Remanufacturing in the European automotive market

DEMANET Project Final Meeting
Tuesday, October 28th, 2014

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Technical University Berlin
Chair of Assembly Technology and Factory Management
Two institutes, one roof

- Fraunhofer IPK – Production Systems and Design Technology
- TU Berlin IWF – Machine Tools and Factory Management

Missions

- Fundamental and applied research
- Education for new generations of engineers
- Optimization of industrial processes – from the product idea through to product development, design and manufacture

Expertise areas

- Design
- Manufacturing
- Assembly
- Process planning/Logistics
- Control
- Quality management
### Ecological Footprint

<table>
<thead>
<tr>
<th>World</th>
<th>Population [Mio.]</th>
<th>Ecological Footprint [global ha/cap]</th>
<th>Biological Capacity [global ha/cap]</th>
<th>Ecological Deficit (-) or Reserve (+) [global ha/cap]</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>6.739,6</td>
<td>2,7</td>
<td>1,8</td>
<td>-0,9</td>
</tr>
<tr>
<td>Brazil</td>
<td>191,5</td>
<td>2,9</td>
<td>9,6</td>
<td>+6,7</td>
</tr>
<tr>
<td>China</td>
<td>1.358,8</td>
<td>2,1</td>
<td>0,9</td>
<td>-1,2</td>
</tr>
<tr>
<td>Germany</td>
<td>82,5</td>
<td>4,6</td>
<td>2,0</td>
<td>-2,6</td>
</tr>
<tr>
<td>India</td>
<td>1.190,9</td>
<td>0,9</td>
<td>0,5</td>
<td>-0,4</td>
</tr>
<tr>
<td>Japan</td>
<td>126,4</td>
<td>4,2</td>
<td>0,6</td>
<td>-3,6</td>
</tr>
<tr>
<td>Russia</td>
<td>142,8</td>
<td>4,4</td>
<td>6,6</td>
<td>+2,2</td>
</tr>
<tr>
<td>USA</td>
<td>305</td>
<td>7,2</td>
<td>3,9</td>
<td>-3,3</td>
</tr>
</tbody>
</table>

- 12.8 billion ha divided by 6,739.6 billion people: The planet’s bio-capacity is 1.8 global ha/cap (2008)
- Global bio-capacity of 1.8 global ha/cap equals an ecological deficit of 50% or 1.5 earths.

Quality of life and consumption of resources

Challenge:
How to convert from 1/5 of global population exploiting 4/5 of global resources to acceptable distribution of wealth within ecological limits.

Source: DFG: Sonderforschungsbereich 1026 Sustainable Manufacturing
Sustainable manufacturing

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The dynamics of global competition and cooperation shall be utilized for lending wings to processes of innovation and mediation towards the reasonably demanded sustainability on our globe.

End-of-life strategies

Product system

Raw material acquisition → Material processing → Manufacturing and assembly → Use and service → Retirement → Treatment and disposal

Reuse → Remanufacturing → Recycling

Material inputs → Energy inputs

Earth and ecosystem

Waste material outputs → Other emissions

Source: Nasr, N., 2006
Remanufacturing preserves the product’s embedded value

Product value retained, compared to a new product:

- **New product**: 15% (Material), 45% (Labor), 30% (Energy), 12% (Plant / Equipment)
- **Remanufactured product**: 25% (Material), 8% (Labor), 8% (Energy), 12% (Plant / Equipment)
- **Recycled product**: 8% (Material), 8% (Labor), 8% (Energy), 8% (Plant / Equipment)

Source of value in the product:  □ Material  □ Labor  □ Energy  □ Plant / Equipment

Percentages show in this chart are illustrative only. Actual percentages vary with product type.

Energy consumption of remanufactured and new goods life cycles
Case of refrigerator designed between 1966 and 2008

Best energetic output: remanufacture

New Refrigerator Total Energy (MJ/m³)

Remanufactured Refrigerator Total Energy (MJ/m³)

Energy consumption per life cycle phase

- Utilization
- Production
- Materials

1966

1980

2008

“Break-even”

Best energetic efficiency: Buy a new product

Source: Gutowski, T. G. and al., 2011.
“Potential” for circular business practices assessed by the product sustainability in terms of:

- Product design
- Reverse logistics
- Customer acceptance

Opportunity captured today is assessed by reuse, recycling or remanufacturing activities.

Potential for raw material savings in 2025 in EU: 
$630 billion p.a.

Remanufacturing – Definition in the EU automotive market

A core...

- is a used part which is intended to become a remanufactured part.
- is properly protected, handled in transport and identified for remanufacturing to avoid damage and preserve its value.
- is not waste or scrap and will not be reused before remanufacturing.

A remanufactured part...

- fulfills a function which is at least equivalent compared to the original part.
- is restored from an existing part (CORE), using standardized industrial processes in line with specific technical specifications.
- is given the same warranty as a new part and it clearly identifies the part as a remanufactured part and states the remanufacturer.
- is different from a reused, repaired, rebuilt, refurbished, reworked or reconditioned part.

Source: Common definitions of ACEA, APRA Europe, CLEPA and FIRM
Remanufacturing intensity, however, is still low, as shown for the US

<table>
<thead>
<tr>
<th>Sector</th>
<th>Exemplary products</th>
<th>Production [thousands $]</th>
<th>Employment [FTE]</th>
<th>Production/FTE [thousands $]</th>
<th>Reman intensity [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerospace</td>
<td>Aircraft engines, chassis</td>
<td>13.045.513</td>
<td>35.201</td>
<td>371</td>
<td>2,6</td>
</tr>
<tr>
<td>2. Heavy-Duty und Off-road equipment</td>
<td>Diesel engines, brakes</td>
<td>7.770.586</td>
<td>20.870</td>
<td>372</td>
<td>3,8</td>
</tr>
<tr>
<td>3. Motor vehicle parts</td>
<td>Starter, generator</td>
<td>6.211.838</td>
<td>30.653</td>
<td>203</td>
<td>1,1</td>
</tr>
<tr>
<td>4. Machinery</td>
<td>Turbine, production equipment</td>
<td>5.795.105</td>
<td>26.843</td>
<td>216</td>
<td>1,0</td>
</tr>
<tr>
<td>5. IT products</td>
<td>Printer, screens</td>
<td>2.681.603</td>
<td>15.442</td>
<td>174</td>
<td>0,4</td>
</tr>
<tr>
<td>6. Medical devices</td>
<td>X-ray system, computer tomography equipment</td>
<td>1.463.313</td>
<td>4.117</td>
<td>355</td>
<td>0,5</td>
</tr>
<tr>
<td>7. Retreaded tires</td>
<td>Automotive and aircraft tires</td>
<td>1.399.088</td>
<td>4.880</td>
<td>287</td>
<td>2,9</td>
</tr>
<tr>
<td>8. Consumer products</td>
<td>Household appliances, mobile phones</td>
<td>659.175</td>
<td>7.613</td>
<td>87</td>
<td>0,1</td>
</tr>
<tr>
<td>9. All others</td>
<td>Office furniture, train components</td>
<td>3.973.923</td>
<td>33.890</td>
<td>117</td>
<td>1,3</td>
</tr>
<tr>
<td><strong>2011 Σ</strong></td>
<td></td>
<td><strong>43.000.144</strong></td>
<td><strong>179.509</strong></td>
<td><strong>240</strong></td>
<td><strong>2,0</strong></td>
</tr>
</tbody>
</table>

