Service Management 4.0 and its applicability in the Swedish railway industry

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Future Industrial Service Management
Agenda

• **New industrial maintenance demands and possibilities**
  Industry 4.0 and Maintenance 4.0, new business opportunities

• **A framework for service business model development**
  Connecting technology development and business model development: Service Management 4.0

• **Possibilities for Swedish railway industry**
  Business ecosystems, partnering, integrated offerings and performance-based contracts
## Industrial development and Industry 4.0

### "Revolutions"

<table>
<thead>
<tr>
<th>Year</th>
<th>Mechatronical Term</th>
<th>System Description</th>
<th>Maintenance Strategy</th>
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<tbody>
<tr>
<td>1750</td>
<td>Mechanisation</td>
<td>Mechanical</td>
<td>Run to failure</td>
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<tr>
<td></td>
<td></td>
<td>Robust</td>
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<td></td>
<td></td>
<td>Low complexity</td>
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<tr>
<td>1900</td>
<td>Electrification</td>
<td>Mechatronical</td>
<td>Run to failure or</td>
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<tr>
<td></td>
<td></td>
<td>Medium complexity</td>
<td>Preventive</td>
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<tr>
<td>1970</td>
<td>Digitalization</td>
<td>Mechatronical</td>
<td>Preventive or</td>
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<td>Computerisation</td>
<td>Predictive</td>
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<tr>
<td>2000</td>
<td>Internetization</td>
<td>Connected</td>
<td>Predictive or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complex</td>
<td>Proactive</td>
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### Industry 4.0: Internet of things and cyber-physical systems creating a distributed network of embedded systems communicating with each other in an ad-hoc and dynamic way
Maintenance 4.0

Maintenance 4.0 is a subset of industry 4.0 with emphasis on the prospects of maintenance that involves automatic data collection, analysis, visualization and decision making for assets.

Data intensive, self-learning and smart systems that predicts failure, makes diagnosis and triggers maintenance actions

Supports maintenance activities through data analysis, visualization and virtual or augmented reality
Business models for after sales services
*Kans and Ingwald, (2016a)*

- **Implied success factors (from literature):**
  - Mixing products and services in customer offers (integrated offerings)
  - A holistic view on the value creation process
  - Performance-based business models with relevant design/metrics
  - ICT as an enabler and a prerequisite for business model development

- **Requires (for industry):**
  - A life cycle approach
  - A focus on benefits and value creation rather on products
  - Positioning yourself in the value chain/network

- **Requires (for research):**
  - Theories and methods supporting new, holistic business models for after sales services
  - ICT solutions that enable new business models
Maintenance service business model 1.0

<table>
<thead>
<tr>
<th>Key partners</th>
<th>Key activities</th>
<th>Value proposition</th>
<th>Customer relationships</th>
<th>Customer segments</th>
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<tr>
<td></td>
<td>Key resources</td>
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<td>Channels</td>
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<table>
<thead>
<tr>
<th>Cost structure</th>
<th>Revenue stream</th>
</tr>
</thead>
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<tr>
<td>![Cost structure graph]</td>
<td>![Revenue stream graph]</td>
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## Maintenance service business model 2.0

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<td><img src="image6.png" alt="Image" /></td>
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### Cost structure

![Graph](graph1.png)

### Revenue stream

![Graph](graph2.png)
## Maintenance service business model 3.0

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<td>Key resources</td>
<td>Value proposition Function</td>
<td>Customer relationships Channels</td>
<td>Customer segments</td>
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### Cost structure
- Creating a UNIQUE SELLING PROPOSITION
- VALUE

### Revenue stream
- Graph showing revenue streams
# Maintenance service business model 4.0

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<tr>
<th>Key resources</th>
<th>Utility</th>
<th>Channels</th>
<th>Cost structure</th>
<th>Revenue stream</th>
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<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Maintenance service business model development

- Key partners
- Key activities
- Value proposition
- Customer relationships
- Customer segments

- Key resources
- Channels

Cost structure
Revenue stream

Creating a UNIQUE SELLING PROPOSITION
VALUE
What does the development tell us?

