Simulation of Lumber Production Planning Using Software Agents: a Case Study

Fabián CID YÁÑEZ, Universidad Austral de Chile
Jean-Marc FRAYRET, École Polytechnique de Montreal
Alain ROUSSEAU, Université Laval
Francois LÉGER, Forintek Canada Corp

SWST 51st Annual Convention
Concepción – Chile
November 10 – 12, 2008
From Physics

• To overcome inertia, is it easier to pull an object or to push it?
Presentation outlook

• Objective
• Lumber market context in Québec
• Production Planning
• Lumber Production Planning (LPP)
• Simulation using agents
• Experiment
• Results and discussion
Objective

• To evaluate the logistical and financial performance of a softwood sawmill production planning process under push and pull based strategies using a simulation platform.
Context for Québec’s Lumber Industry

- Competitive forces from low cost producers
- Timber cost going up
- Economic conditions, such as a stronger CDN$ or taxes
- Market and customer changing forces
Production Planning

• To decide what, when and where to produce it, using different time spans
• Capacity planning (capacity allocation)
• Demand management (ATP and priority allocation)
• Materials requirement planning or sourcing
Production Planning

- **Drivers**
  - Supply driven (upstream signal)
  - Recipe driven
  - Demand driven (downstream signal)

- **Strategy elements**
  - Decision and information decoupling point
  - Performance criteria
Lumber Production Planning

- Divergent industry (V-type flow)
Lumber Production Planning

- **Approaches**
  - **Traditional**: Producing lumber based on recovery optimization
    - Push
  - **Command-based**: Producing lumber based on targeted service levels at different points
    - Pull
Simulation Using Agents
Simulation Using Agents

- **General characteristics:**
  - Emulate actual behavior
  - May have some autonomy
  - Some communication skills
  - Perform a given task

- **Specific**
  - Optimize decisions (Mixed models)
  - Exchange plans
  - Multi-agents
Simulation Platform
Simulation Coordination
Simulation Coordination
Experiment

- Design for deterministic simulation
  - Actual sawmill modeled using Optitek ®
  - Mixed design (54 runs or production plans)
    - 2 Controllable Factors
      - Decoupling Point Position (3 levels)
      - Contracts levels for 2x4 RL 2& Better (60-80-100%)
    - 2 Noise Factors
      - Supply Quality (normal and small)
      - Market prices (3 lists)
Experiment

• Performance evaluation

![Diagram showing performance evaluation metrics]

- Revenues
- Order fill rate (nb of perfect order/nb of order)
- WFR
- Inventory cost
- Work-in-process (MBF)
- DAWIP
- Throughput ($/shift)
- Recovery Factor (MBF/m³)
- PMT
- Production cost
- Procurement cost
Results

• Pull strategy respond better to contracts
Results

- **Push strategy generates more money (at least potentially)**
Discussion

<table>
<thead>
<tr>
<th>Contract level</th>
<th>Average Potential monetary Throughput ($)</th>
<th>Loss ($)</th>
<th>Loss (%)</th>
<th>Premium (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pure push strategy</td>
</tr>
<tr>
<td>0%</td>
<td>$12,433,143</td>
<td>$0</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Pure pull strategy (Configuration C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60%</td>
<td>$11,987,220</td>
<td>$445,924</td>
<td>3.59%</td>
<td>7.75%</td>
</tr>
<tr>
<td>80%</td>
<td>$11,756,677</td>
<td>$676,467</td>
<td>5.44%</td>
<td>8.99%</td>
</tr>
<tr>
<td>100%</td>
<td>$11,637,634</td>
<td>$795,509</td>
<td>6.40%</td>
<td>8.54%</td>
</tr>
</tbody>
</table>

- The sawmill should be “specialized” given its supply and technology and “match” this with the clients it serves.
LPP platform in real time

Decoupling point

Source

Supply Plan

Demand Plan

Sawing

Supply Plan

Demand Plan

Drying

Supply Plan

Demand Plan

Finishing

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Client spot

Client contract

Demand Plan

Supply Plan

Demand Plan (Client)

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Client spot

Client contract

Demand Plan

Supply Plan

Demand Plan (Client)

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan

Supply Plan

Demand Plan
Thanks for your attention
…and congratulations for your endurance.
For further details

- www.forac.ulaval.ca

- www.uach.cl/facultad/forestal/