Strategic planning of investments in forest roads

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Seasonal climate variation

• Insufficient bearing capacity
  • Large stocks to secure continuous supply
  • High costs due to quality losses
  • Higher transport costs due to road blockings
High density forest road network

- High density forest road network
  - 210,000 km forest roads
  - Varying standard (accessibility)
- Detailed road information
  - The National Road Database
Seasons and forest roads

Forest roads classification
- A&B – All year around
- C – All year around, not spring thaw and heavy rain
- D – Only frozen roads

- January - Winter
- April - Spring thaw
- July - Summer
- October - Heavy rain
Road investment problem

- Which links should be upgraded to secure the flow of round wood while minimizing costs?
RoadOpt

- **Objective**
  - Minimize cost for road upgrading, transportation and harvest

- **Decisions**
  - Upgrading decisions for the road links
  - Estimate the overall wood flow
  - Harvest areas to cut

- **Constraints**
  - Limited supply
  - Demand must be fulfilled
  - Road link accessibility classes
Input data

• Estimation of future cuttings
  • Volume per assortment and stand in each time period
  • Connection to the closest road link
• Road information
  • Accessibility classes
• Prognosis of future industrial demands
  • Volume per assortment for each time period and season
• Cost parameters
  • Transportation
  • Harvest
  • Inventory
  • Road upgrading
Case study SCA

- 2.6 million hectares of forest land, of which 2.0 million is used for timber production
- Annual harvest 4.0 million m³
- Wood supply areas
  - Jämtland – 600,000 ha
  - Medelpad – 350,000 ha
  - Ångermanland – 350,000 ha
Objective of case study

• Find the optimal investment level of road upgrading at each wood supply area

• Investigate the potential savings of planning road upgrading, harvest and transport together

Scenarios
• Fixed – using manual harvest plan from SCA
• Free – harvest plan decided by the model
Accessible volumes

- Road upgrading 33 million EUR
  - From class C to B 3,023 km
  - From class D to B 372 km
  - From class D to C 908 km
Results

• Transport cost 1.331 million SEK (192 million CAD)
• Road upgrading 86 million SEK (12.4 CAD)
• Road upgrading
  • From class C to B 3.023 meters
  • From class D to B 372 meters
  • From class D to C 908 meters
Optimal investment level of road upgrading at each wood supply area

- 26.0
- 38.8
- 20.4
Optimal investment level of road upgrading at each wood supply area

10.1 million EUR
15.1 million EUR
7.9 million EUR
Coordinated planning

<table>
<thead>
<tr>
<th>Harvestingplan</th>
<th>Road upgrading</th>
<th>Transportation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed (million EUR)</strong></td>
<td>33.0</td>
<td>166.4</td>
<td>199.4</td>
</tr>
<tr>
<td><strong>Free (million EUR)</strong></td>
<td>13.3</td>
<td>162.0</td>
<td>175.3</td>
</tr>
<tr>
<td><strong>Savings (million EUR)</strong></td>
<td>-19.7</td>
<td>-4.4</td>
<td>-24.1</td>
</tr>
<tr>
<td><strong>Diff cost (%)</strong></td>
<td>-60%</td>
<td>-3%</td>
<td>-12%</td>
</tr>
</tbody>
</table>

Potential savings 24.1 million EUR
Conclusions

• Important with good input data
• Big difference in investments between the wood supply area
• Impossible to do this calculation by hand

• Important results for SCA:
  “Big savings by planning harvest, road upgrading and transport together”
Further investigation

- Sensitivity analysis
  - Placement on gravel pit
  - Length on depreciation period at investments
- Scenario analysis
  - Central Tire Inflation
  - Storage
Thanks for listening

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