FTE = Full-time workers

Remanufacturing is expected to gain momentum

Employment in full-time workers [thousands]

China Association of Automobile Manufacturers Auto Parts Remanufacturing Branch, 2012
Automotive Parts Remanufacturers Association (APRA), 2012
Remanufacturing networks in the European Union
The BRAGECRIM initiative

**BRAGECRIM**
Brazilian - German Collaborative Research Initiative in Manufacturing: 355 members in 16 collaborative projects

Main Objective: Highest Level in Production Technology – High Level Innovation, Time to Market, Cost, Quality, Productivity and High degree of Efficiency, Sustainability

**FOCUS:**

Networking of Small and Medium Enterprises (SME) for competitive remanufacturing

- Objective: facilitate remanufacturing in networks
- Target: SME companies, active or interested by remanufacturing, in Brazil and Europe.
- Solution: provide a set of business models using a guideline structure

Source: BRAGECRIM
BRAGECRIM / DemaNet Survey results
Survey context and population

- 84 companies fully answered the survey
- REMATEC took place from 16 - 18 June 2013 in Amsterdam RAI center
- Results of a parallel survey from VTT Finland (DemaNET) are added.

Company activity sector

- Automotive: 72%
- Industrial machinery: 14%
- Heavy industrial vehicles: 5%
- Furniture: 2%
- Others: 7%

Company country of origin (Headquarters)

- Germany: 18%
- Netherlands: 18%
- United Kingdom: 13%
- France: 5%
- Belgium: 6%
- Switzerland: 3%
- Spain: 1%
- Italy: 13%
- Denmark: 1%
- Sweden: 1%
- Finland: 14%
- Others: 7%

Source: BRAGECRIM, VTT DemaNet
BRAGECRIM / DemaNet Survey results
Remanufacturing networks and actors modeling
### BRAGECRIM / DemaNet Survey results

#### Network typology

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case A: OEM integrated</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>Full OEM remanufacturing</td>
<td>24.05%</td>
</tr>
<tr>
<td>A2</td>
<td>OEM with retailer as distribution and reverse logistics manager</td>
<td>13.92%</td>
</tr>
<tr>
<td>A3</td>
<td>OEM with independent reverse logistics</td>
<td>7.59%</td>
</tr>
<tr>
<td><strong>Case B: Contracted remanufacturers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Full subcontractor-controlled remanufacturing</td>
<td>16.46%</td>
</tr>
<tr>
<td>B2</td>
<td>Subcontracted with independent distribution</td>
<td>8.86%</td>
</tr>
<tr>
<td>B3</td>
<td>Subcontracted with independent reverse logistics</td>
<td>6.33%</td>
</tr>
<tr>
<td>B4</td>
<td>Subcontracted with independent retail and reverse logistics</td>
<td>5.06%</td>
</tr>
<tr>
<td><strong>Case C: Independent remanufacturers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Full independent-controlled</td>
<td>10.13%</td>
</tr>
<tr>
<td>C2</td>
<td>Independent with different reverse logistics managers</td>
<td>5.06%</td>
</tr>
<tr>
<td>C3</td>
<td>Independent with different distribution and reverse logistics manager</td>
<td>2.53%</td>
</tr>
</tbody>
</table>

**Source:** BRAGECRIM, VTT DemaNet
## BRAGECRIM / DemaNet Survey results

### Remanufacturing challenges per typology

<table>
<thead>
<tr>
<th>Network type</th>
<th>Main 3 challenges</th>
<th>Strengths and weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> OEM integrated remanufacture</td>
<td>▪ <strong>End of life products (EOL) collection</strong> (47,2%)&lt;br&gt;▪ <strong>Cost</strong> of remanufacturing process (25%)&lt;br&gt;▪ <strong>Cannibalization</strong> of new products (22,2%)&lt;br&gt;▪ <strong>EOL collection</strong> (62,1%)&lt;br&gt;▪ <strong>Cost</strong> of remanufacturing process (17,2%)&lt;br&gt;▪ <strong>Complexity</strong> of the remanufacturing process (17,2%)&lt;br&gt;▪ <strong>Low demand</strong> for remanufactured products (28,6%)&lt;br&gt;▪ <strong>EOL collection</strong> (28,6%)&lt;br&gt;▪ <strong>Complexity</strong> of the remanufacturing process (21,4%)&lt;br&gt;</td>
<td>▪ <strong>Strengths</strong>: Good access to the market and technical knowledge of remanufacturing process.&lt;br&gt;▪ <strong>Weaknesses</strong>: Weak cost management for remanufacturing and logistics, cannibalism of new products. &lt;br&gt;▪ <strong>Strengths</strong>: Good access to the market and effective management of logistic costs.&lt;br&gt;▪ <strong>Weaknesses</strong>: Technical collaboration with OEM and costs management appear complicated, very problematic core collection. &lt;br&gt;▪ <strong>Strengths</strong>: Small, flexible and cost efficient local actors connected with a good core collection knowledge &lt;br&gt;▪ <strong>Weaknesses</strong>: Difficulties to sell the products and to master the remanufacturing process.</td>
</tr>
<tr>
<td><strong>B</strong> Contracted remanufacture</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C</strong> Independent remanufacture</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: BRAGECRIM, VTT DemaNet
BRAGECRIM: Guidelines for remanufacturing

My requirements and constrains are

Interactive and iterative

My business model

Business Model Template

Business Model Dimensions

Description

Calculation

Source: BRAGECRIM
Thank you for your attention - Work with us!

