Innovative Harvesting Approaches for Tolerant Hardwood Forests

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Key Learnings
from the Hardwood Initiative
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Project 5 - Integration of biomass harvesting
Project 12 - Operational deployment optimization
Project 13 - Merchandising centers
Project 14 - Stand improvement with extensive management tools
Project 15 - Machine productivity improvement in intensively managed stands
Project 5: Integration of Biomass Harvesting

Facts

- Limited knowledge of opportunities for developing viable harvesting operations
- Competitive market for the resource
- Full-tree harvesting rarely seen in some regions
- Partial cutting is widely used, restricting the volume
- Market proximity
Operational Research Activities

1) Forest biomass procurement analysis

2) Preliminary trials for full-tree harvesting in partial cut management in Mont-Laurier (QC) and North Bay (ON)

3) Integrated pellet wood harvesting in Thurso (QC)

4) Test trial of commercial thinning in immature maple stand with biomass product
1) Forest Biomass Procurement Analysis: Tools for Modelized Systems

1) A spreadsheet tool for six harvesting systems
   • For entry level users
   • Forest description provided by local inventory system
   • Machine productivity models developed by FPIInnovations and from BiOS general model
   • Reflects the results of the best hypothesis and models

2) FPInterface
   • Spatially-explicit calculations from current plans and reports in consideration of schedules and hauling distances
   • Provides best product/cost results for educated user
Best Scenario: Full-Tree Systems with Partial Topping
2) Preliminary Trials for Full-tree Harvesting
Learnings from Mont-Laurier

Full-tree skidding with modified guidelines
- Partial topping
- Topping completed at landing
- Roadside residue piling

Additional roadside costs: + $4/m³ or
Biomass: + $10/odmt

Logging damage
Selection: 14% BA
Shelterwood first pass: 14.5% BA
No compliance with rules (2010)
No real appetite for revised criteria!
Learning from de Block 196 trials:

Shelterwood systems: First seeding cut VS Overstory removal

- Roadside DDC residues available at minimal cost
- Competitive chipping operation and manageable procurement chain
- Partial cutting affecting tree bunching opportunities, resulting in undersized loads for skidders and proportional costs
- In the first cut treatment, damage to residual trees was significant.
Learning from Block 183: Full Tree vs Tree Length

- Topping at roadside offers a viable opportunity
- No additional cost noted on conventional product
- Evaluated only in shelterwood first pass

- Modified landing management
- Offers flexibility when pulpwood market is active
3) Learnings from Integration Studies of Pellet Wood Harvesting in Thurso (QC)

- Additional volume: 13% volume with the processing of slashing residue
- Improved sawlog extraction
- Additional 5% process volume with modified topping guidelines
- Procurement costs similar to pulpwood costs
4) Trial of Commercial Thinning in Immature Maple Stand with Biomass Product

- Suitable approach developed in consideration of short hauling distances
- Cost evaluation
- Two products (pallet wood, biomass round wood)
- Branch piling and skidding trials
4) Learning from Commercial Thinning Trials

- Stand density management: A1
- Limited cost increase compared to clearcutting (+ $5/m³)
- A conventional harvester head is suitable for midsized tree tops
- Primary transportation using a small-size forwarder: $25/tma (0-300 m)
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Facts:

- Stand maturity associated with multiple criteria narrowing windows of opportunity
- Typical low removal rate
- Road network not optimally managed
- HWD=Fragmentation
Logistic Analysis of 3-Year Operating Plans (NB Lic. 1 & 8)

- Some indirect and direct costs centers are affected:
  - Planning
  - First-line supervision
  - Transportation of machinery and personnel
  - Road construction and maintenance

- Studied scenarios with increases logging opportunities, using innovative partial cutting treatments:
  - Shelterwood cuts using 1-2-3 method
  - Selection cuts using 1-2-3 method
  - Commercial thinning
  - Overstory removal
Significant opportunities for using shelterwood or selection cut implemented with the 1-2-3 method. Additional 3600 ha partially-harvested stands (26%) on existing passing roads.

<table>
<thead>
<tr>
<th>2007-2010</th>
<th>PLANNED</th>
<th>UPDATED</th>
<th>SAVINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting ($/m³)</td>
<td>23.62 $</td>
<td>26.55 $</td>
<td>1.45 $</td>
</tr>
<tr>
<td>Dispersion ($/m³)</td>
<td>8.14 $</td>
<td>3.76 $</td>
<td></td>
</tr>
</tbody>
</table>

Results
Dispersion cost model

LICENSE 8

Regression

95% PI

S  0.0680470
R-Sq  97.1%
R-Sq(adj)  96.8%

- Blue: Planned
- Green: Optimized
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Maximizing value recovery from tolerant hardwood logging operations

Peter S. Hamilton, Forest Operations
Steve D’Eon, Canadian Wood Fiber Center
RESULTS

Revenue increased 11% per cubic meter harvested

- 15-fold increase in “veneer” grade volumes
- 12% increase in sawlog volume
- 13% decrease in fuelwood and pulp grades
- $70,000 increase in stumpage revenues
How did we get there?

