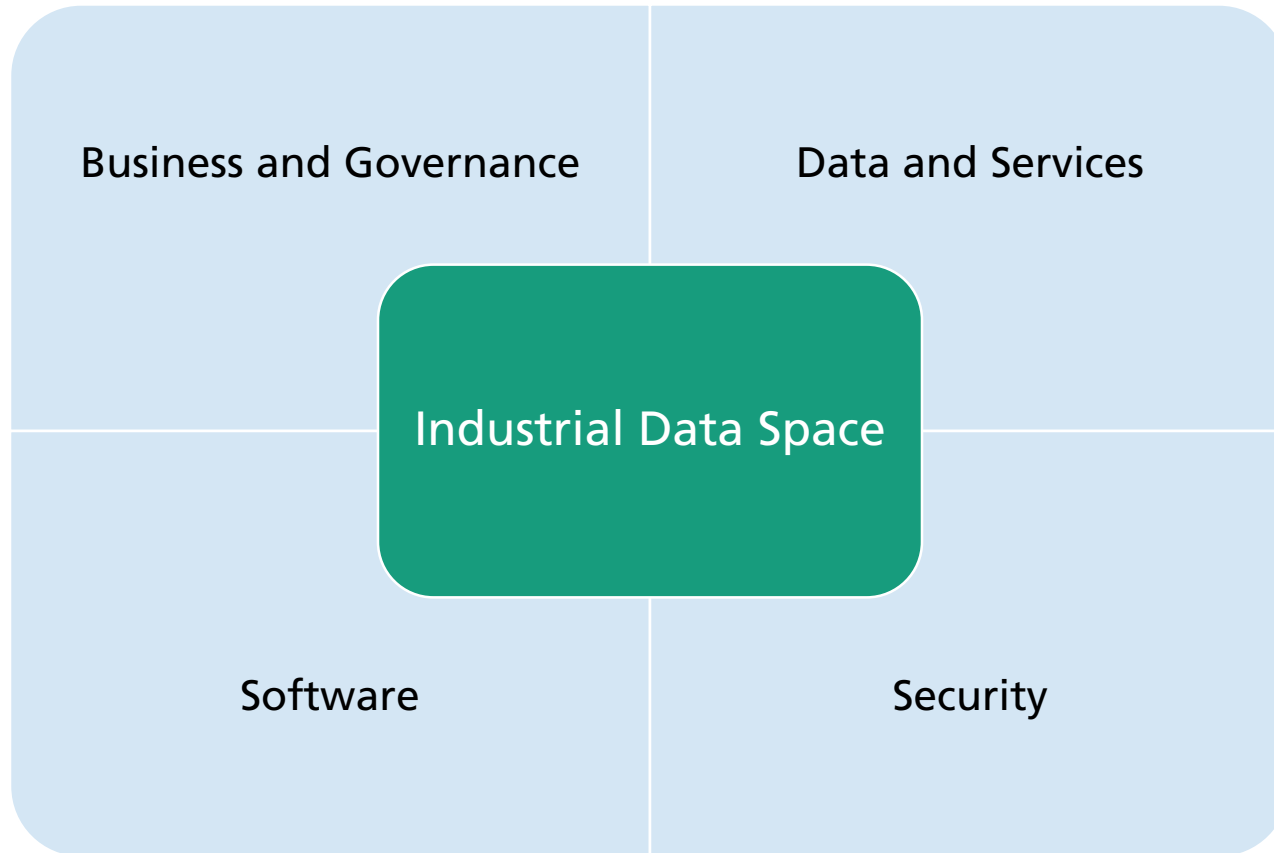
A technology-agnostic »Business Map« describes functional data services