- The more complex machines, the less focus on technology
- Instead – more focus on relationships and utility
- From maintenance focus to focus on operations
- The maintenance service provider’s key resources remains the same but the amount of key activities increase (implying that maintenance increasingly becomes more information and knowledge intensive)
- The modern maintenance service provider has more possibilities to control the cash flow
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of offering</strong></td>
<td>Technology</td>
<td>Mainly product</td>
<td>Product and service</td>
<td>Integrated offerings</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td>Low</td>
<td>High</td>
<td>Dynamic</td>
<td></td>
</tr>
<tr>
<td><strong>Quality dimensions</strong></td>
<td></td>
<td>Mainly product</td>
<td>Combination of product and service</td>
<td></td>
</tr>
<tr>
<td><strong>Business development strategy</strong></td>
<td>Technology-driven</td>
<td>Customer-driven</td>
<td>Utility-driven</td>
<td>Dynamic</td>
</tr>
<tr>
<td><strong>Strategic perspective</strong></td>
<td>Inside-out</td>
<td></td>
<td>Outside-in</td>
<td></td>
</tr>
<tr>
<td><strong>View on profitability</strong></td>
<td>Productivity</td>
<td>Customer satisfaction</td>
<td>Customer satisfaction / relationships</td>
<td>Relationships (more or less formal)</td>
</tr>
<tr>
<td><strong>View on value creation</strong></td>
<td>The own business in focus</td>
<td>Value chain</td>
<td>Value star/network</td>
<td>Ecology</td>
</tr>
<tr>
<td>Maintenance management support</td>
<td>Low level of computerization, no automation</td>
<td>Computerization for effective planning and for efficient execution</td>
<td>Computerization and automation for effective planning and for optimizing maintenance actions</td>
<td>Intelligent and self-adapting systems for effective and automated maintenance planning, execution and improvement (Maintenance 4.0)</td>
</tr>
</tbody>
</table>

*Kans and Ingwald (2016b)*
Service Management 4.0
*Kans and Ingwald (2016c)*

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Level 4</th>
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</thead>
<tbody>
<tr>
<td>Type of offering</td>
<td>Integrated offerings</td>
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<tr>
<td>Density</td>
<td>Dynamic (Low/high)</td>
</tr>
<tr>
<td>Quality dimensions</td>
<td>Combination of product and service</td>
</tr>
<tr>
<td>Business development strategy</td>
<td>Dynamic (Technology, customer, utility driven)</td>
</tr>
<tr>
<td>Strategic perspective</td>
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<td>View on profitability</td>
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<td>View on value creation</td>
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- Partnering
- Business ecosystem
- Integrated offerings
- Life cycle perspective
- Performance-based contacts
Problem situation of Swedish railway maintenance
Ingwald and Kans (2016a); Ingwald and Kans (2016b)

- **Lack of appropriate maintenance resources**
  - **Low availability of rolling stocks**
  - **Conservative buyers’ culture**
  - **Poor quality charging system**
  - **Passive governmental management**

- **Complicated timetabling process**
  - **Low level of competition / feeling that it is not a real market**
  - **Cost model not connected to real needs**

- **Maintenance ineffectiveness**
  - **Maintenance services does not fullfil market needs**

- **Lack of capacity**
  - **Lack of investments in infrastructure**
  - **Degraded infrastructure**

- **Inaccurate/ incomplete analysis models**
  - **Poor information handling**
  - **Poor cooperation amongst actors**
  - **Maintenance ineffectiveness**

- **Inaccurate maintenance plans**
  - **Poor quality assurance system**

- **Lack of suitable IT-support**
  - **Lack of capacity**

- **Problem situation of Swedish railway maintenance**
  - **Conservative buyers’ culture**
  - **Poor quality assurance system**
  - **Lack of suitable IT-support**
  - **Lack of capacity**