Sustainable Manufacturing – CRC 1026

▶ www.sustainable-manufacturing.net

BRAGECRIM – Networking of SME for competitive remanufacturing

▶ http://bragecrim2.wix.com/remanufacturing

VTT Finland - DEMANET

▶ http://www.vtt.fi/sites/DemaNET/?lang=en

Technische Universität Berlin
Institut für Werkzeugmaschinen und Fabrikbetrieb
Univ.-Prof. Dr.-Ing. Günther Seliger
KEY CHALLENGES IN DEMATERIALIZATION

Prof. Dc.S (Tech) Anne Jalkala
Lappeenranta University of Technology
RELATIVE VS. ABSOLUT DEMATERIALIZATION – DIFFERENT MEASURES

• Reduction of materials use per unit of output

• Change in the amount of waste generated per unit of industrial product (Herman et al. 1990)

• Lower use of energy per unit of economic of economic product
  – Energy intensity = energy unit per unit of GDP

• Declining consumption of goods
THE GAP BETWEEN THE 1.5 BILLION AND THE 5.5 BILLION

If only one-third of the "deprived" achieved the average standard of living in the developed countries, we would continue to see the aggregate growth of material consumption for generations to come.

– Vaclav Smil
DEMATERIALIZATION? CASE CHINA

- **Shanghai**

- From now until 2035, the number of personal vehicles on the road is expected reach 1.9 billion, double the size of the global fleet today. *(WEF Energy Vision Report, 2013)*

- In 2011 China accounted for 25% of the global paper supply.
China used more cement in the last three years than the U.S. used in the entire 20th century.

**U.S.**
- In 100 years:
  - 4.5 gigatons (1901-2000)

**China**
- In 3 years:
  - 6.6 gigatons (2011-2013)

LESS AS AN ENABLING AGENT OF MORE

“Relative dematerialization" meaning lighter, less expensive materials and more efficient use of resources have not translated into any absolute declines in materialization.

Instead, relative dematerialization has been a key factor promoting massive expansion of total material consumption.
LESS AS AN ENABLING AGENT OF MORE

Mobile phones in 1990
- Average mass 600 g
- 11 million users
- Aggregate mass < 7000 t

Mobile phones in 2011
- Average mass 118 g
- 6 billion users
- Aggregate mass > 700 000 t
RIVIS – Realizing Intangible Value from Integrated Solutions

28.10.2014
Anne Jalkala
Lappeenranta University of Technology
Project goals

Increase Finnish firms’ competitiveness in creating integrated solutions by:

1. identifying best practices for developing integrated solutions
2. developing tools to assess and demonstrate the resulting (in)tangible customer value
What is a solution?

- Customer’s view of solution goes beyond the integration of goods and services

(Tuli et al., 2007)
When I go to see a customer I do not tell about our offering directly. Instead, I tell them stories through our reference cases. I may have three slides and a picture of our reference on each slide. I tell a story through the reference case, about the business impacts that our solution has brought, what we have done there, what our role has been, what the customer was thinking, and what his initial goal was. References are basically the only sales tool that I have.

- Vice President, Strategic Sales, IT Solutions Provider
Customer Value Assessment

- **Cross-functional process**, involves sales, marketing, and product & service development and delivery units
DemaNET-
Strategic eco-industrial networks

Anne Jalkala & Samuli Patala, LUT
Hanna-Leena Pesonen & Sari Hämäläinen, JyU
Forms of eco-industrial networks

Industrial symbiosis networks  Sustainable supply chains

Environmental issue networks  Sustainable solutions networks

Transformation to eco-industrial networks
Case: Industrial symbiosis in Finland

Public sector organizations
Facilitating activities and building awareness

Businesses
Business development through industrial symbiosis, hub firms

Local authorities
Localized coordination and network building

Universities / research centers
Knowledge developers and expert partners

Coordinated facilitation of network development
Building a supportive knowledge base for action
Joint-problem solving to realize new opportunities
Regional industrial development by industrial symbiosis

Local network building

Expert cooperation, spreading awareness through success stories
Radically new eco-industrial networks
Case: Biofuels

Key drivers for the development of collaborative networks:

• Mutual economic benefit
• Access to resources, knowledge and know-how
• Potential new contacts
• Access to new markets
• Growth and development opportunities
References and publications


Dematerialization through new models for industrial networking

WP2 Industrial Remanufacturing
WP2 Teollinen uudelleenvalmistus
Agenda:

• What is Remanufacturing
• Benefits and Potential
• Results form DemaNET WP2 Industrial Remanufacturing
What is Remanufacturing?

Remanufacturing is an industrial process by which retired or non-functional products are returned to “like-new” or “better than new” condition. This enables sustainable production and consumption.
Three different types of companies that do remanufacturing
1. *Original Equipment Manufacturers* (OEM) that can be either *Product Manufacturers* or *Original Equipment Suppliers* (OES)
2. *Independent Remanufacturers* (IR), sometimes called 3rd party remanufacturers, that are not directly related to the product or the OEM
3. *Contracted Remanufacturers* that perform services to the OEM.

(Lundmark et al. (2009))
Remanufacturing – “ultimate form of recycling”

End-of-life hierarchy. (Sundin&Lee 2011)
Remanufacturing status in industry

- Remanufacturing has its strongest tradition in the automotive and heavy duty sector, accounting for two thirds of all remanufacturing.
- Other industrial sectors are:
  - machine tools and industrial robots,
  - vending machines,
  - copying machines and electronic products
  - office furniture
- North-America the biggest market
- In FINLAND Remanufacturing is still in its infancy
- Some Remanufacturing Statistics
  - 2008 World Market for Remanufactured Items 110 G$
  - Remanufactured automotive share of automotive US Aftermarket Sales = 16%
  - Remanufactured Office Furniture US Market Share = 13%
  - U.S. Remanufacturing Employment 480,000 (1996)
Remanufacturing Benefits and Potential

• Win-win-win strategy (user-supplier-sustainability)

Profit
• Cost reductions
• New Business Strategies
• Driver for new product sales
• Targeting new market segment
• Provide spare parts

Environment
• Legislation
• Moral and ethical considerations
• Green marketing

Policy
• Protecting aftermarket
• Brand protection
• Providing additional after market solutions
• Feedback to new product design
DemNET WP2 Remanufacturing - Main achievement