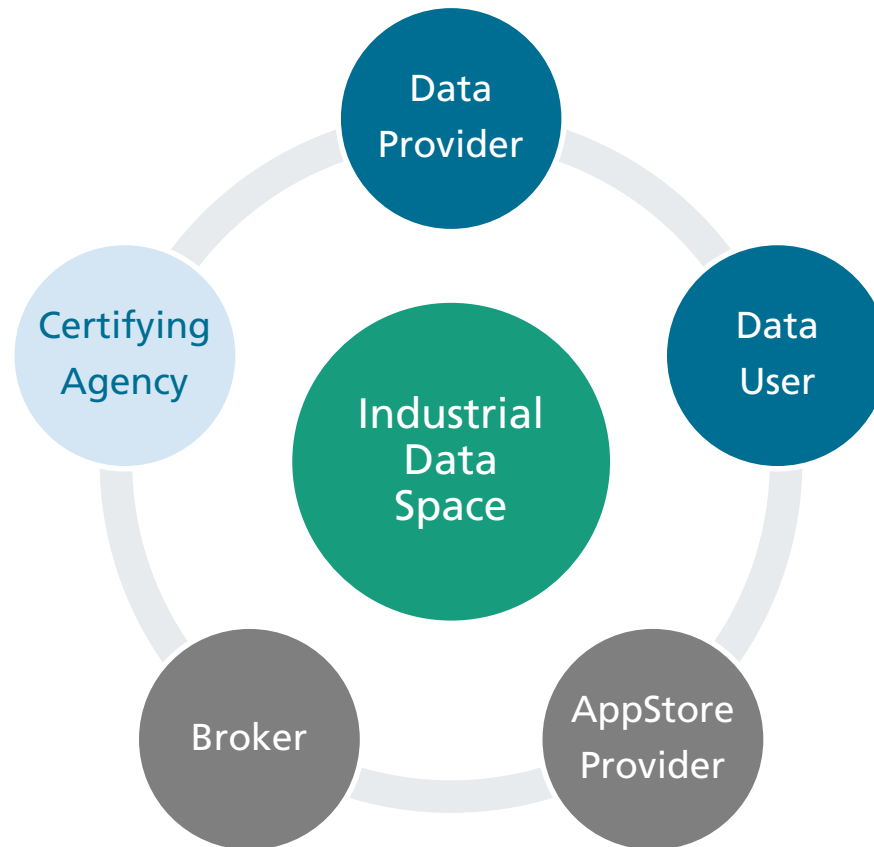
Federal Ministry of Education and Research

