Larger loads and decreased damage – the potentials of a new forwarding concept

Ola Lindroos & Iwan Wästerlund
The dilemma in ground based hauling:

Large loads and no soil impact
Current development

Lightlogg C
Current development
Objective

What are the potentials with forwarder trailers in final fellings with and without ground pressure restrictions?
## Machines

<table>
<thead>
<tr>
<th>Forwarder</th>
<th>Full payload (tonnes)</th>
<th>Ground pressure (kPa)</th>
<th>Payload / laden mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large (L)</td>
<td>18</td>
<td>95</td>
<td>0.8</td>
</tr>
<tr>
<td>Large reduced (LR)</td>
<td>13</td>
<td>70</td>
<td>0.65</td>
</tr>
<tr>
<td>Medium (M)</td>
<td>14</td>
<td>78</td>
<td>0.69</td>
</tr>
<tr>
<td>M reduced (MR)</td>
<td>11.9</td>
<td>70</td>
<td>0.58</td>
</tr>
<tr>
<td>MR + trailer</td>
<td>21.4 (11.9 + 9.5)</td>
<td>70</td>
<td>1.26</td>
</tr>
</tbody>
</table>

8 wheeled forwarders with 4 bogie tracks
Trailer with 2 bogie tracks
Scenarios

Time consumption
• Fast: 5% slower in all work elements
• Slow: 10% slower + 1 min extra per load

Trailer costs
• Cheap: trailer cost 30 000€ (10% of Medium forwarder)
• Expensive: trailer cost 70 000€ (23.3% of M forwarder)

Fuel consumptions
Constant fuel consumption / PMh, correlated to engine effect
Trailer increase consumption with 5% / PMh
Stand characteristics

1 129 Swedish final felling stands, containing 1.6 million m³

<table>
<thead>
<tr>
<th></th>
<th>Volume-weighted mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarding distance one way (m)</td>
<td>389</td>
<td>20 – 1 500</td>
</tr>
<tr>
<td>Stand density (m³/ha)</td>
<td>250</td>
<td>100 - 952</td>
</tr>
</tbody>
</table>
Results

Full payloads + fast trailer

Forwarding distance one way (m)
Results

Full payloads + slow trailer

Forwarding distance one way (m)
Results

Reduced payloads + slow trailer

Forwarding distance one way (m)
Results

Costs

Forwarding distance one way (m)
Results

Fuel consumption

Forwarding distance one way (m)
## Stand volume potentials *(slow trailer)*

<table>
<thead>
<tr>
<th></th>
<th>Trailer vs L</th>
<th>Trailer vs M</th>
<th>Trailer vs LR</th>
<th>Trailer vs MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0%</td>
<td>8%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Central</td>
<td>0%</td>
<td>12%</td>
<td>37%</td>
<td>47%</td>
</tr>
<tr>
<td>South</td>
<td>0%</td>
<td>4%</td>
<td>52%</td>
<td>51%</td>
</tr>
</tbody>
</table>
Results

Stand level costs/benefits

*Fast and cheap trailer*

<table>
<thead>
<tr>
<th>Relative difference (%)</th>
<th>Tr vs L</th>
<th>Tr vs M</th>
<th>Tr vs LR</th>
<th>Tr vs MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>LR vs L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MR vs M</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Money</th>
<th>Time</th>
<th>Fuel</th>
</tr>
</thead>
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<tr>
<td></td>
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</tbody>
</table>

SLU
Stand level costs/benefits

Fast and expensive trailer

Results

Relative difference (%)
Stand level costs/benefits

Slow and cheap trailer

Results
Results

Stand level costs/benefits

Slow and expensive trailer

![Bar chart showing relative differences between Tr vs L, Tr vs M, Tr vs LR, and Tr vs MR.](chart.png)
Conclusions

• Reduced ground pressure with conventional forwarders -> decreased payloads -> expensive
• High potential for forwarder trailers
• Cheap and fast trailers = competitive with conventional forwarders -> decreased ground pressure + increased profitability
• Expensive and slow trailers can be competitive under ground pressure restrictions
• Find the balance between work speed and costs

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Thank you!

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