Industrial Service as a Research Discipline
A global leader in power and automation technologies
Leading market positions in main businesses

~150,000 employees

$42 billion
In revenue (2013)

Present in +100 countries

Formed in 1988
merger of Swiss (BBC, 1891) and Swedish (ASEA, 1883) engineering companies
Cooperation with Universities
Industrial Service
Importance & Definition
Industrial Service
Not just Repair

- Repair and preventive maintenance of industrial assets (e.g. motors, robots, pressure sensors, valves etc.)
- Operator and maintenance training
- Optimization of production systems (to maximize OEE – Overall Equipment Effectiveness)
- Decommissioning of obsolete assets
- ....
Industrial Service
Important Today – Even More Important in the Future

- Industrial service is the **largest segment of all business services** in the UK (Herbert and Paraskevas, 2003)

- Industrial service is a **huge market**
  - VDI: Maintenance of industrial assets in Germany alone had a total cost of 31.14 billion Euro in 2009 (Eick et al, 2011).
  - Roland Berger: Industrial service market in 2008 was 29 billion Euro (RolandBerger 2010)

- Importance of industrial services as a means of increasing **production efficiency** is growing (RolandBerger 2010)

- In the often saturated market of industrial assets, vendors are looking for new markets. **Servicing the installed base** is seen as a lucrative opportunity (Oliva et al 2003).
### Main Types of Definitions for Industrial Service

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset-Focused</strong></td>
<td>„Service for industrial products“</td>
<td>Oliva and Kallenberg 2003</td>
</tr>
<tr>
<td><strong>Provider-Focused</strong></td>
<td>„Type of company“</td>
<td>Homburg and Garbe 1999, Cooper and Jackson 1988, Quinn et al 1990, ...</td>
</tr>
</tbody>
</table>
Industrial services are "processes supporting customers’ industrial production processes, so that value for them is created in those processes" (Kowalkowski 2006)

Important elements:
• Merely support a value creating activity
• Value creation is physical transformation
Industrial Service
Some (Potentially) Surprising Properties

- **Long Asset Life Cycles:** Equipment used is operated for decades, sometimes a century.
- **Value-Driven:** Emotions less important than with consumer goods but value difficult to determine.
- **Not Mass Market:** Often few but big customers – less economies of scale than many B2C services.
- **Unplanned Downtime:** can be very expensive - reliable is preferable to high-tech.
Industrial Service
What makes it attractive to Industry and Academia

Industrial Interest in Industrial Service Research
- Competitive pressure in core business
- Higher margins in service
- Possibility to differentiate

Academic Interest in Industrial Service Research
- Relatively virgin topic which still needs standardization, e.g. in definitions
- Interesting open/emerging challenges
- Multi-disciplinary field with opportunities for many researchers
- Unique challenges as opposed to classical consumer service
Industrial Service
Sub-Areas of Industrial Service
For an alternative subdivision see RolandBerger 2010)
## Industrial Service
### Relevant Scientific Disciplines

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Knowledge Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engineering</strong></td>
<td>Knowledge about the technical properties of the assets</td>
</tr>
<tr>
<td></td>
<td>Knowledge about the domain of the customer (e.g. chemical engineering)</td>
</tr>
<tr>
<td><strong>ICT Infrastructure</strong></td>
<td>Knowledge about cyber-physical systems, mobile devices, ubiquitous computing etc,</td>
</tr>
<tr>
<td></td>
<td>„Hardware-Focused“</td>
</tr>
<tr>
<td><strong>Computer Science</strong></td>
<td>Knowledge about information systems, data management, data quality etc.</td>
</tr>
<tr>
<td></td>
<td>„Software-Focused“</td>
</tr>
<tr>
<td><strong>OR &amp; Statistics</strong></td>
<td>Data Analytics</td>
</tr>
<tr>
<td></td>
<td>Reliability Engineering</td>
</tr>
<tr>
<td><strong>Economics</strong></td>
<td>Knowledge about cost models, business processes etc.</td>
</tr>
<tr>
<td></td>
<td>Business Administration &amp; Economics</td>
</tr>
</tbody>
</table>
## Topics Addressed

Long-term planning of service activities and infrastructure for providers and customers. This is mostly an enabler for other services but can also be provided as a service offering.