Industrial Data Space App Store	Basic Data Services Provisioning	Data Service Management and Use	Vocabulary Management	Software Curation
	Data Provenance Reporting Data Transformation Data Curation Data Anonymization	Data Service Publication Data Service Search Data Service Request Data Service Subscription	Vocabulary Creation Collaborative Vocabulary Maintenance Vocabulary/Schema Matching Knowledge Database Management	Software Quality and Security Testing
Industrial Data Space Broker	Data Source Management	Data Source Search	Data Exchange Agreement	Data Exchange Monitoring
	Data Source Publication Data Source Maintenance Version Controlling	Key Word Search Taxonomy Search Multi-criteria Search	»One Click« Agreement Data Source Subscription	Transaction Accounting Data Exchange Clearing Data Usage Reporting
Industrial Data Space Connector	Data Exchange Execution		Data Preprocessing Software Injection	Remote Software Execution
	Data Request from Certified Endpoint Usage Information Maintenance (Expiration etc.) Data Mapping (from Source to Target Schema) Secure Data Transmission between Trusted Endpoints		Preprocessing Software Deployment and Execution at Trusted Endpoint	Data Compliance Monitoring (Usage Restrictions etc.) Remote Attestation Endpoint Authentication

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The software architecture consists of a set of components

Vocabulary

Apps

Industrial Data Space
App Store

Industrial Data Space

Clearing

Index

Registry

Industrial Data Space
Broker

Download

Upload

Internal IDS
Connector

External IDS
Connector

Upload / Download / Search
Internet

External IDS
Connector

**Third Party
Cloud Provider**

Company A

Internal IDS
Connector

Upload / Download

Company B

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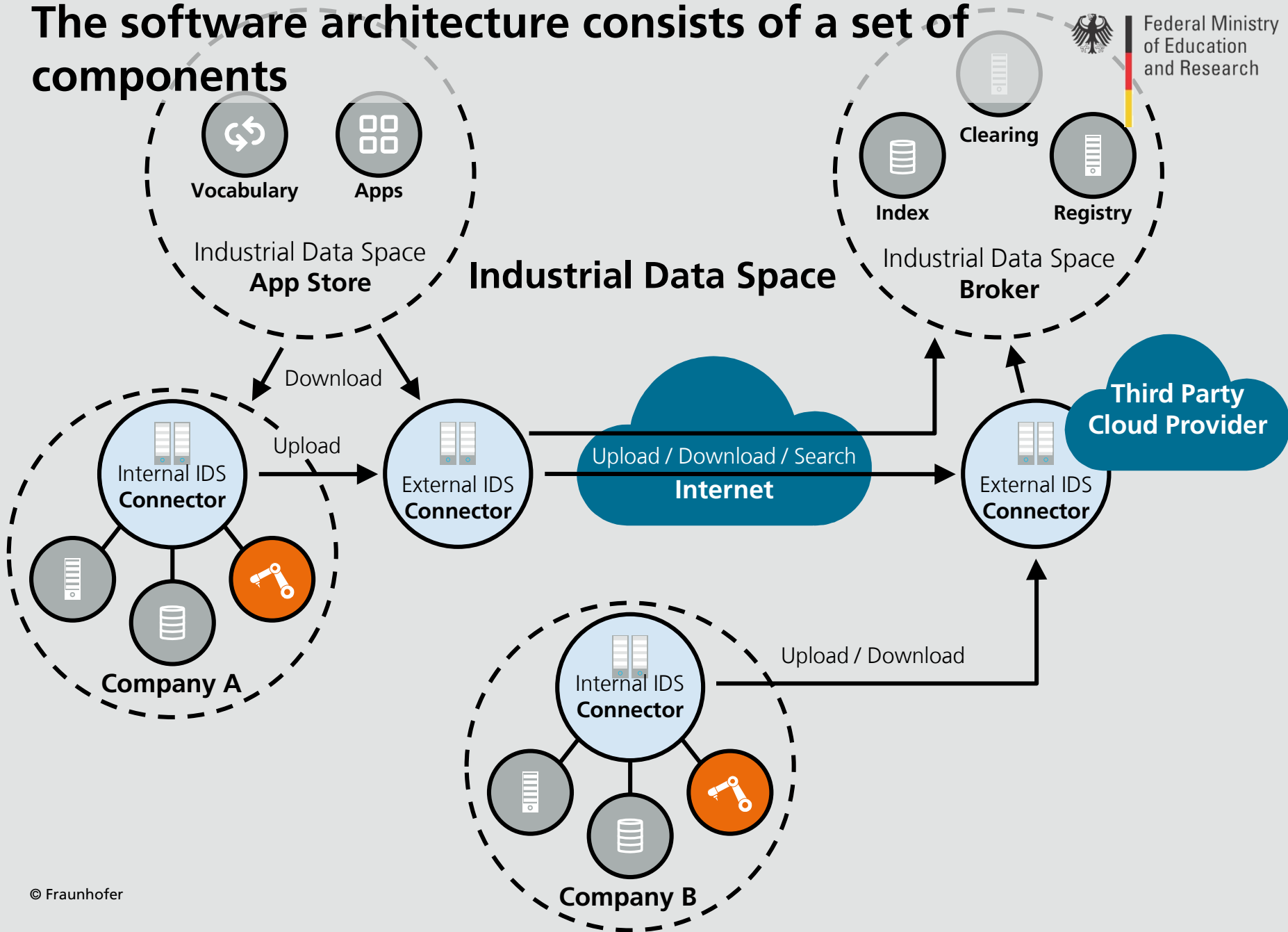
The Industrial Data Space recognizes five different organizational roles

