Strengthening forest value chains in a sustainable Swedish bio economy

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Six areas of R&I at Skogforsk

- Forest-tree breeding for future climate and raw-material needs
- **Value chains and raw material use enabling the bio economy**
  - Efficient and gentle operational systems
  - Silviculture for different goals
- Clarify societal benefits of the forest
- All possibilities in digitalisation
Value chains and raw material use enabling the bio economy

- Development and integration of forest value chains
- Enhance the full potential of forest biomass
- Describe properties, recover information
- Optimize value recovery
- Market orientation and customer order management
Improved processes and products through digitalisation of forest value chains
In March we need 1750 MWh of TRB - 8 and 1350 MWh of TRB - 13. "1750 MWh TRB - 8 is OK!
But we have only 900 MWh of TRB - 13. Can we deliver 450 MWh of TRB - 11 instead?"

<table>
<thead>
<tr>
<th>Fuel product</th>
<th>Moist (M %)</th>
<th>Ash (A %)</th>
<th>Main fract. (P)</th>
<th>Fine fract. (F)</th>
<th>Orgin</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRB-8</td>
<td>M45+</td>
<td>A1.0</td>
<td>P45</td>
<td>F15</td>
<td>Woody biomass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stem wood</td>
</tr>
<tr>
<td>TRB-11</td>
<td>M45</td>
<td>A3.0</td>
<td>P45</td>
<td>F15</td>
<td>Woody biomass</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Logging residues</td>
</tr>
<tr>
<td>TRB-13</td>
<td>M45+</td>
<td>A3.0</td>
<td>P45</td>
<td>F15</td>
<td>Woody biomass</td>
</tr>
<tr>
<td></td>
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<td>Logging residues</td>
</tr>
</tbody>
</table>

Productify to communicate effective management of forest fuel by well-specified fuel products.
Product specifications

Followed in the production chain…

Feedback & control of prognosis & delivery

… with measurement data, experience and prognosis
Wood properties can be modelled

Moberg, 2004
Wilhelmsson et al, 2002

Dry raw density
Spruce saw timber
kg/m3
- 370
370 - 375
375 - 380
380 - 385
385 - 390
390 - 395
395

Max diameter of knots
Spruce
(mm)
- 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 -
StanForD 2010

• Global de-facto standard for communication with forest machines

• Detailed information on every log produced – big data!

• Harvester data + information from forest inventories are input data to calculation of wood properties in large scale
Harvester data is a key to large-scale use
Pre-study indicate strong potential!

- 60 harvesting sites – calculation of wood properties
- Properties – harvester data – X-ray
- Timber
  - 226,270 pine sawlogs
- Pulpwood
  - 297,271 pine pulplogs
  - 287,600 spruce pulplogs
Calculated wood properties vs X-ray

Harvester
Sawmill

Log diameter class (mm) vs Share of volume %
Yield forecasts – imputation method (kMSN)

<table>
<thead>
<tr>
<th>Object</th>
<th>Tree sp (%)</th>
<th>BA</th>
<th>$H_{BA}$</th>
<th>$D_{BA}$</th>
<th>PT</th>
<th>SWP</th>
<th>ST</th>
<th>SP</th>
<th>BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>88</td>
<td>8</td>
<td>33.0</td>
<td>23.4</td>
<td>24.8</td>
<td>5.8</td>
<td>193.2</td>
<td>57.4</td>
<td>6.1</td>
</tr>
</tbody>
</table>
Conclusion

- Value chains and digitalization=hot topics for development
- Great potential in new knowledge and tools
- Standards and big data are strong enablers
- Knowledge of customer demands and communication are key to capture this potential