Dissent of Reman Knowledge to Industry

- Working papers
  - Remanufacturing Baseline
  - Remanufacturing System Modelling
  - Sustainability in Remanufacturing
  - JohnDeere Sustainability Assessment
  - DemaNET Remanufacturing final report for industry

- Conference papers
  - The Extended Product Paradigm as an Enabler for Implementing Remanufacturing Systems
  - Promoting Remanufacturing through Collaboration
  - Remanufacturing & Ship Repair Possibilities, networking and outlook
  - A classification of remanufacturing networks in Europe and their influence on new entrants (with BTU)
  - Advancing Remanufacturing in Finnish Industry – Development Path Approach

- Assessment tool for companies

Collaboration

- National industry & academic
- Contacts to key European research organisations
- European Remanufacturing Network – project starting, opportunity for collaboration with remanufacturing companies
- Remanufacturing Week June 2015 Amsterdam:
  - ICOR-Conference 15.6.2015
  - World Remanufacturing Summit 2015
  - Rematec Exhibition
Thank you!
UPM’S APPROACH TO BIOECONOMY OPPORTUNITIES

DemaNET Seminar
28.10.2014
Esa Laurinsilta
The Biofore Concept Car presented in Geneva 2014

- Majority of oil-based plastic parts are replaced by parts from **biobased renewable composite materials** which can be **recycled** and **reused**.
- The Biofore Concept Car weighs 150 kg less than similar-sized cars leading to **lower fuel consumption**
- Wood-based renewable diesel enables **emissions reduction** up to 80%
- Street-legal in Finland

Driven by Biofore
• Concept Car

Biofore in the shape of a car

UPM Formi
- Door panels
- Centre console
- Side skirts

UPM Grada
- Dash board
- Interior panels
- Display panel cover
- Door panels

UPM Raflatac
- Upholstery detailing
- Exterior/Interior
- Spare parts labeling

UPM BioVerno
- Wood-based renewable diesel
- Emissions reduction up to 80%
UPM today

Turnover 2013: **EUR 10 billion**
Personnel: **21,000**
Shareowners: **over 90,000**

- **UPM Plywood**
  - Plywood products

- **UPM Paper ENA**
  - Magazine papers in Europe and the USA
  - Newsprint and fine papers in Europe

- **UPM Paper Asia**
  - Fine papers in China
  - Label papers globally

- **UPM Biorefining**
  - Pulp
  - Plantations
  - Biofuels
  - Sawmills

- **UPM Energy**
  - Hydro-, nuclear- and condensing power (incl. shares in energy companies)
  - Electricity production and trading

- **UPM Raflatac**
  - Label materials for product and information labeling

- **UPM Biocomposites**
  - UPM Biochemicals
The sixth industrial revolution is bio-based

1. wave
   Iron
   Water power
   Machines
   Textile
   Trade

2. wave
   Steam engine
   Railways
   Steel
   Cotton

3. wave
   Electricity
   Chemicals
   Combustion
   engine

4. wave
   Petrochemicals
   Aircrafts and space
   Electronics

5. wave
   Digital web
   Biotechnology
   Information technology

6. wave
   Sustainable Bioeconomy
   Renewable energy
   Green chemicals
   Industrial ecology
   Green nanotechnology

Source: Worldwatch Institute / State of the World
THE FOREST OF NEW OPPORTUNITIES

The world is changing
Resource scarcity
Change in economic gravity
Climate change
Digitalization

Biofore – growth and competitive advantage
Material and energy efficiency
Renewable and recyclable products
Innovations and new businesses
Biofore growth opportunities – value from wood and biomass

- Transport biofuels
- Bioenergy – heat and electricity
- Self-adhesive laminates and labels
- Pulp, paper, plywood and sawn timber
- Wood and biomass sourcing and logistics

UPM BioVerno
Biochemicals
Biocomposites
UPM ProFi
UPM Grada
UPM Formi

© UPM
Resource efficiency is the direction for a sustainable future!

**Biofore!**
More value
Efficient and innovative use of renewable biomass for various sustainable products

**Less waste**
- Waste and sidestream utilisation
- Efficient technologies

**Less water usage**
- Water management optimisation
- Advanced technologies
- Less effluent

**Less raw materials**
- Responsible sourcing
- Efficient processes
- Product lifetime optimisation
- End-of-life systems

**Less energy**
- Systematic energy management
- Energy efficient processes and technologies
- Less air emissions

It's our direction!
Forest based biomass offers versatile product innovation and UPM new business opportunities.

- Bark and branches to bioenergy and biofuels
- Lignin to energy and biochemicals
- Cellulose or hemicellulose to biochemicals
- Logs for sawn goods and plywood
- Fibres to pulp
- Fibres to biofibrils
- Extractives to biodiesel or biochemicals
- Fibres to biocomposites
New businesses based on UPM’s development work

- **Biofuels** renewable drop-in diesel suitable for all diesel engines
- **Biochemicals** renewable drop-in alternatives for oil-based chemicals
- **Biocomposites** for injection moulding to replace oil-based raw materials

![Annual patent filings 2009–2013](chart.png)
UPM is in an excellent competitive position to integrate processes for new bioproducts.

Three areas of competence bring UPM in the position to become the frontrunner in new bioproducts:

1) Access, management and sourcing of biomass
2) Processes of biomass conversion
3) Run sustainably large industrial processes

**Biomass handling**
- Debarking
- Saw mills
- Mechanical pulping

**Chemical processes**
- Kraft pulping
- Biodiesel production

**Bioenergy & Infrastructure**
- Biomass boilers
- CHP
- Water treatment
Shifting gear in UPM transformation

Business portfolio development and value creation

New businesses
- BIOFUELS
- BIOCHEMICALS
- BIOCOMPOSITES

Profit improvement programme EUR 200m

UPM Biorefining

Biofuels: Lappeenranta biorefinery
Pulp: 10% capacity increase

EBITDA target for growth initiatives EUR 200m

UPM Paper Asia

Labelling materials: Changshu expansion
Self-adhesive labels: advancing in growth markets and in higher value added products

UPM Plywood

UPM Paper ENA

UPM Raflatac

UPM Energy

UPM Paper
UPM-Kymmene Annual Report 1997:

“In terms of turnover and market capitalization UPM-Kymmene is Europe’s biggest forest industry group, and in terms of production capacity one of the world’s largest paper manufacturers.”

