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OUR NAME IS INNOVATION

SM²: Tomorrow's Smart and Agile Manufacturing

Mill Optimization and Automation Forum

Crowne Plaza Montreal Airport

November 28, 2018

By Serge Constantineau, F. Eng, MSc

Partners:

Québec — Ministère des Forêts, de la Faune et des Parcs; Ministère de l'Économie, de la Science et de l'Innovation

Natural Resources Canada / Ressources naturelles Canada — Canada

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- **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

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World economic drivers

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





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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**

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Eastern Canada wood fibre supply evolution

WOOD SUPPLY EVOLUTION
(1970-2015)

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

Increase of variability in log sizes, species, and quality

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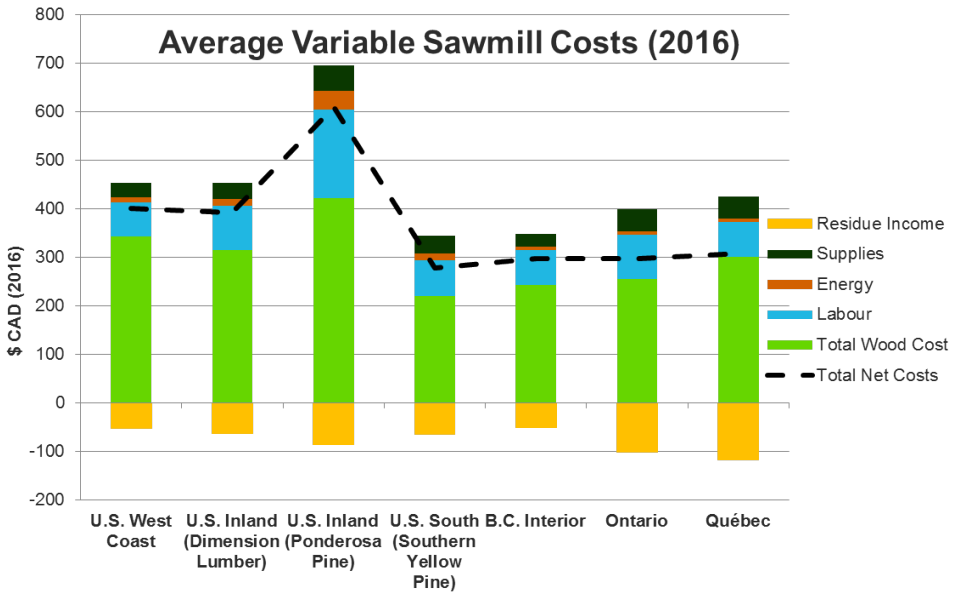
SM² origin: the industry must reinvent itself to improve its competiveness

- **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

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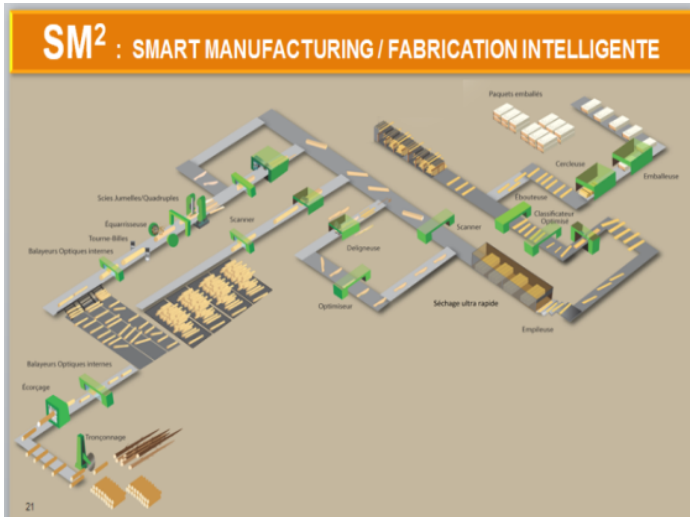
SM^2 mission: in sync with 21st century needs

- 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 21st century** business needs and market demands
  - **Accelerating research to commercialization by facilitating** partnerships between industry, government, and academia.