- Service Strategies
- Resource Planning
- Business Models and Value Proposition
- Maintenance Strategy and Planning
- Obsolescence Management

## Types of Services Covered

Strategic Consulting (e.g. Asset Optimization, Parts & Inventory Management, Maintenance Strategy and Planning)

## Scientific Input

Economics, OR & Statistics

## Impact of Future Developments

Advanced Business Models
Industrial Service
Service Strategy

Long-Term Planning

Business Models

Value Proposition

(Maintenance) Activities

Resources

Life Cycle Management

e.g. planning intervals for inspections, preventive maintenance etc. (RCM, TPM)
e.g. defining a spare parts policy
e.g. planning best time for equipment replacements
## Industrial Service
### New Service Offerings

<table>
<thead>
<tr>
<th>Topics Addressed</th>
<th>Provide service which does beyond maintaining the status quo – „value added“, proactive, customer-oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of Services Covered</td>
<td>Operation, Warranty Extension, Advanced Solutions, Remote Service, Engineering, Process Safety &amp; Environmental, Cyber Security, Software as a Service, Data Engineering, Energy Efficiency</td>
</tr>
<tr>
<td>Scientific Input</td>
<td>Economics, OR &amp; Statistics, Engineering, ICT, Computer Science</td>
</tr>
<tr>
<td>Impact of Future Developments</td>
<td>Industrie 4.0, Big Data</td>
</tr>
</tbody>
</table>
Industrial Service
New Service Offerings

Value Generated by Service

Time

Value-Added Service Value Contribution (e.g. Adv. Process Control)

Baseline Asset Value Contribution

Classical Service Value Contribution (e.g. Repair)
### Topics Addressed
- Providing information to the customer in order to better use/maintain the equipment

### Types of Services Covered
- Technical Support, Technical Consulting, Performance Audit, Customer Training

### Scientific Input
- Computer Science, Engineering, ICT

### Impact of Future Developments
- Internet of Things, Virtual Reality
Industrial Service
Customer Support

Providing **Information** to the Customer

- Information about Products
- Technical Consulting
- Audits
- Training

- e.g. phone support
- e.g. plant engineering
- e.g. maintenance performance audit
- e.g. operator training
### Industrial Service Service Operations

<table>
<thead>
<tr>
<th>Topics Addressed</th>
<th>Providing supporting activities for the customer’s assets throughout its life cycle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of Services Covered</td>
<td>Spare Parts &amp; Consumables, Installation &amp; Commissioning, Repair, Reconditioning, Performance Upgrade, Inspection, Maintenance, End-of-Life Services</td>
</tr>
<tr>
<td>Scientific Input</td>
<td>CS, ICT, Engineering</td>
</tr>
<tr>
<td>Impact of Future Developments</td>
<td>Cyber-Physical Systems, Wearable Computing</td>
</tr>
</tbody>
</table>
Industrial Service
Service Operations

Asset Life Cycle
- Installation
- Inspection
- Preventive Maintenance
- Repair
- Upgrade
- Decommissioning
Industrial Service
CS and BI Challenges
Challenge: Tracking the Installed Base

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>A lot of equipment is sold through third parties (e.g. OEMs) and there is little incentive to share the information. IB collection must be simple or automated and there need be incentives. Also, condition etc. is often not known.</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>ICT, Computer Science</td>
</tr>
<tr>
<td>OEM</td>
<td></td>
</tr>
</tbody>
</table>
## Industrial Service Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Proof of Value Proposition/Service Level Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>Service Strategy</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>Economics, OR &amp; Statistics</td>
</tr>
<tr>
<td>Description</td>
<td>Showing the value of service offerings (esp. advanced ones) is very difficult because of lack of data and ill-understood cause-effect-relationship</td>
</tr>
</tbody>
</table>

**Diagram:**

- **Cause-Effect not Understood**
  - **Real World Plant**
  - **Inadequate Models**
    - Lack of Data
    - High Complexity
  - **Bonus/Penalty Contract**
  - **Internal Improvement Initiative**

**Questions:**

- Should I get a bonus?
## Industrial Service Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Life Cycle Management &amp; Obsolescence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional Area</strong></td>
<td>Service Strategy</td>
</tr>
<tr>
<td><strong>Scient. Discipline</strong></td>
<td>Economics, OR &amp; Statistics</td>
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</table>

<table>
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<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Customers like to keep their current equipment (aka „Asset Sweating“) but what kind of service is suitable for old/obsolete equipment? Also, what is the best evolution strategy?</td>
</tr>
</tbody>
</table>

- **Why invest when it still works?**
- **We cannot stop the plant for an upgrade!**
- **Which evolution strategy minimizes my life cycle cost?**
- **What are the service requirements of old equipment?**
2014-06-04 - Control systems customers worldwide face a critical situation after Microsoft in April ended support for Windows XP, prompting ABB to establish a Process Automation XP task force to coordinate replacement of systems still running the 12-year-old operating system.