UPM Annual Report 2013:

“UPM integrates bio and forest industries and builds a sustainable future across six business areas”
Industrial symbiosis in Forssa Region

DemaNET seminar, Dipoli, Espoo, 28.10.2014

Juha Pirkkamaa
Environment and Energy Cluster Manager
Forssa Region Development Centre Ltd. (FSKK) Finland
Who am I?

Name: Juha Pirkkamaa
Profession: Environment and Energy Cluster Manager
Name of Firm: Forssa Region Development Centre Ltd., Finland

Key Qualifications:

✓ Experience in international, national and regional environmental, food and rural project management
✓ Experience in marketing and commercialisation of research results
✓ Experience in business incubation services
✓ Experience in marketing of farm supplies
✓ Experience in marketing and product development of animal feed
Brightgreen Forssa region today is known about the Envi Grow Park – eco-industrial park of material recycling, bio-economy and renewable energy, located in the Forssa Envitech area, Finland.
Envi Grow Park is...

...a modern industrial symbiosis of circular economy processing annually:
- 50,000 tn municipal waste
- 69,000 tn biodegradable waste (the biggest biogas plant in Finland)
- 3,200 tn different qualities of glass
- 200 tn different plastics
- 5,500 tn different metals
- 15,600 tn paper and cardboard
- 4,000 pin confidential materials

In addition:
WEEE (Waste Electrical and Electronic Equipment) recycling and treatment of:
- electrical equipment
- televisions and monitors
- office electronics
- other electronics
- refrigerators and freezers
- household and professional appliances

And:
- contaminated soil remediation and solid hazardous waste treatment
- construction waste treatment

Photo: LHJ
Envi Grow Park is...

A closed loop system, where:
- the waste of one is raw-material or energy to another!

There are 20 companies located in the area, with over 200 professionals.
Only yesterday, less than 20 years ago
- the area was nothing more than typical Finnish forest and swamp:

What has made the rapid change possible?
Superior success factors of Forssa

- Good public-private partnership!
- Forward looking entrepreneurs!
- A functioning infrastructure
- Network of high knowledge experts
- Commendable availability of recycled materials
- Skilled and motivied employees
- MTT Agrifood Research Finland is located in the region
- A good supply of education and training in the field
- Diverse support services for the environment sector
- An ideal location in the centre of Southern Finland
The promising development of environmental industry

- CHP-power plant
- Integration of REF plant and power plant
- Modern glass cleaning plant
- Industrial scale composting plant
- Recycling of plastics
- Processing of collected paper and cardboard
- Processing of glass waste
- The first landfill in Finland to meet EU requirements

In 90’s about one industrial innovation per year
The rapid development since Millennium!

- The plant for the treatment of contaminated soil
- Environmental friendly truck wash station
- Biogas used in the production of glasswool
- Bioethanol production plant
- The consultancy company for biogas technology
- Recycling plant for different construction wastes
- Foam glass cullet from recycled glass
- Electricity made from biogas used in a printing house
- First mobile thermal desorption plant for contaminated soil
- The company for the improving of data security
- Modern glass cleaning plant
- Humppila - Urjala wind power company
- Laser technology for recycling ray tube class
- The company for the treatment of refrigerators
- Biogas plant for the packaged food waste
- Forssa - Tammela wind power company

Since 2000 several innovations per year!
Bright Green Forssa Region

The business development strategy of the Forssa region is based on a "bright green" (Järkivihreä) approach = resource efficiency = sustainable development!

Our goal is, that in the near future, residents, businesses, communities and decision makers will recognise the environmental impacts of their actions and make a commitment to reduce them.

The bright green business development is a common strategy, without borders between different industrial branches!
The near future of Envi Grow Park

Huge investments to
- biorefinery and two wind power parks
- totally about 200 mill €

The biorefinery
- combination of biogas and bio-ethanol production
- production of 100 000 tn bio-ethanol annually, which means 750 000 MWh and fuel for about 50 000 cars
- production of 300 000 MWh biogas annually, which means fuel for about 30 000 cars
- the need of 340 000 tn of energy grain as raw material, which means the area of 90 000 hectares

Two wind power parks
- potential energy production totally 280 GWh annually
- green electricity means sustainability!
Envi Grow Park - eco industrial park
business from the bioeconomy innovations

Raw-materials
- Wind power park
- Biowaste from municipalities, industry and trade, manure
- Energy from ryewheat
- Packaging waste
- Waste Textile

Processes
- Biogas plant
- Bioethanol plant
- Slow pyrolysis plant
- Collection
- Sorting
- Upgrading

Products
- Vegetable greenhouse
- CHP-unit for electricity and heat production
- Industry Agriculture Households
- Industry
- Local food
- Biofertilizers
- Biogas
- Biochar
- Feed
- Biochemicals
Envi Grow Park - eco industrial park
business from the bioeconomy innovations

Wind power park

Biowaste from municipalities, industry and trade, manure

Energy grain: ryewheat

Wood waste

Packaging waste

Waste Textile

Collection

Sorting

Upgrading

Biochar

Industry Agriculture Households

Industry

Vegetable greenhouse

CHP-unit for electricity and heat production

Bioethanol plant

Bioethanol

Feed

Biochemicals

Biotreators

Local food

Industry Agriculture Households

Biogas
Todays example: biomethane as fuel for cars and trucks
The global future of bio-economy and recycling

To export our knowledge of circulation economy we’ll cross the borders: - to India, Russia, China etc. The networking of companies for export has started and pre-studies will start in 2015. Our goal is a centre for export of many-sided know-how in circulation economy (technology, administration, training).
Because some things have to be changed anyway...
Thank You for your attention!

Please, visit us:
www.fskk.fi
www.brightgreen.fi

juha.pirkkamaa@fskk.fi
Kohti resurssitehokasta ja kannattavaa kiertotaloutta yritysten yhteistyöömallien avulla

DemaNET-projektin loppuseminaari 28.10.2014
Iris Karvonen VTT
Dematerialization through new models for industrial networking

Teollisuuden uudet verkostomaiset toimintamallit materiaalitehokkuuden ja arvopohjaisen kilpailukyvyn edistäjinä 2012-2014

Tekes Green Growth programme
http://www.tekes.fi/programmes/Kestavatalous

Dematerialization through new models for industrial networking
DemNET main objectives

• Promotion of dematerialization and value-based sustainable competitiveness

• Development of new models of industrial ecoefficient networks for Finnish industry (remanufacturing and strategic ecoindustrial networks)

• Development path towards radical change in industrial dematerialization and value-based business

• Application field: industry – manufacturing and process industry; collaboration between different industrial fields
 Participating companies

- John Deere Forestry Oy
- Valtra Oy Ab
- Fortum Oyj
- UPM Oyj
- Kemira Oyj
- Pöyry Finland Oy
- Martela Oyj
- The Federation of Finnish Technology Industries
- Benet Oy
- Turku Repair Yard Oy
- Tana Oy
Dematerialization through new models for industrial networking

DemaNET focus areas

SUSTAINABLE BUSINESS MODELS, COMPETITIVENESS

REMANUFACTURING

DEMATERNALIZATION

CIRCULAR ECONOMY

STRATEGIC ECO-INDUSTRIAL NETWORKS

Requires

Supports acceptance

Is one form of

Contributes, enables

Requires, creates new

Is one form of

Requires
Circular economy
(EllenMcArthur Foundation 2012)
Collaboration of different actors is needed

• Traditionally drivers for collaboration come from need for flexibility, cost-efficiency, concurrency, additional competencies and capabilities, globalization ...