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SM^2 outcome: a smart and flexible manufacturing toolbox

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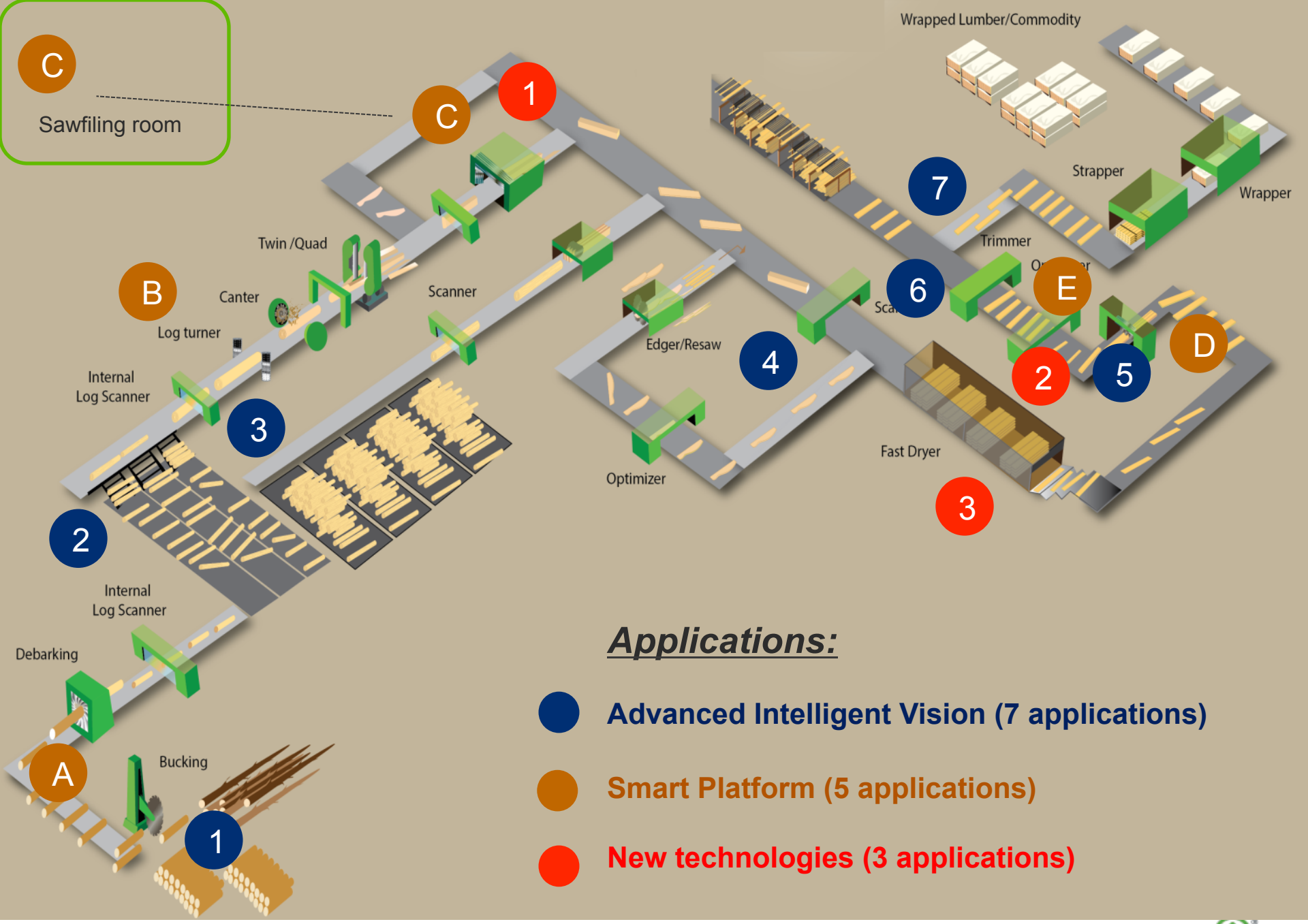

Applications:

- **Advanced Intelligent Vision (7 applications)**
- **Smart Platform (5 applications)**
- **New technologies (3 applications)**

