Tools for Lifecycle Modeling and Engineering – Necessity from Megatrends in Industry

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Department of Management and Engineering
Our industry partners (examples)
Environmental challenges

- Climate change

Globally averaged combined land and ocean surface temperature anomaly

(IPCC, 2014)
Environmental challenges

- Resource issue

→ Circular Economy
Manufacturers providing services

(Neely, 2011)
Product/Service System (PSS)

- Case from production machine provider

  Training

  Spare Parts

  Hotline and Remote Service

  Field Service

(Meier et al. 2010)
PSS of Rolls-Royce with aero engines

Cost for a customer

Selling engines plus maintenance, etc. ("Traditional" offering)

Power By The Hour®:
a fixed price for engine maintenance over an extended period of time.
→ maintenance becomes cost for Rolls-Royce.

(Based on Smith 2013)
PSS with forklift trucks

• Comparison of PSS and a reference product (i.e. product sales) in total Lifecycle Cost from the buyer’s perspective:

(Sakao et al. 2015)
PSS and environmental impacts

<table>
<thead>
<tr>
<th>PSS type</th>
<th>Impacts compared to reference situation (product)</th>
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<tbody>
<tr>
<td></td>
<td>Worse =&gt; Equal =&gt; Incremental reduction (&lt;=20%) =&gt; Considerable reduction (&lt;=50%) =&gt; Radical reduction (&lt;=90%)</td>
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<tr>
<td>1. Product-related service</td>
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<td>2. Advice and consultancy</td>
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<td>3. Product lease</td>
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<td>4. Product renting and sharing</td>
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<td>5. Product pooling</td>
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<td>6. Activity management</td>
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<td>7. Pay per unit use</td>
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<td>8. Functional result</td>
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PSS is more likely to decrease environmental impacts.

(Tukker 2004)
Need of Lifecycle modeling and engineering

Traditional manufacturer’s boundary


Improved material flows needed

Improved communication / sharing of data needed
“Over the wall problem”: a classic problem

(Munro & Associates in Boothroyd et al. 1992)
What are needed for manufacturers to provide PSS?

(Ulaga et al. 2010)
Need of coupling tools and methods

Data from lifecycle phases

Information technology tools

Engineering & management methods

Value created
Our track record on PSS design


A PSS design method – SPIPS

1. Customer segmentation
2. Extracting customer value
3. Prioritising customer value
4. Translation to design parameters
5. Generating improvement options
6. Investigating economic efficiency

Effective and efficient PSS

* SPIPS: Customer-Oriented Solution Provider – through Integrated Product and Service Development (Sakao et al. 2009a)
CAD Software for PSS

(Sakao et al. 2009b)
CAD Software for PSS

(Sakao et al. 2009b)
CAD Software for PSS

(Sakao et al. 2009b)
CAD Software for PSS

(Sakao et al. 2009b)
### Our track record on publication on PSS

<table>
<thead>
<tr>
<th>Rank</th>
<th>Author</th>
<th>Discipline</th>
<th>Publications</th>
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<td>Sakao, Tomohiko</td>
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<td>Prox, Thomas, Oliver</td>
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(Thomas et al. 2013)
Solution having revitalized US manufacturing in 80s

Change realized by methods of “quality management” in product design

Modified from (B. King, 1989, Better Designs in Half the Time.)
Analogy to current situation

Quality of offering

$q_n$

$q_o$

New system

Old system

Support needed

Offering definition

Design of product / service

Redesign of product / service

$t_n$

$t_o$

Time

(Sakao et al. 2013)
Key take aways

1. Two mega trends are making stronger need on new way of managing data for lifecycle modeling and engineering:
   - Environmental challenges
   - Product and service integration (Product/Service System: PSS)

2. Current ways of data management are insufficient.

3. Coupling methods (work procedures) and tools is needed to maximize the benefits.
Interested in collaborating? Contact me!

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