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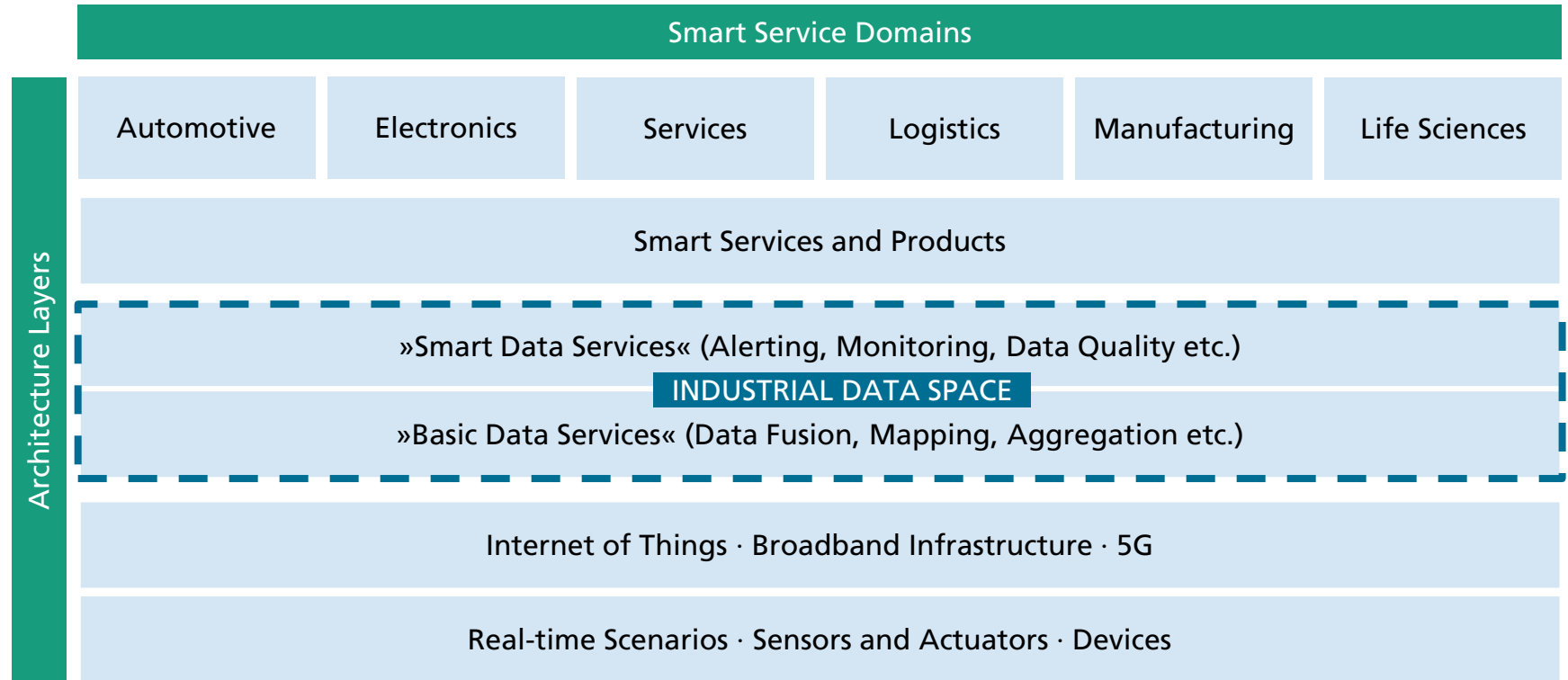dortmund

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Some key features characterize the Industrial Data Space

- Digital sovereignty over data assets

- Secure »Data Supply Chain«

- Easy data linking

- Data economy blueprint

- Trusted participants through certification

- Federated/distributed data storage

- Collaborative data governance models

- Open participation process

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The Industrial Data Space focuses on data services

Smart Service Domains					
Automotive	Electronics	Services	Logistics	Manufacturing	Life Sciences

Architecture Layers

Smart Services and Products

»Smart Data Services« (Alerting, Monitoring, Data Quality etc.)

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»Basic Data Services« (Data Fusion, Mapping, Aggregation etc.)

Internet of Things · Broadband Infrastructure · 5G

Real-time Scenarios · Sensors and Actuators · Devices

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The activities are organized as a research project and within a chartered association

