Economics of Segregation based on Internal Wood Properties

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What Do Mills Want?

Obtaining the logs that are **best suited for their purpose** at the lowest cost possible is of prime importance for most mill managers.

- ✔ Right External Properties
- ✔ Right Internal Properties
Literature Review

- Many tools and techniques are available for segregating wood based on internal properties.

- Few have been implemented commercially - acoustics, density cores and visual indicators are more mature approaches.

- The benefits of segregating stands, stems and logs are not clear due to:
  - High variability in wood properties
  - Poor market signals in terms of price for wood with superior internal properties
  - Poor understanding of costs across the value chain.
Study Aims

To determine if the benefits of segregating stands, stems and logs outweighed the additional costs.

[Images of balance scales showing benefits and costs for segregate and don’t segregate]
SEGMOD – a techno-economic model

- SEGMOD designed and constructed to determine costs and benefits of segregating logs at various intervention points in the supply chain.

- Calculates return-to-log values at each intervention point for user-specified log types.

- Optimally bucks tree lists based on in-forest RTL values.

- Reports RTL value per hectare at each intervention point.

- Facilitates comparison of alternative log segregation strategies.
Log Type RTL Flow Chart

Scion Sawing Models

Scion models, Solid Wood Innovation models & Industry experts

Frankly, chip, hog prices - lumber, chip, hog prices

Mill Gate Or Port Gate Value - minus mill processing costs

Minus mill yard handling and sorting costs

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Log Type RTL Flow Chart (cont.)

Mill Gate Or Port Gate Value

CPY Gate Value

Standing Tree Value

Pre-PHI Tree Value “Stumpage”

minus mill yard handling and sorting costs

minus transport and harvesting costs [\# sorts adj, sort cost, “normal” cost]

minus transport and CPY costs

If negative value for fibre set to $1 per m³

minus inventory costs
Stand Optimization Flow Chart

Log specifications with “stumpage” prices

Tree Descriptions

SEGMOD Optimizer

“Stumpage” Value ($/ha)

Yields and $$$ for each mill type

adjust for negative fibre and waste

Landing Value ($/ha)

CPY Value ($/ha)

Mill Gate or Port Gate Value ($/ha)
SEGMOD Features

● Mill Door Values
  ➢ Volume conversion factors based on Scion Sawing Studies
  ➢ Appearance grade recovery factors based on Scion Sawing Studies plus Industry Adjustments
  ➢ Structural grade recovery factors based on SWI Sawing Studies
  ➢ Product prices supplied by user
  ➢ Mill processing costs accounted for

● Mill Yard Costs
  ➢ No Sort
  ➢ Sort at each mill type

● CPY Costs
  ➢ No Sort
  ➢ Structural: Acoustic Sort or Density Sort
  ➢ Appearance: Resin Sort or PLI Sort
SEGMOD Features

● Transport Costs
  ➢ Related to distance to CPY or Mill/Wharf
  ➢ Adjustment for Product Type
  ➢ Potential for truck configuration adjustment

● Harvesting Costs
  ➢ Steep vs Not Steep
  ➢ No Sort
  ➢ Structural  Acoustic Sort
  ➢ Appearance  Resin Sort
  ➢ Adjustment for number of sorts
  ➢ Potential for piece size adjustment

● Inventory Costs
  ➢ No Sort
  ➢ Structural  Acoustic Sort and/or Density Sort
  ➢ Appearance  Resin Sort and/or PLI Sort
SEGMOD Features

- Tree List supplied by user (decimetre height intervals)
  - Diameter
  - Sweep offset
  - Acoustic Velocity
  - Density
  - Quality Codes

- Optimal bucking using Dynamic Programming procedures. Handles up to 350 stems and up to 40 m break height per stem

- Reporting includes
  - RTL values ($/ha): total and by product class at each intervention point
  - Average mill gate RTL ($/m^3) by product class and mill door by log type
  - Optimal yields by product class (m^3/ha and % of total)
  - Individual stem bucking solution
SEGMOD Demonstration

Log Segregation Economics Model

Overall "Stumpage" Value ($/ha) 49733

Return to Log Values ($/ha)

<table>
<thead>
<tr>
<th>Mill Door</th>
<th>Structural</th>
<th>Fibre</th>
<th>Export</th>
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</thead>
<tbody>
<tr>
<td>22420</td>
<td>46203</td>
<td>2503</td>
<td>32737</td>
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<tr>
<td>Mill Gate</td>
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<td></td>
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<tr>
<td>22190</td>
<td>45650</td>
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<td>32737</td>
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<tr>
<td>CPY Gate</td>
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<td></td>
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<tr>
<td>Pre-Harvest Inventory</td>
<td>13433</td>
<td>23616</td>
<td>-475</td>
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<tr>
<td>Stump</td>
<td></td>
<td>-470</td>
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Distances (km)

| Forest to CPY | 0 |
| Forest to App. Mill | 113 |
| Forest to Struct. Mill | 135 |
| Forest to Fibre Mill | 94 |
| Forest to Port | 155 |
| CPY to App. Mill | 0 |
| CPY to Struct. Mill | 0 |
| CPY to Fibre Mill | 0 |
| CPY to Port | 0 |

Terrain

- Steep
- Not Steep

Segregation Type

- Size and External Quality
- Plus Internal Quality

Sort Methods

- Acoustic
- Density
- Resin
- PLI
Four Case Studies

- SEGMOD populated with price, cost and stand data from companies operating in four regions of NZ
- 255 segregation scenarios were modelled
- Variations in segregation approach, stand type, stand location, terrain type, market focus, market horizon
- Number of sorts depended on where and when segregation was done and market focus
Structural Grade Sorting

Acoustics and Density Cores

Standing Tree

Mechanized Processing

In Mill Bucking

Mill Yard

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Appearance Grade Sorting

✓

Resin (Visual) and Pruned Log Index
Results: Highest Stumpage Value

Segregation Approach with Highest Stumpage Value

Relative Frequency (%)

Combined

NoSeg  PHISeg  LandSeg  CPYSeg  MillSeg
Results: Stumpage Value Increase

Stumpage Value Increase
(compared with NoSeg)

Relative Increase (%)

PHISeg  LandSeg  CPYSeg  MillSeg
## Results: Stumpage Value Sensitivity

<table>
<thead>
<tr>
<th>Key Variable</th>
<th>Variable Option</th>
<th>PHISeg</th>
<th>LandSeg</th>
<th>MillSeg</th>
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</thead>
<tbody>
<tr>
<td>Terrain type</td>
<td>Steep</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td>Not steep</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>Stand type</td>
<td>Pruned</td>
<td>☒</td>
<td>☒</td>
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<td>Unpruned</td>
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<td>Market type</td>
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<td>“Equal” domestic and export focus</td>
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<td>Market horizon</td>
<td>Current</td>
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<td>Long term</td>
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<td>✔</td>
<td>☒</td>
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</table>

- ✓: Significant difference, at the alpha = 0.05 level, between variable option pairs within segregation approach columns.
Results: Highest Mill Door Value

Segregation Approach with Highest Mill Door Value

Relative Frequency (%)

- NoSeg
- PHISeg
- LandSeg
- CPYSeg
- MillSeg
Effect of Segregation on Allocation of Volume to Markets

- NoSeg
- PHISeg
- LandSeg
- CPYSeg
- MillSeg

Volume Allocation (%)

- Appearance
- Structural
- Fibre
- Export
- Waste

Results: Allocation to Markets
Conclusions

The economic benefits of segregating stands, stems and logs, based on wood properties, outweighed the additional costs for forest and mill owners in most of the scenarios evaluated.
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