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

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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

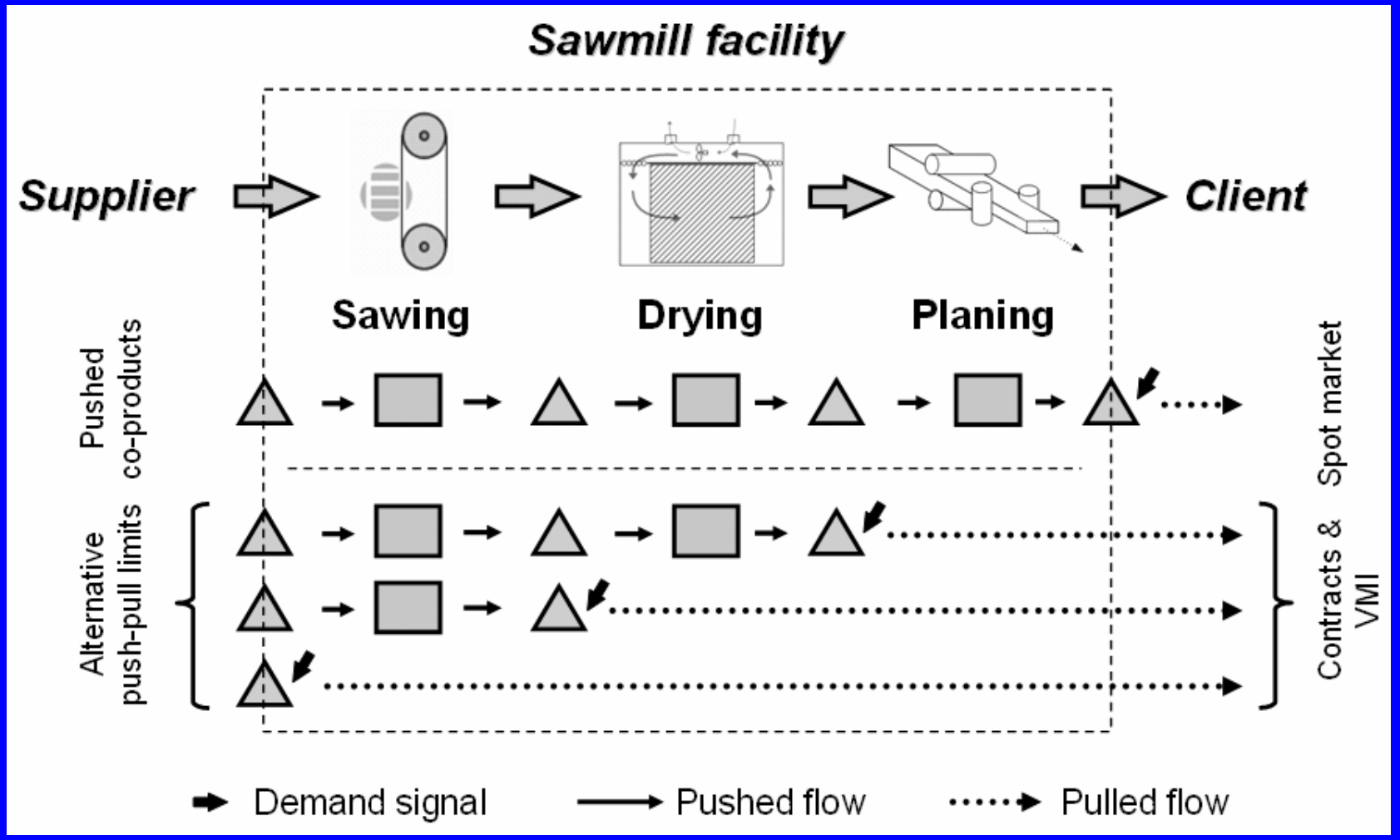
Production Planning

- 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

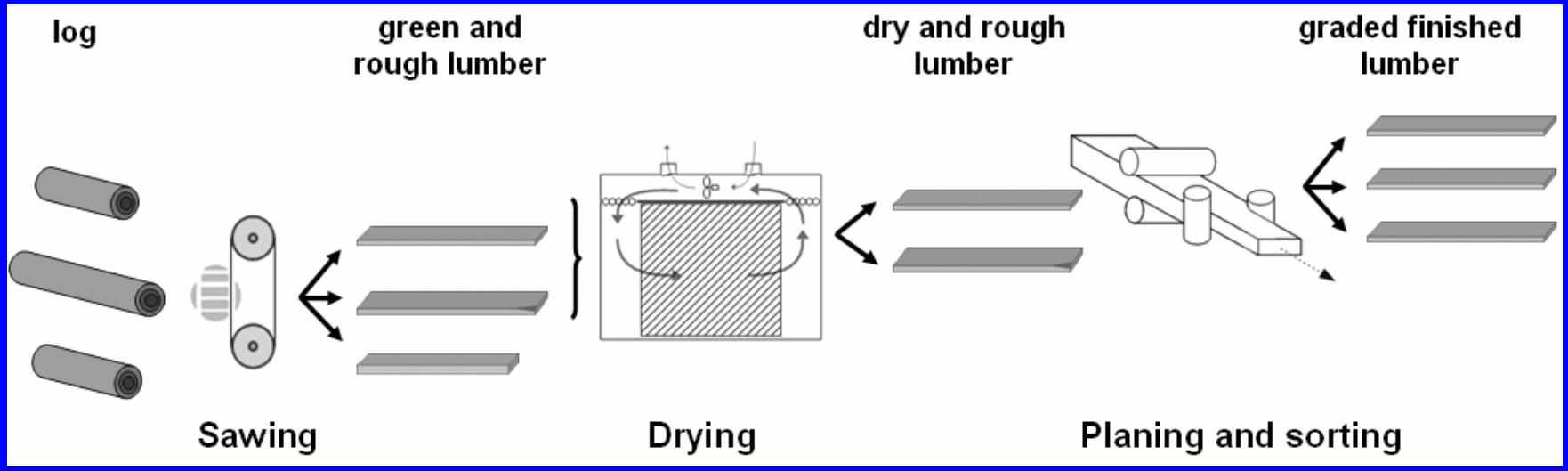
- Drivers
  - Supply driven (upstream signal)
  - Recipe driven
  - Demand driven (downstream signal)
- Strategy elements