Combination of directions

- Value recognition
- Segregation
- Merchandising
- Concentration

Marketing

= value-added yard
Value Recognition

- Identification of loss opportunity
- Formal training
- Ongoing informal training (market intelligence)
Segregation/Sorting

- Feller buncher
- Grapple skidder
- Slasher/log maker
- Trucker
- Yard loader operator
Merchandising

- Two-stage merchandising
  - pulp and standard logs
  - specialty and veneers
- Not an entry level position
- Must invest time in 5% of wood
Concentration/Value-added Yard

- Accumulate critical mass
- Attractive to buyers
  - One-stop shopping
  - “Browsing for buys”
- Allows for “value-added sorting/marketing”
- Custom log manufacturing
First load......

- 42 sticks
- 2803 bdft (Doyle)
- $8242 US FOB yard

The right log to the right buyer!
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Facts:

- Stands that don’t have the exact maturity properties are not contributing to the AAC, at the risk of tree losses.

- Silvicultural investment funds on Crown Lands are tightly managed. Application of intensive management tools is changing. Clearcutting is not a valid answer.

- Traditional selection cuts are strongly skewed toward vigor management and wood product baskets are suffering.

- Stands that contain mature trees have changed:
  - Density is lower
  - AGS/UGS are decreasing
  - The historical disturbance patterns aren’t having the same effect
Approach

- Guidelines were developed for selection cut using 1-2-3 method
- Overstory removals were optimized
- Guidelines were adjusted for regular and irregular shelterwood management
- Damage to regeneration was monitored
- Multi-treatment decision rules were tested
As a result of 10 development trials and evaluation:

The 1-2-3 method can be applied to manage the viability on harvesting operations.
The 1-2-3 method

1- The trail network

2- Tree selection process

3- A control method
1- The trail network

- Untouched zone
- Trail
- Selection zone
With regular trail spacing, it is easier to maintain uniform removal.
The development of the trail system in time allows uneven aged management.
An Operational Tree Classification Allows for Vigor Management

<table>
<thead>
<tr>
<th>Quality (Q)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality 1 (Q1)</td>
<td>Stems without significant defects</td>
</tr>
<tr>
<td>Quality 2 (Q2)</td>
<td>Trees with defects that can be seen on one or two faces: seams, cancer, fungus, holes, and other defects</td>
</tr>
<tr>
<td>Quality 3 (Q3)</td>
<td>Trees with defects that can be seen on three or four faces: leaning, forked, crocked, seams, cancer, fungus, holes and other defects</td>
</tr>
</tbody>
</table>
### Guidelines Must Be Kept Simple

**Ex.: Guidelines given to feller-buncher operators**

**In parallel and straight trails**
- **Width:** 5 m
- **Spacing:** 30 m

**In the selection zones: 10 m x 5 m**

**Tree count:**
- **Among the big trees (36+ cm DBH):** felling of 1 out of 2
  - felling of 1 out of 1
  - **Priority:** Maple or yellow birch with sawlogs, any large ones among others
- **If no big trees:**
  - **DBH from 24 to 34 cm:** felling of 1 over 4
  - **Priority:** mid-sized trees with defects, Balsam Fir, mid-sized trees with no defects

**Significant defects (1st 6m):** leaning, forked, crocked, seams, cancer, fungus, holes and others
Two Silvicultural Criteria Were Monitored

Removal rate

Proportion Q1-class trees
Feller-Buncher Productivity Contributes to Operational Viability
Next step: Effects on wood product baskets
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Facts:

- Traditional silvicultural treatments for hardwood forests are expensive

- Protecting the residual stand is very challenging with tree-length harvesting systems
Cut-to-length Harvesting System in Hardwood

Findings:

- Cut-to-length allows at-the-stump processing of sawlogs, if log specifications are simple
- If not, a semi-tree-length approach with all pulpwood processed and sawlogs are processed with conventional slasher
- CTL is cost-competitive
- Damage to residual reduced by 30% and accidental felling by 66%
- CTL allows for intensive management opportunities with commercial thinning in immature stands
Processing Studies: Pulpwood Extraction and Marginal Cost

- The last pulpwood logs processed from a complex crown cost 4X the average expense of $12/m³

- Overall, the additional 2.6% volume impacted the overall felling-processing costs by an increase of 4.5%
Processing Studies
Semi-tree-length VS Logs-at-the stump

Processing the semi-tree-length is an extra cost but may result in significant added-value extraction.

Secondary processing results with residue production.
Typical harvesting cost* comparison (0.576 m³/t)

Tree length

3.58 + 1.50 + 9.70 + 3.93 = $18.71/m³

Semi-tree length

50 %

50 %

9.80 + 6.61 + 3.93 = $18.38/m³

* Direct operational cost excluding transportation, supervision, profits and other charges
Severe damage to residual trees

<table>
<thead>
<tr>
<th>Distance from trail</th>
<th>Kruger-A</th>
<th>Kruger-B</th>
<th>AFA</th>
<th>Domtar</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 m</td>
<td>1.4</td>
<td>1.9</td>
<td>6.5</td>
<td>2</td>
</tr>
<tr>
<td>5-10 m</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cutover</td>
<td>0.6</td>
<td>0.8</td>
<td>2.6</td>
<td>3</td>
</tr>
</tbody>
</table>
The use of CTL systems allows for easy commercial thinning as an intensive management tool.
Improvement in Intensively Managed Stands

• Better use of available investments

• Progressive use of CTL will indicate which niche is good, depending local market

• Traditional treatment guidelines offer flexibility to improve profitability of treatment
What are the next steps?