• **Emerging driver:** Efficiency in use of material and energy resources

• Different actors and roles are needed to create circular economy (for example remanufacturing or symbiosis networks)

• Different forms of networks are possible

• Business potential also for SMEs

• ”Network managers” are needed.
DemaNET focus area presentations

- Remanufacturing
- Strategic eco-industrial networks
- Sustainable business models and competitiveness

DemaNET Project web site
http://www.vtt.fi/sites/DemaNET/
Opening remarks by Green Growth program

DemaNET final seminar
Kari Herlevi
Tekes
28.10.2014
Shortage of resources is a global challenge...

Demand for most resources has grown strongly since 2000, a trend that is likely to continue to 2030.

Source: Resource revolution, McKinsey 2011
...creating business opportunities for players in the innovative green economy

Source: Waste-to-Energy Research and Technology Council (adapted after Five-step waste hierarchy in the EU directive 2008/98/EC and Zunft and Fröhlig, 2009)
2. Tekes Green Growth program
Green Growth

The Green Growth programme funds companies and value networks which have growth potential in the area of a resource-efficient and sustainable economy.

During the five-year programme, projects are funded to the tune of about EUR 80 million, half of which comes from Tekes, and half from the companies.

Companies can apply for funding continuously.

The focus areas of Green Growth

- Energy and material efficiency
- Bioeconomy and biomaterials
- Recycling, recovery of raw materials, and waste processing
- Business models, service concepts, and comprehensive solutions
Green Growth - Innovations and joint projects

The Green Growth programme funds companies and value networks which have growth potential in the area of a resource-efficient and sustainable economy.

Funding so far 30 m€, 72 funded companies
<table>
<thead>
<tr>
<th>Aika</th>
<th>Kuvaus</th>
<th>Paikka</th>
<th>Tilaisuus/tapahtuma</th>
<th>Green Growthin rooli</th>
</tr>
</thead>
</table>
| 24.10.    | Kotimaan tapahtuma    | Teke Pasila +   | Aamukahvitilaisuus biotalouden piloteista – "Euroopan benchmarking"                 | • Mitä biotalouden pilottipalveluja Tekes on tunnistanut 10 Euroopan maata kattaneessa kartoituksessa?  
• Miten eri Euroopan maissa on onnistuttu yhdistämään julkisen rahoituksen pilottijärjestelyjen kehittämiseen?  
• Miten Tekes voi tukea suomalaisten pilottijärjestelyjen kehittämistä? |
| 27-29.10. | Ulkomaan tapahtuma    | Hollanti        | Biotalous match making matka                                                        | Lisätietoja: Heikki Aro                                                                                                                                 |
| 28.10     | Kotimaan tapahtuma    | Espoo           | Yritysten yhteistyöllä kohti kannattavaa kiertotaloutta - DemaNET –projektin päätösseminaariin | Green Growth –ohjelman rahoittama tutkimusprojekti                                                                                                                                 |
| Marraskuu | Rahoitushaku          | -               | Brasilia-haku yrityksille                                                           | Yhteistyössä FINEPin kanssa                                                                                                                                 |
| 9.12      | Kotimaan tapahtuma    |                 | Grooven päätösseminaari                                                               |                                                                                                                                                      |
3. Funding for Green Growth
Piloting and Demonstration
What benefits can be gained from pilots and demonstrations?

- Piloting and demonstrating a product or service helps your customers get a **practical understanding of what you are offering**.
- **Get important customer feedback** before beginning the commercial production phase.
- You can develop **credibility** in the eyes of your potential customers.
- **Catalyst for market entry**
- **Facilitate commercialisation**
- Involving clients in development work and piloting is **beneficial in all business sectors**
- Piloting **can be quick**, as is often the case in the software development sector, or
- it can involve long development processes, such as those in the energy or processing industries
- Tekes funding is **available for even the largest of projects**.
Verkkokauppaan tarjolla kierrätyspakkausmalli

Saksassa palkitut suomalais-konsepti tähtää suoraan kansainvälisille markkinoille.

Post Nord osoittautui kymmeniä prosentteja halvemmaksi kuin Itella.


Se on osoittanut kierrätysohjelmaa kehittäväksi erityiskoossa. Post Nord on myös osoittanut kierrätysohjelmien laajuuden ja monipuolisuuden.

Post Nord on palkittu kierrätysohjelmastaan suomalaisissa ja kansainvälisissä markkinoilla.


Post Nord on osoittautunut kierrätysohjelmistaan suomalaisissa ja kansainvälisissä markkinoilla.

"Post Nord on osoittautunut kierrätysohjelmistaan suomalaisissa ja kansainvälisissä markkinoilla."
Puukivi sisältää kierrätyspuuta

KIERRÄTYS / Perinteinen pihakivi voi sisältää puuta. Rakennusjätteitä kehitävä suomalainen Destamatic aikoo tuoda uudenlaisen puukiven markkinoille ensi vuonna.

–Puukuitubetonissa ei sinänsä ole mitään uutta. Uutta on jätteraka-aineen käyttö, sanoo Destamaticin hallituksen puheenjohtaja Reino Partanen.

Puukiveksi nimetyssä pihakivessä on noin 30 prosenttia puuta, joka on pihakiven kierrätetty osuus. Kiven kiviraaka-aine ei sen sijaan ole kierrätettyä.

–Kyllä betonimurskeen käyttö raaka-aineena olisi periaatteessa mahdollista, mutta olemme lähteneet purkamaan tätä asiaa helppomman kautta, sanoo yrityksen teknologiajohtaja Kimmo Rinne.