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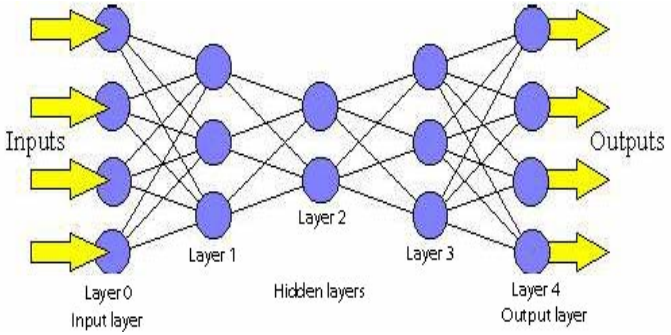
1: LOG/TREE IDENTIFICATION VISION

- **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)

Deep Learning Algorithm



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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

NIR Sensor

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:

Date and species scanned	Number of boards	Prediction accuracy
November 5th - Spruce	7835	97.68 %
November 6th - Fir	17124	95.16 %
November 7th - Spruce	4218	95.33 %
November 7th - Fir	11477	94.21 %
November 8th - Spruce	4174	96.41 %

- Spruce prediction accuracy over 4 days : 96.74 %
- Fir prediction accuracy over 4 days : 94.78 %

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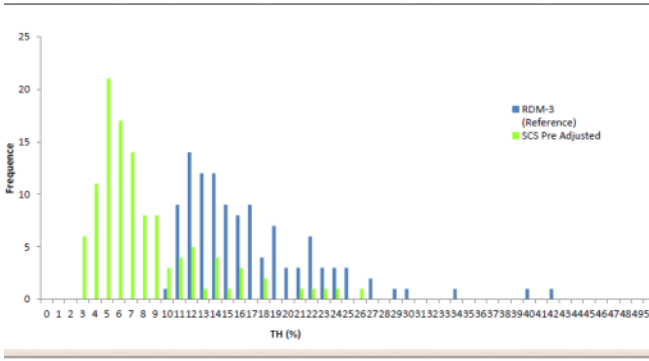
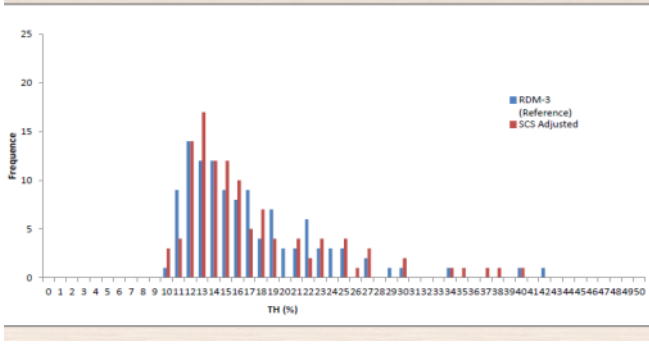
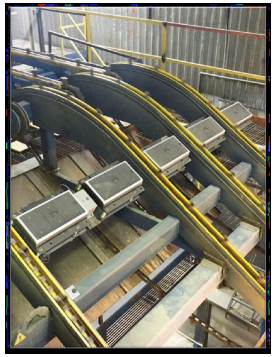
6: ENHANCED LUMBER MOISTURE MEASUREMENT ACCURACY

