SM²: Tomorrow’s Smart and Agile Manufacturing

Mill Optimization and Automation Forum
Crowne Plaza Montreal Airport
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Partners:
FPInnovations

- Not-for-profit research & innovation organization
  - $75M in R&D and innovation activities
  - 425 employees
  - 175 member companies (Canada only)
  - Research partnerships with universities
  - ISO-certified laboratories

- Major innovation programs
  - Forest Operations
  - Wood Products
  - Pulp & Paper, Packaging, and Tissue
  - Bioproducts and Bioenergy
World economic drivers

- Population growth
- Urbanization and densification
- Climate change
- Increasing needs for products and sustainable housing
- 21st century: product customization
Canadian industry manufacturing challenges

- Demographic changes and shortage of skilled labour
- Increasing fibre supply costs and greater quality/attributes variability
- Reliance on U.S. markets
- Increasing market and business need changes
- Desire to diversify production in non-traditional markets and applications
- Operational excellence varies considerably between companies, within mills of the same company, between shifts, and even within a department
## Eastern Canada wood fibre supply evolution

### WOOD SUPPLY EVOLUTION

*(1970-2015)*

<table>
<thead>
<tr>
<th>Decade</th>
<th>Tree Volume (dm3/tree)</th>
<th>Fiber Cost ($/m3)</th>
<th>Yield (bf/m3)</th>
<th>Proportion 2x3 (%)</th>
<th>Proportion Fir</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-1980</td>
<td>170-200</td>
<td>170-190</td>
<td>&lt;10%</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>1980-1990</td>
<td>135-150</td>
<td>200-220</td>
<td></td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>1990-2000</td>
<td>120-135</td>
<td>35-50</td>
<td>200-230</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>2000-2010</td>
<td>100-120</td>
<td>45-55</td>
<td>225-235</td>
<td>++</td>
<td></td>
</tr>
<tr>
<td>2010-2018</td>
<td>90-115</td>
<td>55-65</td>
<td>235-260</td>
<td>20-40%</td>
<td>+++</td>
</tr>
<tr>
<td>Leaders</td>
<td></td>
<td></td>
<td>280-300</td>
<td></td>
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</tbody>
</table>

Increase of variability in log sizes, species, and quality
SM² origin: the industry must reinvent itself to improve its competitiveness

- Reduce financial dependency on co-product revenues - “do less"
- Offer greater diversification of solid wood products (structural and appearance)
- Develop a co-product offer to ensure the competitiveness of users

Maximize recovery and value to offset high delivered log costs

Offer greater diversification of solid wood products (structural, engineered, and value-added)

Manufacturing flexibility and agility for a rapidly changing resource base and availability, and shifting markets needs
SM² mission: in sync with 21\textsuperscript{st} century needs

- Stimulate the growth and prosperity of the Canadian processing sector by:
  - Reducing dependency on co-product revenues
  - Enhancing value & recovery and productivity via breakthrough technologies
  - Enabling SMART and AGILE manufacturing solution for the 21\textsuperscript{st} century business needs and market demands
  - Accelerating research to commercialization by facilitating partnerships between industry, government, and academia.
SM² outcome: a smart and flexible manufacturing toolbox
Applications:

- **Advanced Intelligent Vision (7 applications)**
- **Smart Platform (5 applications)**
- **New technologies (3 applications)**
1: LOG/TREE IDENTIFICATION VISION

- **Need**
  - Automatic tree or log species ID using bark

- **Area of application**
  - Debarking and bucking control

- **Benefits**
  - Yield recovery improvement: debarking
  - Productivity gain: debarking
  - Production costs reduction

- **Partners**
  - Industrial: Resolute Forest Products
  - OEM: TBD (TRL still too low)
  - Research: FPInnovations, Université Laval (software engineering)
4/5 : AUTOMATED LUMBER SPECIES ID (green and dry conditions)

- **Need**
  - Provide a 95% accurate species identification system in lumber (sawmill and planer mill)