  - Decision and information decoupling point
  - Performance criteria

Lumber Production Planning



Lumber Production Planning

- **Divergent industry (V-type flow)**



Lumber Production Planning

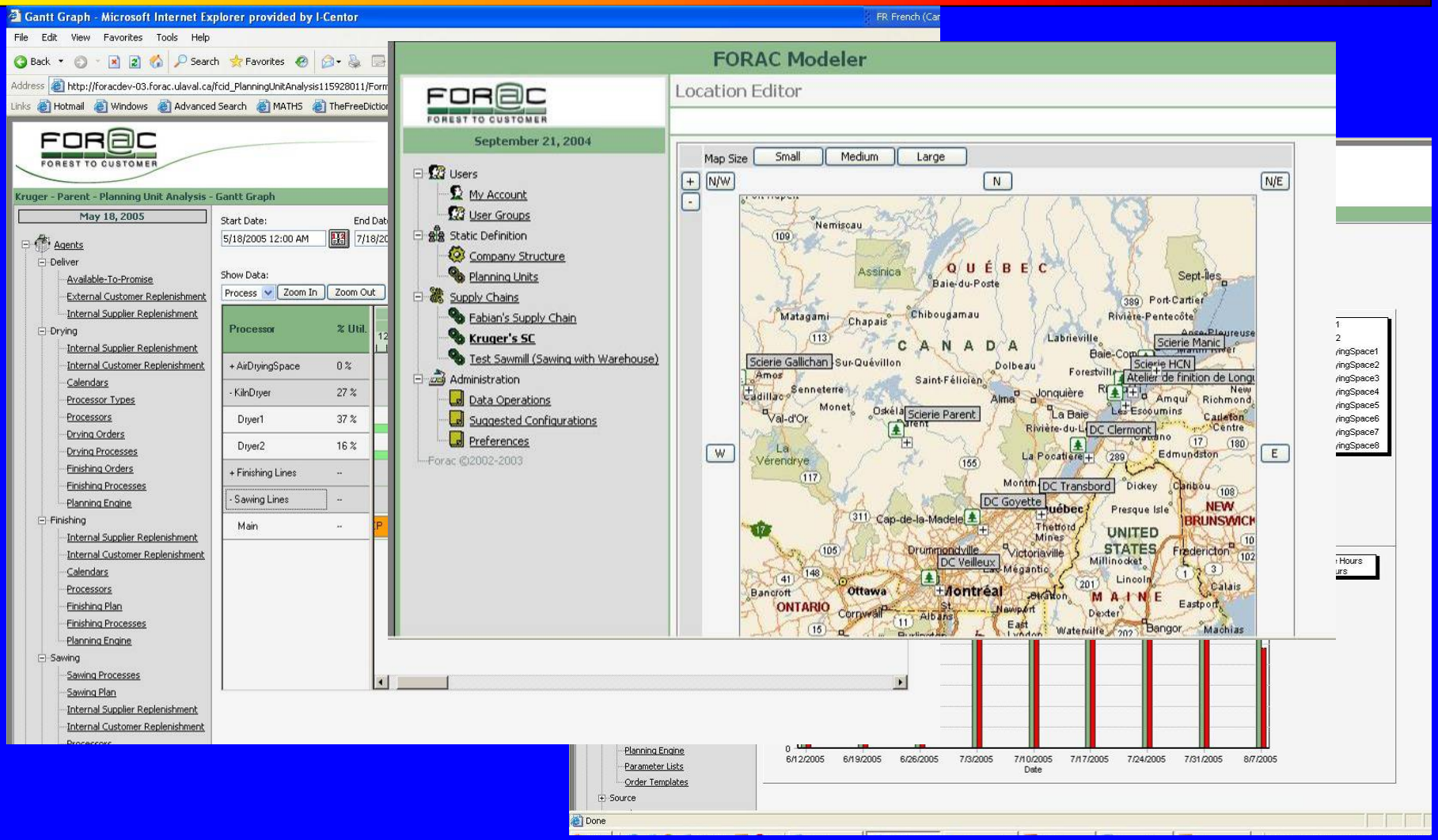
- **Approaches**
  - **Traditional: Producing lumber based on recovery optimization**
    - **Push**
  - **Command-based: Producing lumber based on targeted service levels at different points**
    - **Pull**