- **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

Before & after New CF







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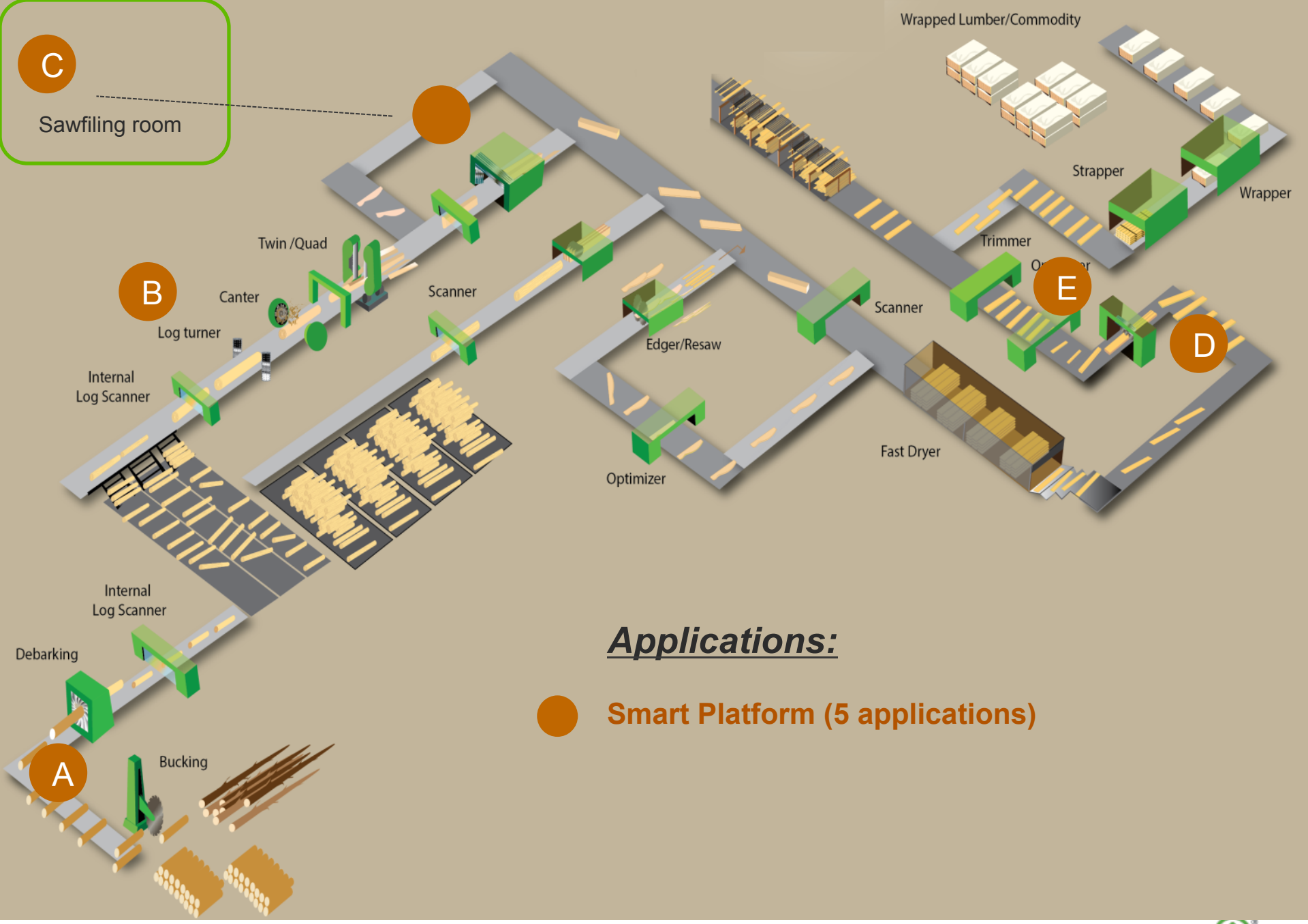

Applications:

- **Smart Platform (5 applications)**

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A: REAL TIME ADAPTIVE CONTROL FOR DEBARKING

Need

- Automatic measurements of log attributes (temperature, moisture content, species)
  - Control in real-time of debarkers operational parameters from infeed information