- **Poor quality assurance system**
  - ** Poor cooperation amongst actors**

- **Poor internal management**
  - **Poor quality assurance system**

- **Poor cooperation amongst actors**
  - **Poor quality assurance system**

- **Inaccurate maintenance plans**
  - **Poor quality assurance system**

- **Poor internal management**
  - **Poor cooperation amongst actors**

- **Poor quality assurance system**
  - **Poor cooperation amongst actors**
The same value chain, different representations

Ingwald and Kans (2016a)
The same value chain, different representations

Ingwald and Kans (2016a)
The same value chain, different representations

Metso and Kans (unpublished)
The problem area viewed from an ecosystem perspective

*Ingwald and Kans (2016a)*

Some characteristics:

- Different actors involved in different life cycles.
- There exists one dominant actor, The Swedish Transport Administration.
- The agreements between The Swedish Transport Administration and actors involved in construction/maintenance are very detailed on what each actor should do.
- Many actors and many different relations between actors, complicated information situation.
- Many different demands needs to be handled, bodies/operators related to punctuality/time slots, owners regarding value and life-length of rolling stock, etc.

**Business ecosystem:** an economic community consisting of interacting organisations and individuals, which are the organisms of the business world.
Possible ways of action – the ecosystem perspective
Ingwald and Kans (2016a); Metso and Kans (unpublished)

- Contracts covering larger parts of the lifecycle for infrastructure.
- Contracts giving incentives for internal as well as external improvements for the service provider.
- Better utilisation of the experience and knowledge available amongst different actors.
- Develop systems for better coordination of different actors and for information handling.
Possible ways of action – the ecosystem perspective

- Maintenance provider
- Manufacturer
- Train manager
- Train
- Operator
- Customer
- System

- Asset value throughout the life
- Low life cycle cost
- High availability
- High reliability
- Low operational costs
- Punctuality
- Safety
- Service reliability
- Comfort
- Competitive price
- Environmental friendly transport

- Maintenance and operations data and feedback as input to product development
- Incomes
- Internal efficiency
Integrated offerings
Erkoyuncu et al. (2013)
Integrated offerings and performance-based contracts

- Labour-intensive offerings, such as maintenance, show the greatest positive effect for extending products with service offerings (Visnjic Kastalli and Van Looy, 2013)
- Customers enter into performance-based contracts for mature products, but choose a resource-based contract for new products because of perceived reliability (Bakshi et al., 2015)
- No single best practice exist; type of business model is context dependent (Kowalkowski et al., 2013)
- Performance should be measured using suitable metrics (input, process, outcome) (Famurewa et al., 2013)
Is partnering a solution?
Ingwald and Kans (2016b)

- Partnering is potentially beneficial in situations with high complexity and limited amount of contractors available in the market, and where activities are business critical. Cost reduction to up to 30 percent and high availability performance (Olsson and Esping, 2004).

- Partnering potentially increases the information/knowledge sharing by building trust, and resource-efficiency could be reached by involving contractors already in the design phase (Lingegård, 2014).

- Partnering requires agreed goals, cooperation and openness, which address problems such as vague contracts, a conservative buyers’ culture and poor quality charging system (Abdi et al., 2014).

- Partnering creates better conditions to develop a suitable IT-solution that are beneficial for all involved actors (Ingwald and Kans, 2016).

**Partnering**: Establishing a long term win-win relationship based on mutual trust and teamwork, and on sharing of both risks and rewards.
Our approach: Modular maintenance offerings

- Utility
- Performance
- Resource

Scope:
- Level 1
- Level 2
- Level 3
- Level 4

Maturity:
- Level 1
- Level 2
- Level 3
- Level 4

Time:
- Rigid
- Dynamic

Dynamic
Value creation throughout the whole life-cycle and for all actors
Thank you for the attention.

Questions?

Lnu.se
Reference list

Request@: mirka.kans@lnu.se


Metso, L, Kans, M. An ecosystem perspective on asset management information. Article in progress