Destamaticilla on Hyvinkään puunmurksauslinja, joka toimittaa rakennustyömaiden jätepuuta polttettavaksi. Nyt tätä puuta on tarkoitus saada enenevissä määrin uusiin pihakiviin.

Käiken taustalla on EU:n rakennusjärjestelyitä. Se linjaa, että vuoteen 2020 mennessä jäsenmaiden pitää kierrättää 70 prosenttia rakennus- ja purkujätteistä materiaalina. Polttoa ei kelpuuteta kierrätykseksi, se on vain hyödyntämistä.

–Ei polttaimin välttämättä ole huono vaihtoehto, tarvitaan Suomessa lämpää, mutta me olemme lähteneet hake maan aidosti vaihtoehtoa polt tamiselle, Rinne sanoo.

Rinteen mukaan tavoitteena on tarjota kuluttajille ekologinen vaihtoehto.

–Tavoite on saada kevyempi ja lujempi tuote. Keveyden ansioista asennus on helpompaa ja keveys on myös kuljetuskustannuksia.
Rohkeutta Riskinottoa Rahoitusta
Seuraa meitä, ota yhteyttä tai ehdota hanketta

Green Growth sosiaalisessa mediassa

@Tekesfi
Tekes – Green Growth
Tekesvideo / Green Growth
DemaNet-project

DEVELOPMENT PATH

Sari Hämäläinen, Jyväskylän yliopisto
Roadmap to a Resource Efficient Europe (2011)

THE VISION:
By 2050 the EU's economy has grown in a way that respects resource constraints and planetary boundaries, thus contributing to global economic transformation. Our economy is competitive, inclusive and provides a high standard of living with much lower environmental impacts. All resources are sustainably managed, from raw materials to energy, water, air, land and soil. Climate change milestones have been reached, while biodiversity and the ecosystem services it underpins have been protected, valued and substantially restored.

BOOSTING EFFICIENT PRODUCTION

IMPROVING PRODUCTS AND CHANGING CONSUMPTION PATTERNS

TURNING WASTE INTO A RESOURCE

PHASING OUT INEFFICIENT SUBSIDIES

SUPPORTING RESEARCH AND INNOVATION

GETTING THE PRICES RIGHT AND REORIENTING THE BURDEN OF TAXATION

EU, 2014: Towards a circular economy
TEM, 2013: Programme for material efficiency
Change in Finnish waste legislation in 2016
DEVELOPMENT PATH PROCESS

PARALLEL GREEN GROWTH PROJECTS
- Work shop, May 2014
  - Key actors
  - Needed actions per each key actors
  - Success stories

ACTION PLAN (preliminary)
- Work shop, January 2014
  - Business perspective
  - Customer perspective

ACTION PLAN
- Work shop, March 2014
  - Key actors
  - Prioritization of actions

Present situation and barriers
- Literature, interviews and enquiry

Vision
- Work shop, January 2014

MOTIVA
- Work shop, January 2014

SITRA
- Work shop, March 2014
VISION 2030

Enterprises will operate resource wisely in 2030. They will operate in networks, will form closed loops for materials (reuse, remanufacturing, recycling) and will substitute services for products. Organisations will concentrate on satisfaction of customer needs and they will look for solutions which promote ecological and social sustainability and which bring about competitiveness of a value network. Produced products will be modular and eco-efficiency.

BARRIERS

➢ Legislative barriers

➢ Business barriers
  • Lack of know-how

➢ Social barriers
  • Lack of trust
  • Lack of customers’ acceptance
KEY ACTORS

AUTHORITIES
Regulation

COMPANIES
Supply

CUSTOMERS
Demand

SUPPORT ORGANISATIONS
Knowledge, Financing
KEY ACTIONS

- An increase of awareness
  - Communication
  - Collaboration, a collective development, experiments
  - Management and leadership
  - Research
  - Education

- Change of values and attitudes

- Formation and/or reorganisation of support organisations

- Change of regulations
Nykytila

- Yritykset tehneet energia- ja materiaalitehokkuuteen liittyviä toimenpiteitä (talous & ympäristö win-win)
- Edelläkävijäyritykset sisäistäneet kestävien liiketoimintamallien potentiaalin; uusi tapa toimia = kohdennetut markkinat; kilpailukyky
- Edelläkävijäyritykset toimivat uudelleenvalmistuksessa ja ekoteollisissa verkostoissa

2020 – 2025

- Yritykset miettivät resurssitehokkuutta kokonaisvaltaisesti; pyritään pikkuhiljaa symbioosimaiseen toimintaan, kohti kiertotaloutta
- Edelläkävijäyritykset huomioivat kestävän tuotannon lisäksi kestävän kulutuksen
- Kestävät liiketoimintamallit ovat yleistyneet verkostoitumisen kautta
- Uudelleenvalmistus lisääntyy esim. kokeilujen kautta; esimerkiksi yhdessä ekoteollisten puistojen kanssa
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Visio 2030

- Laajenevassa määrin yrityksiä, jotka arvottavat sosiaalisen ja ekologisen kestävyyden yhdenvertaisena taloudellisen kestävyyden rinnalla
- Kestävät liiketoimintamallit ovat yleistyneet
- Ekoteolliset verkostot ja uudelleenvalmistus ovat yleisiä toimintatapoja (kiertotalous)

Tietoisuuden lisää

- Tiedon ja kokemusten levittäminen & markkinointi
- Parhaat käytännöt ja liiketoimintamallit
- Resurssipankki kiierräysmateriaaleista
- Asenteiden muutos
- Koulutusmateriaalien tuottaminen & mukaan koulutusohjelmiin
- Tutkimus
- Mittarit ja kestävyysslaskelmat
- Informaatio-ohjaus: tuotemerkkinnät jne.