Q3/2014   01.10.15   26.01.16   01.10.18

Preparation

Research Project

Industrial Data Space Chartered Association

Use Phase
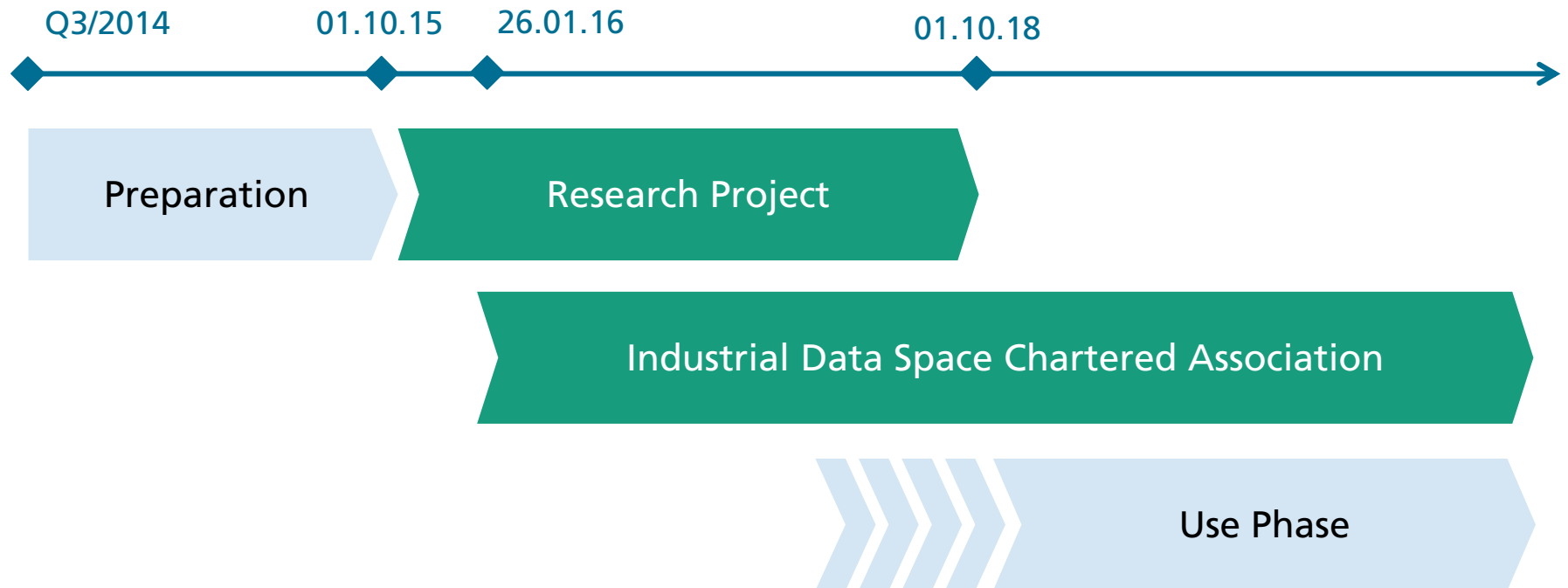
The Industrial Data Space Chartered Association was founded on January 26th, 2015, in Berlin

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The work plan for the upcoming months is all set