Simulation Using Agents

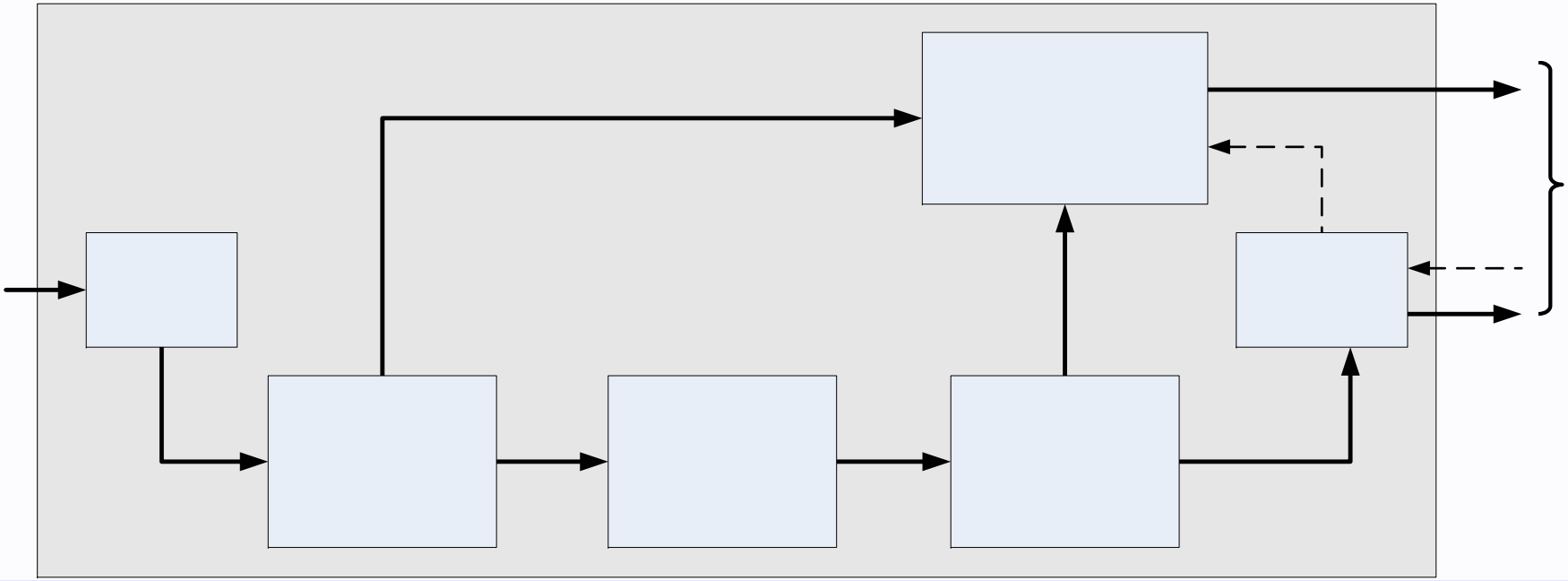
Simulation Using Agents

- 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

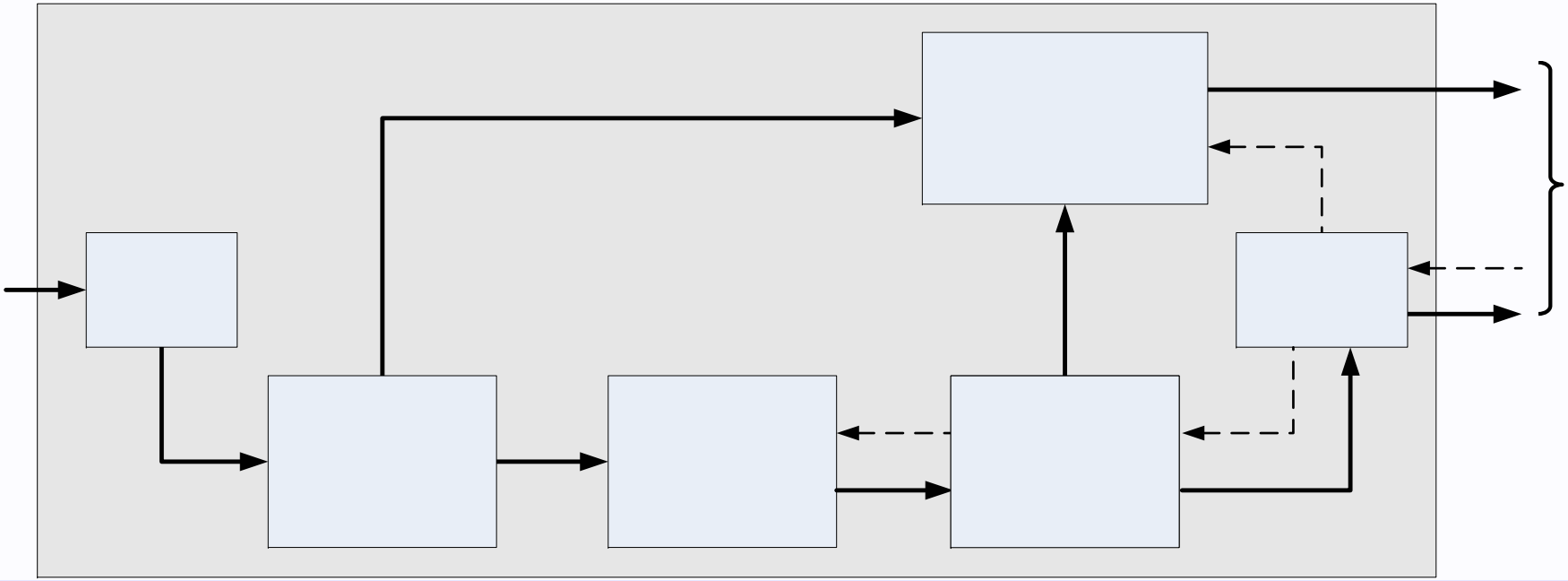
Simulation Platform



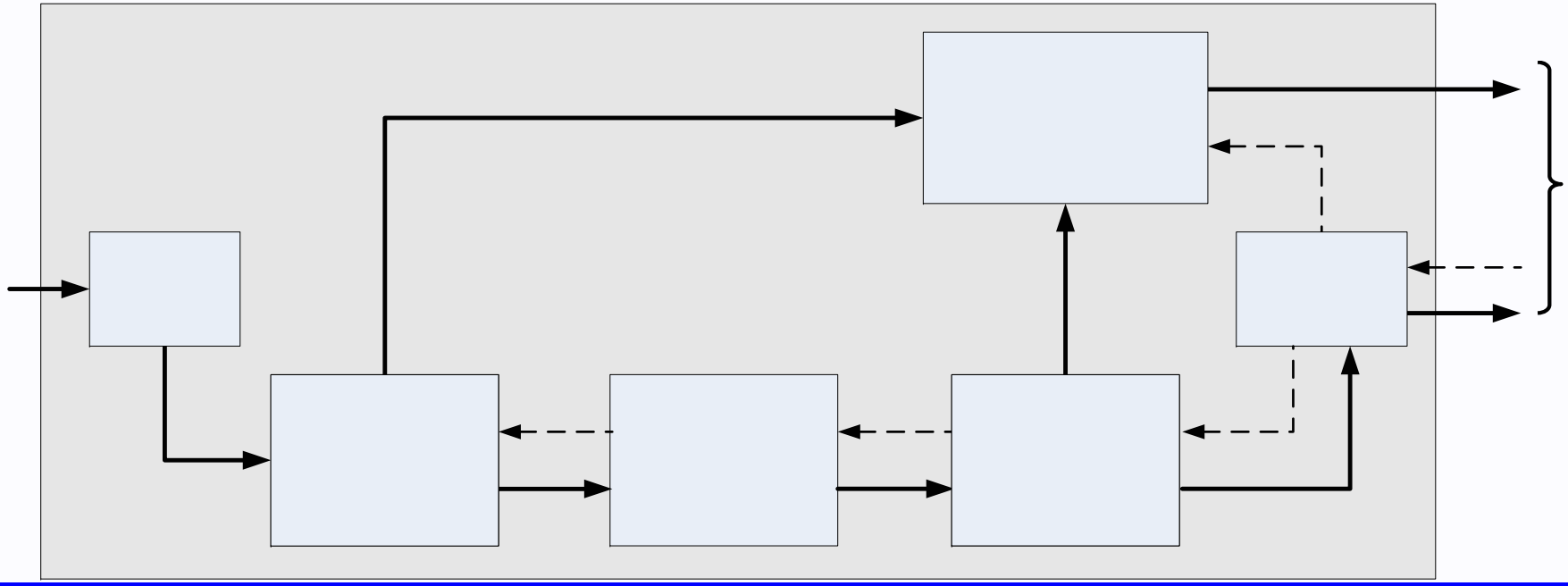