More than a quarter of the world’s industrial systems and government operations still rely on Windows XP.

http://www.abb.com/cawp/seitp202/964F7AB1D1D80E46C1257CED0048C0E3.aspx
### Industrial Service Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Monitoring/Failure Prediction/Demand Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>Service Operation, New Service Offerings</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>Engineering, OR &amp; Statistics</td>
</tr>
<tr>
<td>Description</td>
<td>How can we create an understandable, affordable system for condition monitoring? Different life cycles, data quality</td>
</tr>
</tbody>
</table>

Currently, this works only for very expensive equipment.
# Industrial Service Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Knowledge Retention &amp; Training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional Area</strong></td>
<td>Service Operations</td>
</tr>
<tr>
<td><strong>Scient. Discipline</strong></td>
<td>CS, ICT, Engineering</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Demographic change leads to service knowledge being lost</td>
</tr>
<tr>
<td></td>
<td>• Some types of service are so rare that none of current staff have done it before</td>
</tr>
<tr>
<td></td>
<td>• Customers’ automation knowledge depth decreases</td>
</tr>
</tbody>
</table>

## Industrial Service

### Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Information Access (esp. In the field)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>Customer Support, Service Operations</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>CS, ICT</td>
</tr>
</tbody>
</table>
| Description        | - The high number of products/variants, their age and complexity make documentation hard to find/read.  
                     - Additional information (e.g. service history) can facilitate service execution  
                     - Requirements in the field:  
                       - The information should be limited to what is relevant  
                       - A user interface which can be used while doing physical work  
                       - Equipment can resist an industrial environment  
                       - Provides instructions how to do work  
                       - Makes it easy to update and maintain information |

### Additional Information

- Appropriate Manual
- Short and Relevant
- UI & Device Suitable for Industrial Environment
- Information Easy to Update and Maintain
## Industrial Service Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>B2B E-Commerce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>Service Operations</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>Economics, CS</td>
</tr>
<tr>
<td>Description</td>
<td>• Price Lists are customer specific, negotiations common</td>
</tr>
<tr>
<td></td>
<td>• Massive amount of master data for parts which are rarely sold</td>
</tr>
<tr>
<td></td>
<td>• Identification of parts (name unknown or not unique)</td>
</tr>
</tbody>
</table>

- Name???
- In catalogue?
- Price?
## Industrial Service Top Challenges

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Selling Advanced Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>New service offerings</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>OR &amp; Statistics, CS, ICT, Engineering</td>
</tr>
</tbody>
</table>
| Description         | • Advanced solutions today are often custom-made  
|                     | • How to reduce the cost of providing/delivering the service?  
|                     | • How to maintain complex algorithm, even after process drift/change?  
|                     | • Business models? |

**Industrial Service Top Challenges**

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Software and Remote Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Area</td>
<td>Customer Support, Service Operation</td>
</tr>
<tr>
<td>Scient. Discipline</td>
<td>ICT, CS</td>
</tr>
</tbody>
</table>
| Description        | • Security and privacy are of key importance for production plants – e.g. safety, trade secrets  
                   | • Updates can be major risks for plant  
                   | • Software in industrial environments is often not zero cost (adaptions)  
                   | • How to sell software as a service? |
Industrial Service
More Challenges relevant for CS/BI

- **Renewable Energy**: How to best plan maintenance for renewable energy plants? (e.g. use of low-wind phases for maintenance)

- **Future Production Systems**: How to maintain an „Industrie 4.0“ production system (i.e. a Cyber-Physical System)

- **System Integration**: Integration of technology infrastructure from ERP level to MES and process control level.

- **Parts Management**: Part tracking, dispatching, warehouse management for spare parts

Industrial Service
Examples of CS/BI Contributions Today

ABB’s Augmented Reality
Demonstrator at Hanover Fair

ABB Safety Vest

ABB PA LCC Tool

ABB Smart Spare Part Concept
Industrial Service

Conclusion
Industrial Service

Conclusions

- Industrial service is not the same as consumer-oriented service
- Industrial service is divided into several functional areas and supported by multiple scientific disciplines
- Many of the key challenges are of interest for the CS & BI community

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Power and productivity for a better world™
Industrial Service
References