Julkisen vallan toimenpiteet

- Julkiset hankinnat kannustamaan, lupa-menettelyyn nopeuttaminen, jatemaksut, poliittinen pitkäaikäinen tahtotilaa

Ympäristöpolitiikka

- Uudelleenvalmistus näkyväksi, esteiden poistaminen jätteiden hyödyntämiseltä, kestävyyttä tukeva sääntely
- Kestävyyden tekeminen näkyväksi asiakkaille; asiakkaat mukaan kehitykseen

Rahoituksen saamisen helpottaminen: uudet rahoitustehokkuudet, lainat ja tuet

Suomalaisen uudelleenvalmistuksen tukiorganisaation järjestely ja toiminnan käynnistäminen

Teknisten esteiden poistaminen ekoteollisilta verkostoilta: tekninen konsultointi, välittäjä-organisaatiot

SHOK-ohjelmat tukemaan kiertotaloutta

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SHOK-ohjelmat tukemaan kiertotaloutta

Yhteistyöverkostojen edistäminen ja tukeminen; areenat, joihin helppo liittyä

Pidennetty elinkaari otetaan huomioon tuotesuunnittelussa, eron kertakäyttötuotteista

Kestävyyden tekeminen näkyväksi asiakkaille; asiakkaat mukaan kehitykseen

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SHOK-ohjelmat tukemaan kiertotaloutta
REPORT ON THE DEVELOPMENT PATH

Soon available:

https://www.jyu.fi/jsbe/tutkimus/julkaisut/ttkjulkaisuja

• Introduction
• New industrial business models for a promotion of resource efficiency
• New collaborative resource efficient business models for industry – Vision 2030
• The development path towards new resource efficient business models
• New research challenges
THANK YOU FOR YOUR ATTENTION

Sari Hämäläinen, Jyväskylän yliopisto
sari.m.hamalainen@jyu.fi
Q4 2014

SUORAA TOIMINTAA.
DIRECT ACTION.
VALTRA REMAN

- Remanufactured transmission components
  - Gearboxes & Shuttle Units
- Facilities on site (Factory)
  - 3 mechanics
    - +10,000 units assembly experience
- Competitive pricing vs. Repair / New
  - 12month warranty
- 140t core’s received
  - 99% core return ratio
  - ~70% re-usable
- 2013 Sales
  - 215 gearboxes
  - € 970k
  - Finland, Sweden, France, Germany, UK
MARKETING

Valtra liihamarkkinoinnin osasto: Japa

Huoltoa & Huolenpitoa

Valtra Huoltopalveluiden asiakastapa!

Valtra "98%:n" ihme tapahtuu, joka päivä!

Tehdaskunnostetut vaihteistot ja suurimmanvaihtajat Suolahdesta

Tekniset flashback

- Valmistaja: Japa
- Valmistajan vuokratila
- Valmistajan viipurintasuoja
- Materiaaliluokka

Japa 305 - yksi kone, monta mahdollisuutta

JAPA 305 helpoiten puhtaan

JAPA 305 on vapaaseen käytölle valittu, mikä on sopia erityisesti rautakoneille ja kesäkoneille.

Noustan ja kunnostus

- Toiminta on erittäin helpoin
- Palkatut ja vapaat käyttäjät
- Japa 305 on yleistä käytössä

Japa 305 on rautakone, joka on lämpimästi ja nopeasti käyttössä.

JAPA 305 Tinh

Suositeltu käytön ja pitkäaikaisen osaaminen

Japa 305 Tinh on paitsi rautakone, myös pitkäaikainen osaaminen

Puhelin: 010-5045777

Tuki koneilman JAPA-koottimesta kannalta 01-31-10-2014
Our Share Of The "Saving The Climate"
WP 4 Sustainable Business Models

Lappeenranta University of Technology
Faculty of Industrial Management
Value Networks Management

Janne Huiskonen, Professor, D.Sc. (Tech.)
Jouni Koivuniemi, Associate professor, D.Sc. (Tech.)
Minttu Laukkanen, Doctoral Student, M.Sc. (Tech.)

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Sustainable Business Model / Business Model for Sustainability

- **Business model (BM)** describes the rationale of how an organization creates, delivers, and captures value (Osterwalder & Pigneur 2010).

- **Business model innovation (BMI)** is recognised as a key to the creation of sustainable business (e.g. Boons et al. 2013; Boons & Lüdeke-Freund 2013; Carayannis et al. 2014; Girotra & Netessine 2013).

- **Sustainable business model innovation (SBMI)** is an approach for firms to re-conceptualise their purpose and value-creation logic to improve their environmental and social sustainability (Bocken et al. 2014).

- **Sustainable business model (SBM)** encompasses both a systems and firm-level perspective, draws on economic, environmental and social aspects of sustainability in defining an organisation`s purpose and measuring performance, considers the needs of all stakeholders, and treats nature as a stakeholder (Stubbs & Cocklin 2008).
**WP1 Theoretical data gathering and analysis**

**Literature review**
- The aim is to carry out a state-of-the-art research on the literature about the sustainability issues in business models and about the linkages between sustainability and success of a firm. → SBM archetypes (adapted from Bocken et al. 2014)

**WP2 Fostering favourable conditions for value transition**

**Delphi study**
- The aim is to increase understanding about the favourable conditions and mechanisms through which sustainability could be effectively built in business models. → Voluntary vs. coercive actions

**WP3 Business model development and value innovation**

**Industrial workshops**
- The aim is to increase understanding how to build sustainability in business models, and develop tools for sustainable business model development. → Short-term vs. long-term actions
Barriers to the diffusion of SBMs

- Main barriers to the diffusion of sustainable business model innovations are

1. **regulatory**,  
   - e.g. lack of long-term strict legal regulatory frameworks; inconsistent and overlapping regulatory mechanisms

2. **market and financial** and  
   - e.g. financial risk; short-termism

3. **behavioural and social** barriers.  
   - e.g. lack of motivation; lack of risk-taking; enterprise culture; attitudes & values
In conclusion

1. **Systemic change**
   - Organisations can only be sustainable when the whole societal system is sustainable. Both structural and cultural changes are required to facilitate firm- and system-level sustainability.
   - Design scope involves both the environment and the business models.

2. **Long-term vision & strategy**
   - Sustainability issues should be fully integrated into the long-term strategy of a company as well as political framework.

3. **Collaboration**
   - Well-functioning regulatory frameworks, customers/consumers demand as well as voluntary business activities are vital for the diffusion of SBMIs.
   - Collaboration across industry boundaries and non-industry actors is a key to a number of the SBM archetypes. The process towards SBMs and business operations must be carried through in collaboration with various network actors.

4. **Tailored design processes and tools** can effectively foster sustainable business model innovation.

5. Some leading firms have adopted the idea of SBM, but there are still many steps to be taken to make SBMs a mainstream.
References


Publications

• WP 4.1
  – Eronen, M. Master’s thesis (12/2014)

• WP 4.2
    • Journal article (12/2014)

• WP 4.3
  – Handbook (12/2014)
  – Eronen, M. Master’s thesis (12/2014)