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
adidas combines digital services and lot size 1 production

Smart Service »Runtastic«

In-Store Production

Source: Handelsblatt, August 6, 2015, No. 149; http://www.adidas-group.com/de/medien/newsarchiv/pressemitteilungen/2015/adidas-gruppe-erwirbt-runtastic/; startjp.com
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Successful value propositions are becoming increasingly »hybrid«—as the example of adidas shows.
Tool machine manufacturer TRUMPF wants to offer an AppStore around metal sheet processing.

Tool Machine as Physical Asset

Digital Value-Added Service

Digital products follow a platform architecture logic

- 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

Digital Business Architecture

- SMART SERVICES
- SMART DATA
- SMART PRODUCTS
- SMART SPACES

Agricultural machinery manufacturers are driving comprehensive digital farming solutions

Precision Farming

Value Creation in Ecosystems

- Machine Providers
- Crop Science Companies
- Influencers
- Technology Providers
- Farmers
- Wholesale

Source: Beecham Research Ltd. (2014).
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 \( \uparrow \)
- Number of models, variants, features \( \uparrow \)
- Product life-cycles \( \downarrow \)
- Globalization of processes \( \uparrow \)

**Manufacturing and Logistics**
- Process and product complexity \( \uparrow \)
- Cost targets \( \uparrow \)
- Decision needs (strategic, tactical, operational) \( \uparrow \)

**Implications and Needs for Action**
- »Autonomization« of manufacturing \( \uparrow \)
- Real-time information availability \( \uparrow \)
- Interoperability of production systems \( \uparrow \)

**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

I have to be at the goods issue in 2 hours!

I’m booked out till Friday!

I can work on Saturday.

Magazine will be empty soon, please refill!

Sorry, I’m not available on Saturday.

I need to go home now. Who can take over my orders?

New customer order: We need an extra shift on Saturday.
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

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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!
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

Source: Fraunhofer IML (2014).
Industry 4.0 is a design principle for the industrial enterprise of the future.
As a consequence production and supply chain complexity is dramatically increasing.
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Data has evolved from a byproduct of operations to a strategic resource.
Data is the strategic resource to link »Industry 4.0« and »Smart Service Welt«

Legend:
- Green arrow: Information flow
- Blue arrow: Material flow
The Industrial Data Space aims at a »Network of Trusted Data«

- Trustworthiness
  - Certified Members

- Openness
  - Neutral and User-Driven

- Decentralization
  - Federated Architecture

- Sovereignty
  - Data and Services

- Security
  - Data Exchange

- Governance
  - Common Rules of the Game

- Scalability
  - Network Effects

- Ecosystem
  - Platform and Services
The overall Industrial Data Space architecture takes four different viewpoints
A technology-agnostic »Business Map« describes functional data services

<table>
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<th>Industrial Data Space App Store</th>
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<th>Data Service Management and Use</th>
<th>Vocabulary Management</th>
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<td>Data Anonymization</td>
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<td>Knowledge Database Management</td>
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<tr>
<th>Industrial Data Space Broker</th>
<th>Data Source Management</th>
<th>Data Source Search</th>
<th>Data Exchange Agreement</th>
<th>Data Exchange Monitoring</th>
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<td>Data Source Publication</td>
<td>Key Word Search</td>
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<th>Industrial Data Space Connector</th>
<th>Data Exchange Execution</th>
<th>Data Preprocessing Software Injection</th>
<th>Remote Software Execution</th>
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<tr>
<td>Data Request from Certified Endpoint</td>
<td>Preprocessing Software Deployment and Execution at Trusted Endpoint</td>
<td>Data Compliance Monitoring (Usage Restrictions etc.) Remote Attestation Endpoint Authentication</td>
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</table>
The software architecture consists of a set of components.

- **Industrial Data Space**
  - App Store
  - Broker
  - Clearing
  - Registry
  - Index

- **Industrial Data Space** components:
  - **Vocabulary**
  - **Apps**

- **Internal IDS Connector**
  - Company A

- **External IDS Connectors**
  - Company A
  - Company B

- **Third Party Cloud Provider**

- **Upload / Download / Search**
  - Internet
The Industrial Data Space recognizes five different organizational roles:

- Data Provider
- Data User
- AppStore Provider
- Broker
- Certifying Agency
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
The Industrial Data Space focuses on data services

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<th>Smart Service Domains</th>
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<th>Smart Services and Products</th>
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<tr>
<td>»Smart Data Services« (Alerting, Monitoring, Data Quality etc.)</td>
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<td>»Basic Data Services« (Data Fusion, Mapping, Aggregation etc.)</td>
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<td>Real-time Scenarios</td>
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<td>Sensors and Actuators</td>
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<td>Devices</td>
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The activities are organized as a research project and within a chartered association.
The Industrial Data Space Chartered Association was founded on January 26\textsuperscript{th}, 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
The Industrial Data Space activities are closely aligned with the »plattform Industrie 4.0«.
Innovative Digital Business Models require the »Tactile Internet«

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

Technology
- DSL boxes and streep lights become transmitters
- Fibreglass

Mobile High Speed Internet
Car2Car & Car2X Communication
Industrial Wireless
The Industrial Data Space at a Glance!
Thank you very much for your attention!

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INDUSTRIAL DATA SPACE: STATUS UPDATE

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