- **Area of application**
  - Green sorting of lumber (SPF)
  - Sorting for niche market/value (planer)

- **Benefits**
  - Improved drying productivity
  - Improved grade and yield recovery

- **Partners**
  - Industrial: GDS
  - OEM: Autolog
  - Research: FPInnovations

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### 4. Results:

- System installed at GDS mill in Matane, QC, in August 2018.
- Data collected during the last ~ 3 months.
- Validate the performance during a visit in early November:

<table>
<thead>
<tr>
<th>Date and species scanned</th>
<th>Number of boards</th>
<th>Prediction accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 5th - Spruce</td>
<td>7835</td>
<td>97.68 %</td>
</tr>
<tr>
<td>November 6th - Fir</td>
<td>17124</td>
<td>95.16 %</td>
</tr>
<tr>
<td>November 7th - Spruce</td>
<td>4216</td>
<td>95.33 %</td>
</tr>
<tr>
<td>November 7th - Fir</td>
<td>11477</td>
<td>94.21 %</td>
</tr>
<tr>
<td>November 8th - Spruce</td>
<td>4174</td>
<td>96.41 %</td>
</tr>
</tbody>
</table>

- Spruce prediction accuracy over 4 days : 96.74 %
- Fir prediction accuracy over 4 days : 94.78 %
6: ENHANCED LUMBER MOISTURE MEASUREMENT ACCURACY

Need
- Operational correction factors (specific parameters) for SPF combined
  - Spruce and balsam fir at ambient, high, and frozen temperatures
- Using moisture content, species, and temperature probes allow for self-calibration/correction system

Area of application
- Lumber sorting (planer mill)

Benefits
- Improve drying and planer mill operational performance
- Reduce drying defects

Partners
- Industrial: GDS
- OEM: SCS
- Research: FPInnovations
Applications:

Smart Platform (5 applications)
Need
- Automatic measurements of log attributes (temperature, moisture content, species)
  • Control in real-time of debarkers operational parameters from infeed information

Benefits
- Improve LRF
- Increase speed
- Reduce costs

Partners
- Industrial: Resolute Forest Products
- OEMs: various
- Research: FPInnovations, Université Laval
B: REAL TIME ADAPTIVE CONTROL FOR LOG TURNING

- **Need**
  - Create smart log turner with auto diagnostic
  - Combine AVS with AI (machine learning, data science…) for RT PC
  - First step for future applications on other machine-centres

- **Benefits**
  - Improve volume and value recovery
  - $500K+ annually or $1.75/m³

- **Partners**
  - Industrial: Scierie Dion, Resolute Forest Products, Maibec
  - OEM: Bid Group
  - Research: FPInnovations, CRM, INO

Rotational Error Impact (Optitek™)

Monetary losses are close to 1.75$ per m³
C: AUTOMATED SAW FILING ROOM

- **Need**
  - Improve operational excellence in sawfiling room
  - Interconnectivity between smart machines, tooling, and materials (tracking)
  - Mitigate shortage of skilled sawfilers
  - Increase feed speeds

- **Benefits**
  - Reduce sawkerfs (0.075 in.)
  - Improve lumber recovery
  - Reduce production costs

- **Partners**
  - Industrial: Maibec
  - OEM: TBD
  - Research: FPInnovations, CVRI
D: REAL TIME ADAPTIVE CONTROL FOR PLANER SETTINGS

Needs
- Self-adjust cuttings tools, bed, etc. on a continuous basis
  • Using data from the incoming lumber, tooling quality, and outcoming lumber quality
- Combine AVS with AI (machine learning, data science,…) for RT planer control

Benefits
- Improve grade recovery (7%)
- Improved value gains $4.45/Mbf

Partners
- Industrial: Maibec
- OEM: Les Produits Gilbert
- Research: FPInnovations, CRM, INO, LVRI

Courtesy of Les Produits Gilbert
**E: “SMART, FLEXIBLE & AGILE” SECONDARY MANUFACTURING**

