Estimating poplar plantation stand value and log product yields using terrestrial laser scanning and optimal bucking

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The Value Chain Opportunity

Foresters spend decades creating potential value in each tree.

The challenge is to optimally capture this value and deliver it to the right customers, in full, on-time and on-spec!!
Accurate estimates of timber assortments and value require accurate measurements and appropriate allocation procedures.
Purpose of Inventory

Some inventory methods are best suited for providing broad-based metrics (e.g. total volume) at the landscape or large area level.

Bucking simulation, based on detailed stem descriptions, produces the most accurate estimates for predicting timber assortment and value recovery for specific stands.

Malinen et al. 2007.
Detailed tree descriptions

Detailed assessments of stem size, shape and quality within each forest unit

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Non-Traditional Approaches

Remote Sensing

Satellite

Aerial LIDAR
Non-Traditional Approaches

New Inventory Technologies

“Data mining” harvester stem descriptions from nearby stands or presampling with the harvester

Terrestrial laser scanning

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Terrestrial Laser Scanning

VALMAX™
Forest Value Management Tools

Tree bole measurements linked to markets and combined with wood density profiles and biomass expansion factors

Gathering data with laser scanner

Automated tree detection and stem profiling with Autostem

C
Above Ground Carbon

Log Product Yields

$$$
Stand Value
Past Research

- Douglas-fir plantations in Oregon, USA
- Sitka Spruce plantations in Ireland
- Radiata pine plantations in Australia
- Eucalyptus plantations in Australia
- Ash and oak hardwoods in Poland
- Maritime pine in France
- Spruce and pine in Scandinavia
Greenwood Resources, USA

Intensive management – seedling to sawmill. Largest drip fertigation (fertilizer and irrigation) system in the world. Automated soil moisture sensing. Manage energy and water use for cost control as well as environmental reasons.

Growth rates 40 m³ per ha per year.
Current Research

- Three stands selected in Greenwood Resources poplar plantation at Boardman, OR
  - 12 year old, 725 trees per ha (290 tpa)
  - 7 year old, 550 trees per ha (220 tpa)
  - 7 year old, 360 trees per ha (145 tpa)
Plot size and number

- 10 m radius plots (~ 0.08 ac) plots established in July 2010
- 60 plots total: 20 plots per stand type
- Wind conditions recorded
Laser scanner

Trimble FX Scanner

- 360° hemispherical scan
- 2 to 8 minutes per scan
- scans out to ~ 30 m radius
- phase shift scanning of distance
- wavelength: 690 nm

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Trimble FX Laser Scan Data
Rapid technology changes

FARO Focus 3D laser scanner

Price: ~ $40,000
Speed: ~ 1 million points per sec.
Weight: < 5 kg
Built in: computer, color camera
Standing and felled tree measurements

- All trees numbered
- Diameter breast height
- Tree height (five trees per plot)

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- Four to eight plots in each stand felled (remainder to be rescanned and measured in summer 2011)
- Overbark & underbark diameters measured at 0, 3, 6, 12, 18 … m above stump
4 to 8 plots per stand were felled, extracted to roadside, trucked to mill, bucked at about 17 m
Stems delivered to mill scanner

Some scanned with both bark on and bark off.

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Scanned stems bucked

Nelson Brother scan data captured for all stems.

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Bucked logs enter mill
Logs Sawn

Lumber yield and grade data also captured.

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Sawlog Value: SED & Sweep

Value based on lumber plus chip sales minus mill costs.

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Chiplogs and Veneer Logs

- Chiplog values based on $80 per bdt FOB for chips. Less transport and chipping costs ($28 per bdt) ➔ $23 per GT ➔ $21 per m³.

- Veneer log values based on $300 per MBF at mill door
  - > 380 mm ....$73 per m³
  - > 330 mm ....$67 per m³
  - > 250 mm ....$60 per m³
  - > 200 mm ....$53 per m³
Planned data flows

Delivered veneer log prices

Lumber and chip yields per log category (size and sweep)

Grade recovery data

Lumber and chip prices

Mill operating costs

Delivered mill door breakeven price per log category for sawlogs and chiplogs

Tree descriptions from laser scans

Treemetrics & VALMAX software

Optimal stand value and log yields

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VALMAX™
Forest Value Management Tools

Log Product Yields

Stand Value
How good is the TLS data?

Stand 1, Plot 1, Tree 11

Preliminary Results from Stand 1

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How good is the TLS data?

Preliminary Results from Stand 1, Plot 1, Tree 11
How good is the TLS data?

Preliminary Results from Stand 1

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# Preliminary Results from Stand 1

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**TLS vs NBE vs Manual**

<table>
<thead>
<tr>
<th>Height (m)</th>
<th>TLS</th>
<th>NBE</th>
<th>Manual</th>
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</thead>
<tbody>
<tr>
<td>24</td>
<td>112</td>
<td>-</td>
<td>112</td>
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<td>DBH</td>
<td>287</td>
<td>281</td>
<td>274</td>
</tr>
<tr>
<td>Butt</td>
<td>345</td>
<td>289</td>
<td>316</td>
</tr>
</tbody>
</table>

*Tree 11 from Plot 1 of Stand 1*
VALMAX vs NBE Buck4

Tree 11 from Plot 1 of Stand 1

AutoStem plus VALMAX

Preliminary Results from Stand 1

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# Value and Yields

Preliminary Results from Stand 1 Plots 1 to 7

<table>
<thead>
<tr>
<th>Total Volume (m³/ha)</th>
<th>Total Value ($/ha)</th>
<th>Sawlog (%)</th>
<th>Chip (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>523</td>
<td>$20,968</td>
<td>78.1</td>
<td>21.5</td>
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</tbody>
</table>

Add another $1700 per ha if can get veneer from 200 to 250 mm SED

3 to 11% increase by adding veneer

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Bucking for Trucking

If buck at ~ 17.0 m (~ 56’9”)

- 9.4% of sawlogs (by number) would have extended above this point for Plots 1 to 7.

Range 3.0% to 13.2%

Based on standing tree scans and AutoStem/VALMAX analyses.
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