Simulation Coordination



Simulation Coordination



Simulation Coordination

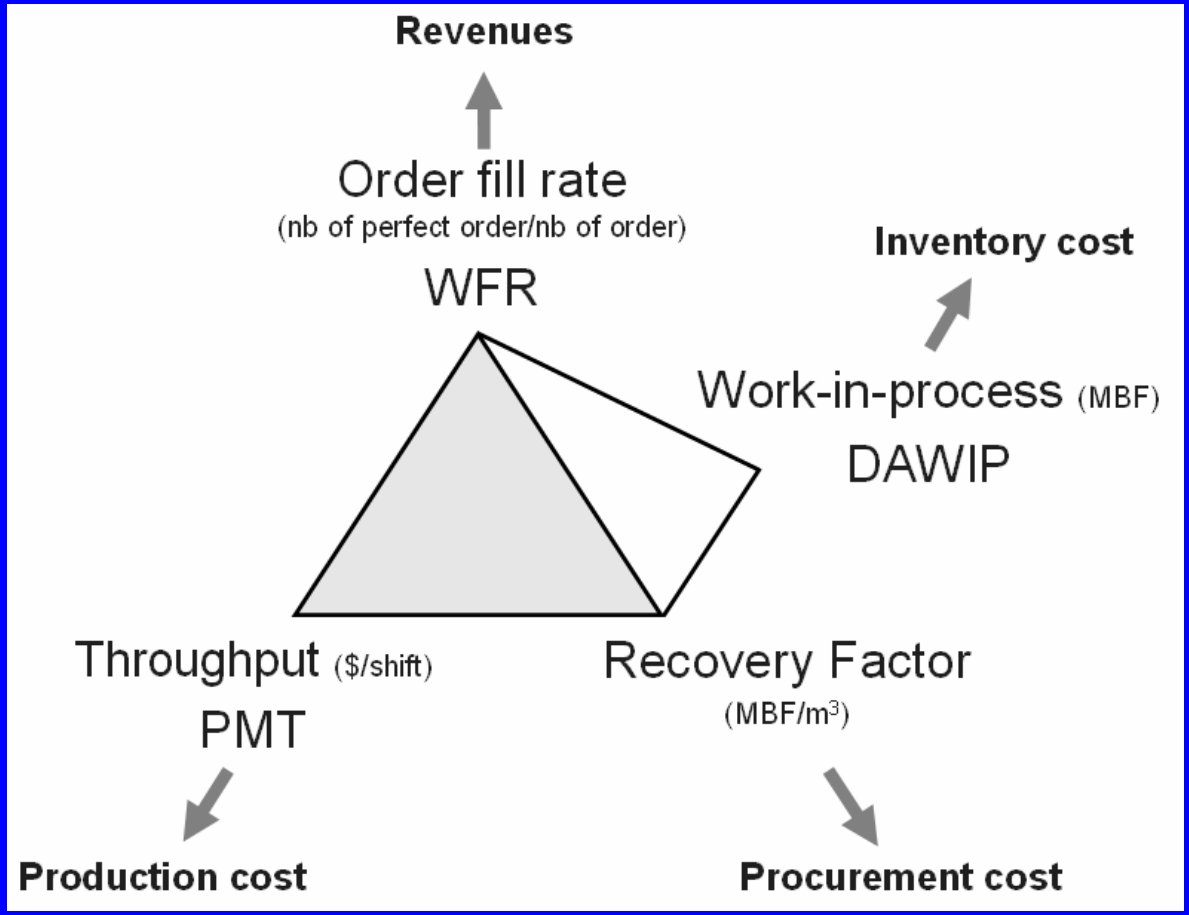


Experiment

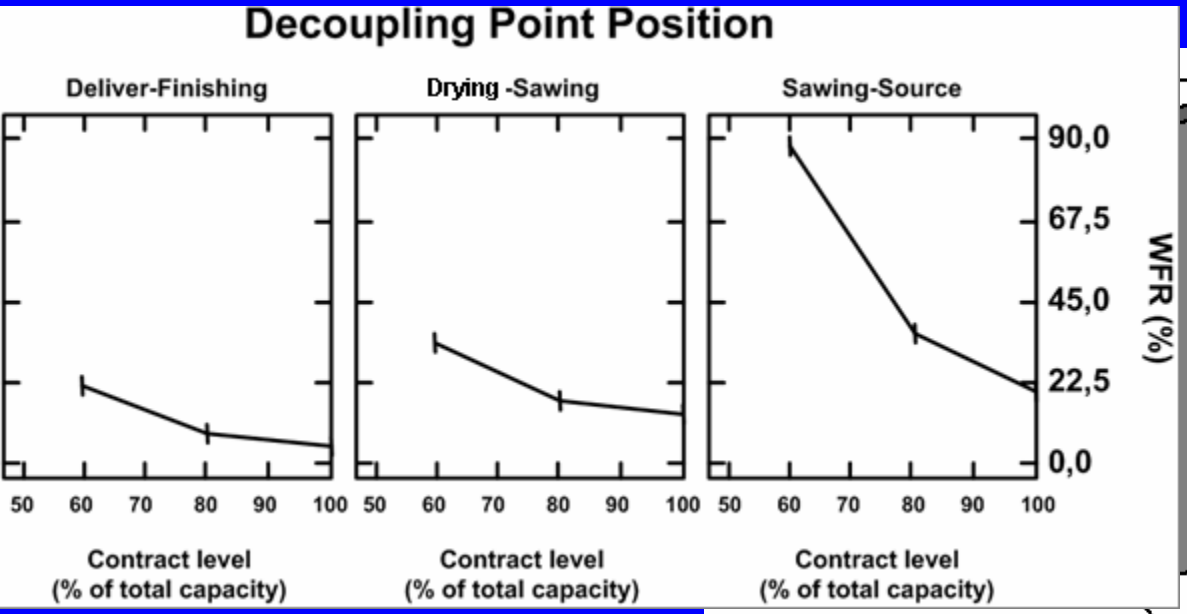
- **Design for deterministic simulation**
  - **Actual sawmill modeled using Optitek ®**
  - **Mixed design (54 runs or production plans)**
    - **2 Controllable Factors**
      - **Decoupling Point Position (3 levels)**
      - **Contracts levels for 2x4 RL 2& Better (60-80-100%)**
    - **2 Noise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