- Delivering BMBF research project

- Identification of further use cases

- Positioning on European level

- Joint preparation of usage and operating models

- Communication and public relations

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The Industrial Data Space activites are closely aligned with the »plattform Industrie 4.0«
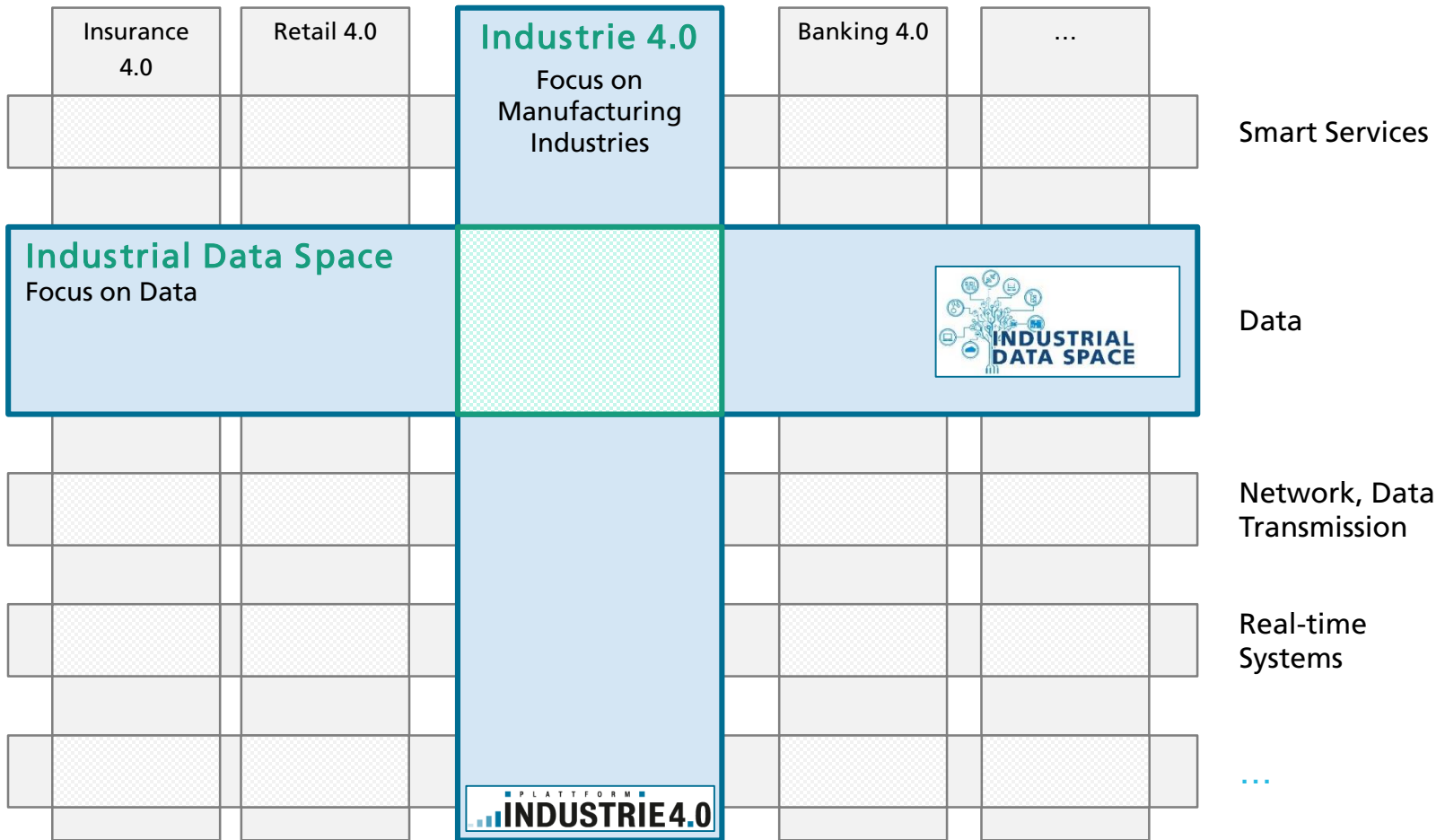
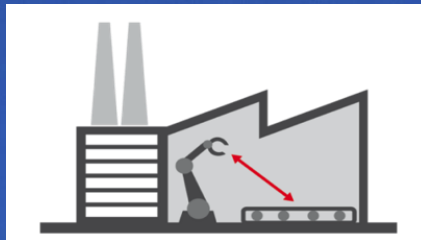# Innovative Digital Business Models require the »Tactile Internet«

5G Berlin Testbed

Requirements
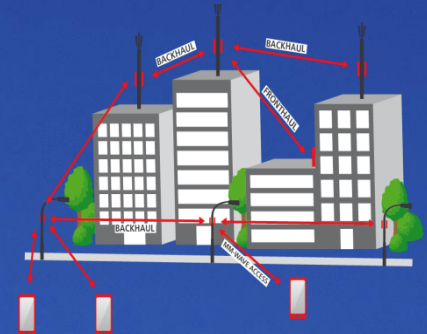- 1000 x Data Throughput
- 100 x Devices
- 10 x Battery Lifespan
- 1 ms Latency

Mobile High Speed Internet
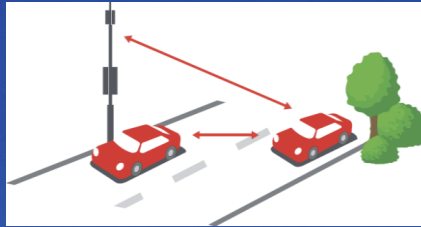
Car2Car & Car2X Communication