- **Need**
  - Improve operational performance combining multi-production lines
  - Real-time smart control system to optimize production flow
  - Design a framework for an intelligent and smart platform; Industry 4.0

- **Benefits**
  - Productivity and grade increase
  - Agility and flexibility

- **Partners**
  - Industrial: GDS, Maibec
  - OEMs: various
  - Research: FPInnovations, CRM
Applications:

- New technologies (3 applications)
1: NEW GENERATION OF SAWBLADES

Need
- Narrower kerfs target 0.080 in., feed speed > 1,000 fpm
- Increased durability (2x)

Benefits
- $1.25/Mbf/0.01 in. reduction
- $375,000 (100MMbf) mill
- Improved lumber recovery, %2x4 ↑, ↑ predominant length
- Reduced chips, reduced sawdust
- Lower production costs

Partners
- Industrial: Maibec
- OEM: TBD
- Research: FPIInnovations, Université Laval, CCTT TR
2: COMMERCIAL DEMO OF CONTINUOUS PRECISION RADIO-FREQUENCY (RF) DRYING (Spruce and Fir)

- **Needs**
  - Match the drying productivity to the sawmill productivity
  - Adapt process to mixed lumber thickness, width, and length
  - Eliminate the sorting line
  - Dry at different final moisture content specifications and quality requirements depending on product end use

- **Benefits**
  - Reduce production costs
  - Increase mill flexibility and agility (pull approach)

- **Partners**
  - Industrial: GDS
  - OEMs: MEC, Carbotech, SCS, Autolog, Nautel
  - Research: FPInnovations, HQ

- **Schedules and deliverables**
  - Summer 2018
  - Commercial demonstration of a continuous precision RF drying system
3: ULTRAFAST DRYING

- **Needs**
  - Match the drying productivity to the sawmill productivity
  - Adapt process to mixed lumber thickness, width and length
  - Eliminate the sorting line
  - Dry at different final MC specifications and quality requirements depending on product end-use

- **Benefits**
  - Reduce production costs
  - Increase mill flexibility and agility
    (pull approach)

- **Partners**
  - Industrial: TBD
  - OEM: TBD
  - Research: FPInnovations

- **Schedules and deliverables**
  - Summer 2020 ; Small laboratory demonstration
SM² outcome: product and coproduct diversification
Sawmill coproducts for PB/OSB

- **Objectives**
  - Convert sawmill intermediate residual materials into wafers and strands by adapting existing and available technologies

- **Benefits**
  - Diversify coproducts towards panel industry

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**Sawmill intermediate residual materials (SIRMs)**

- Rejected logs (black spruce and balsam fir)
- Slaps (white spruce and balsam fir)
- Trim blocks (black spruce and balsam fir)

**Converting chips into wafers/strands with a two-step process**

1. Drum chipper
2. Knife ring flaker
Novel wood impregnability process

- **Objectives**
  - Increase impregnability potential of softwood
    - Especially for heartwood

- **Benefits**
  - Improve softwood characteristics
    - Dimensional stability, durability, hardness, etc.
  - Promote its use, develop new products, and regain market share.
Soluble salt treatment for wood protection

- **Objective**
  - Improve the resistance of wood using a "green" process based on soluble salts
  - **Adapt existing sawmilling and drying technology** to diversify markets and applications of wood
  - Validate the technico-economical viability

![Image of treated wood](image-url)
Closing remarks

- Companies react faster to market changes by producing smaller, more profitable production runs or batches
- New generations of advanced vision systems, new technologies
  
  **PLUS**
  Smarter machines with artificial Intelligence, and machine and deep learning for real-time adaptive control
  
  **EQUAL**
  Manufacturing of the future adapted to business needs and market demands of the 21st century for **SMART and AGILE manufacturing solutions**.
- This century will reward the “gazelles” - smart, fast, and flexible companies and businesses
- **You want to participate: don’t hesitate to call us**
Thank you

For additional information:

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