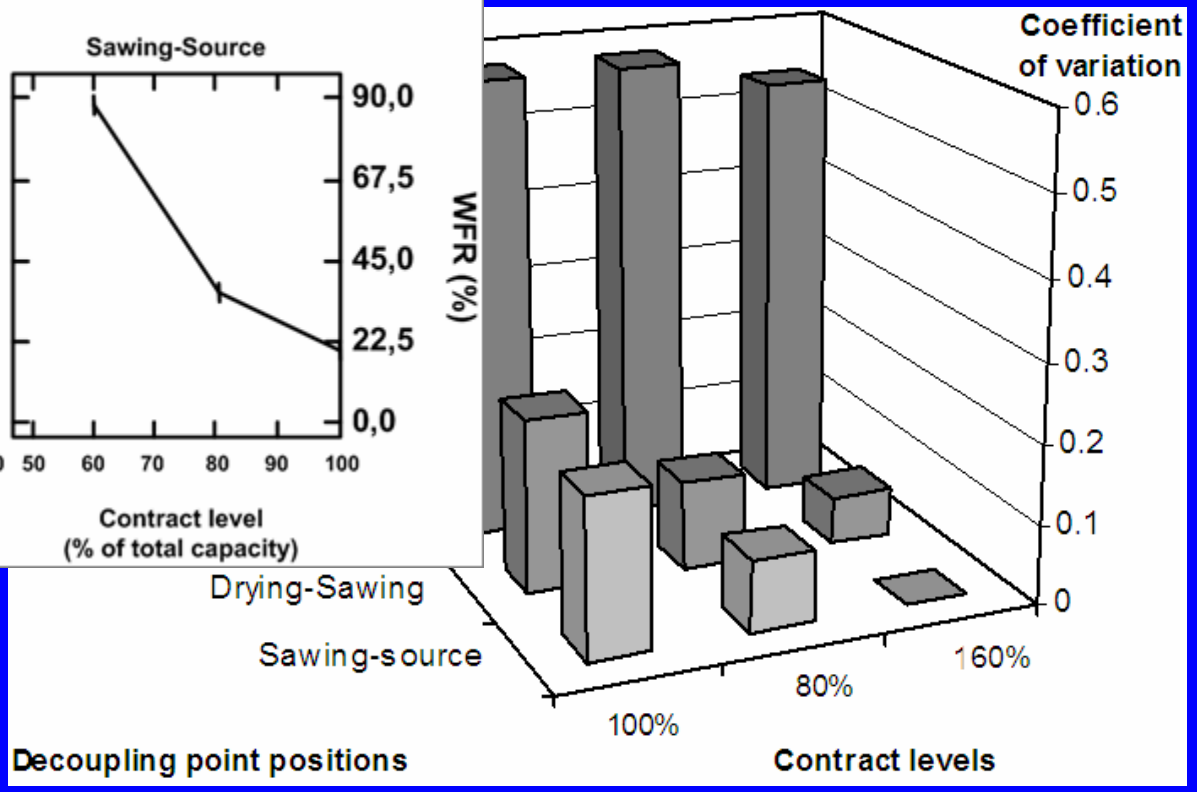
Experiment

- **Performance evaluation**



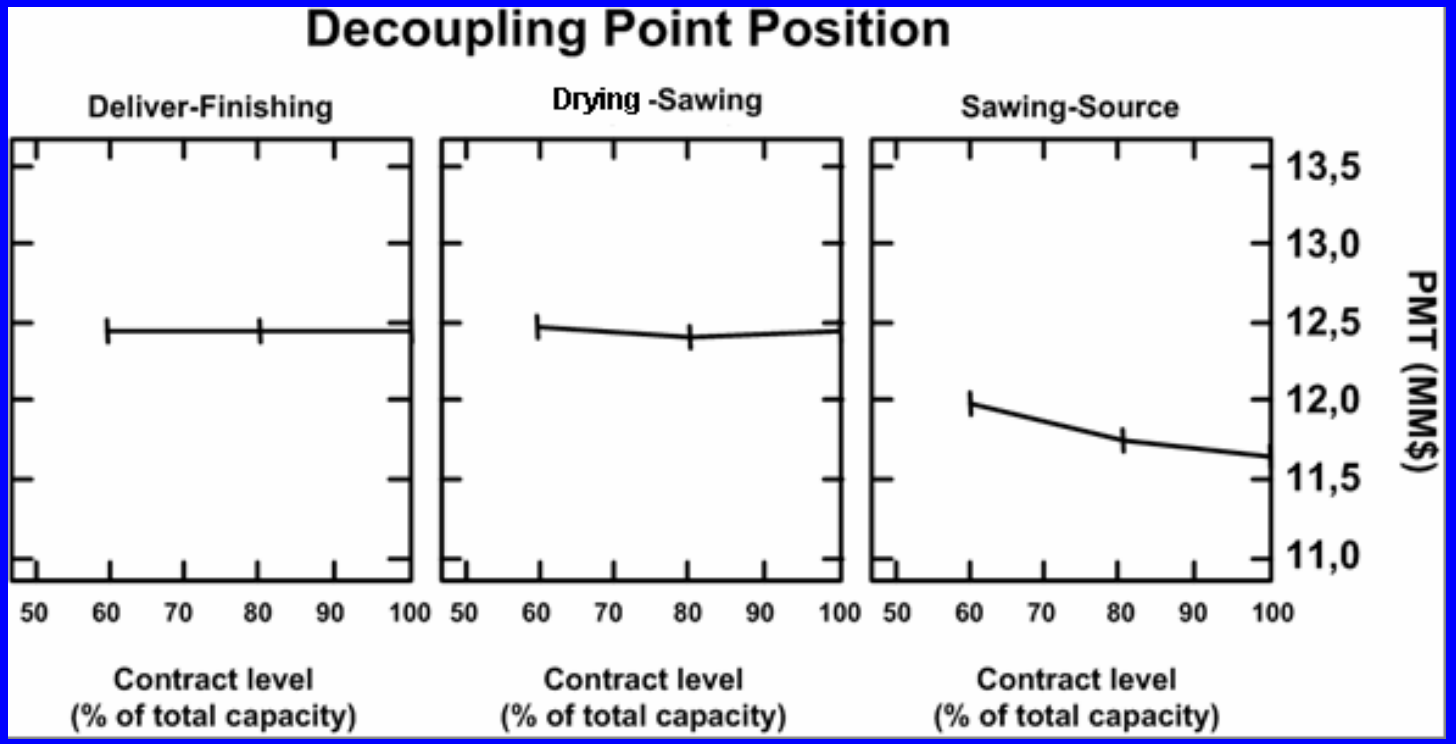
Results





- **Pull strategy respond better to contracts**

Results



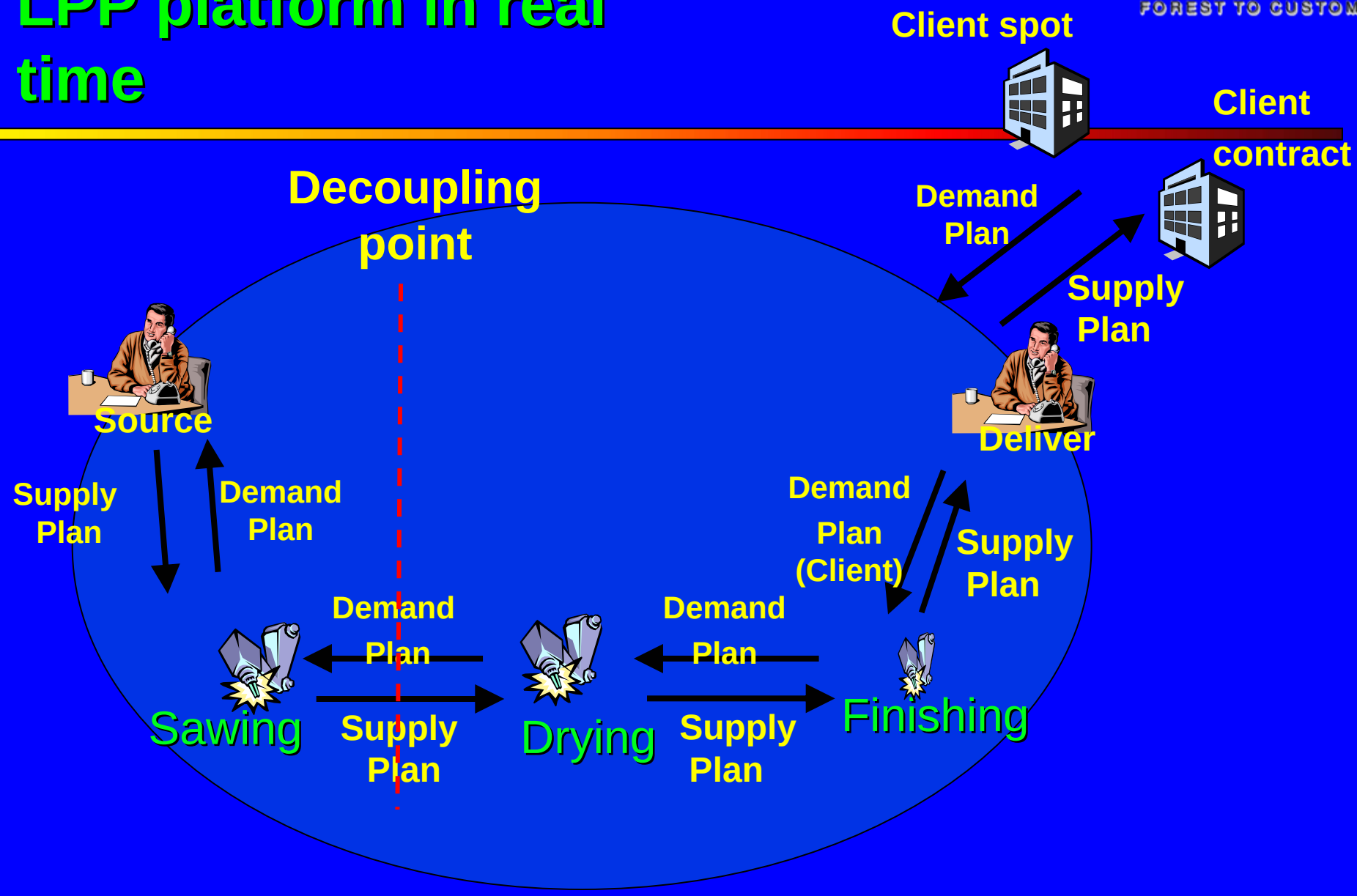
- **Push strategy generates more money (at least potentially)**

Discussion

Contract level	Average Potential monetary Throughput ($)	Loss ($)	Loss (%)	Premium (%)
Pure push strategy				
0%	$ 12 433 143	$0	0%	0%
Pure pull strategy (Configuration C)				
60%	$11 987 220	$ 445 924	3,59%	7,75%
80%	$11 756 677	$ 676 467	5,44%	8,99%
100%	$11 637 634	$ 795 509	6,40%	8,54%

- The sawmill should be “specialized” given its supply and technology and “match” this with the clients it serves

LPP platform in real time



Thanks for your attention

…and congratulations for your endurance.

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