Industrial Wireless

Technology
- DSL boxes and streep lights become transmitters
- Fibreglass

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The Industrial Data Space at a Glance!
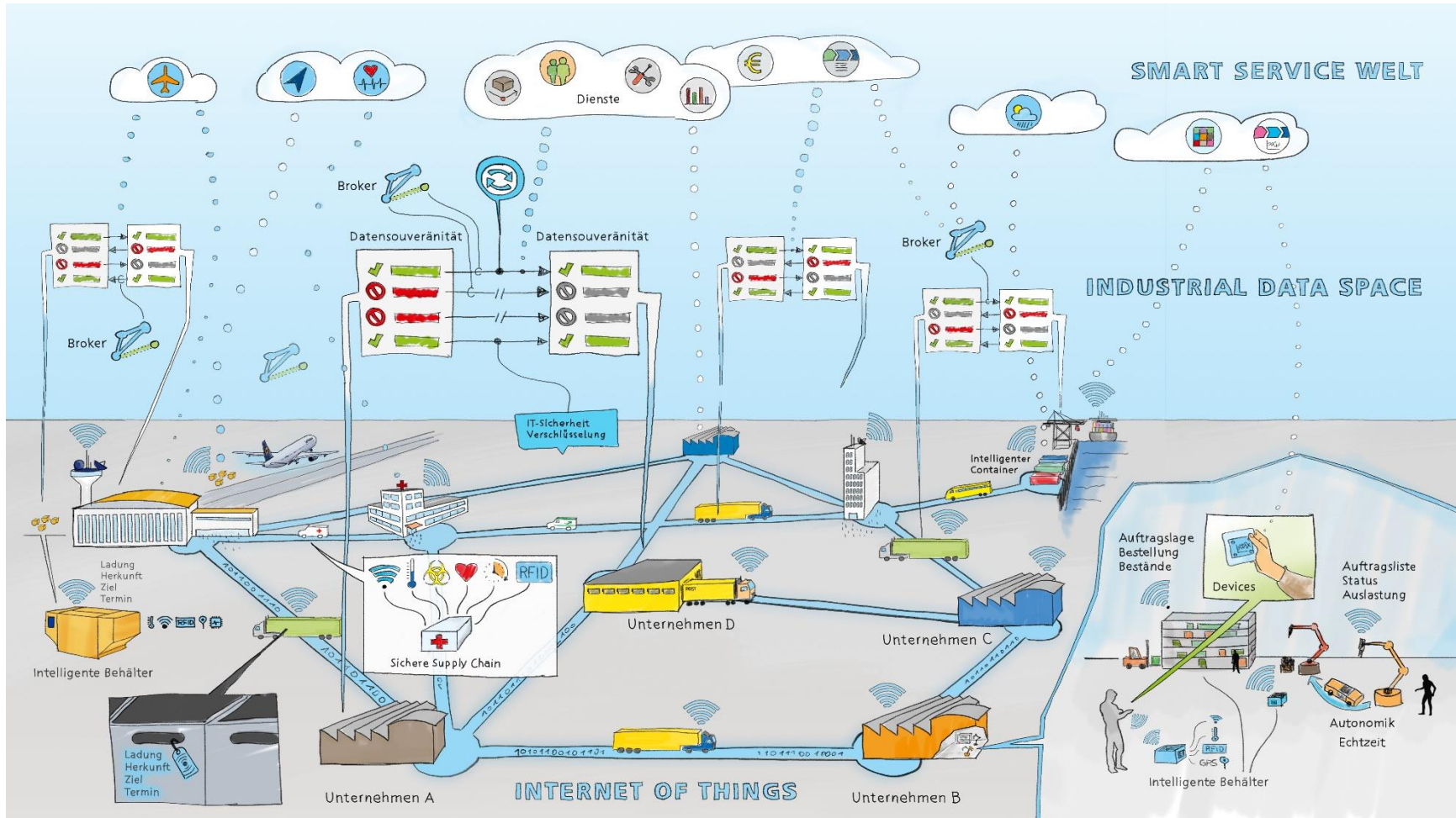
Thank you very much for your attention!

Prof. Dr. Boris Otto

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https://www.xing.com/profile/Boris_Otto

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INDUSTRIAL DATA SPACE: STATUS UPDATE

Prof. Dr. Boris Otto · Zurich · December 9th, 2015