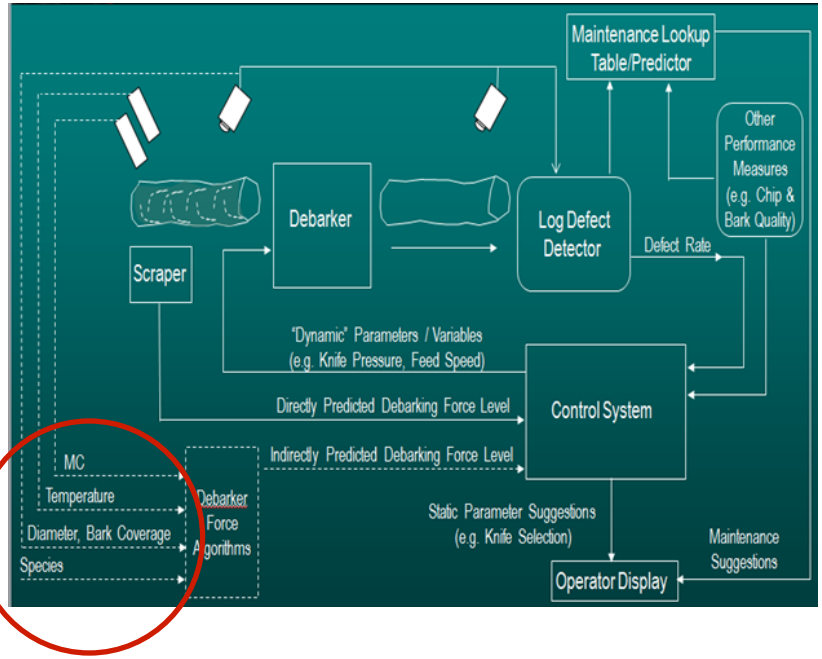
Benefits

- Improve LRF
- Increase speed
- Reduce costs

Partners

- Industrial: Resolute Forest Products
- OEMs: various
- Research: FPInnovations, Université Laval

RT Controller



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B: REAL TIME ADAPTIVE CONTROL FOR LOG TURNING

Need

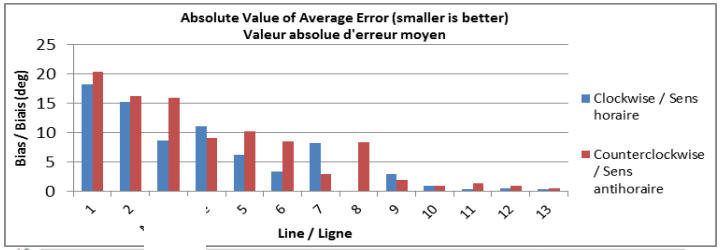
- Create smart log turner with auto diagnostic
- Combine AVS with AI (machine learning, data science…) for RT PC
- First step for future applications on other machine-centres

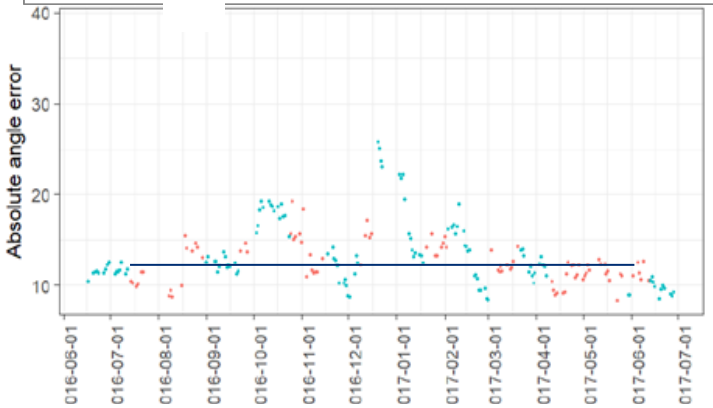
Benefits

- Improve volume and value recovery
- $500K+ annually or $1.75/m^3

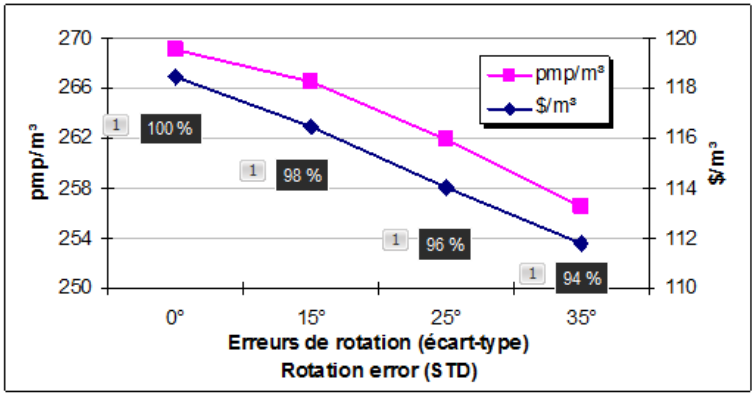
Partners

- 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 m^3

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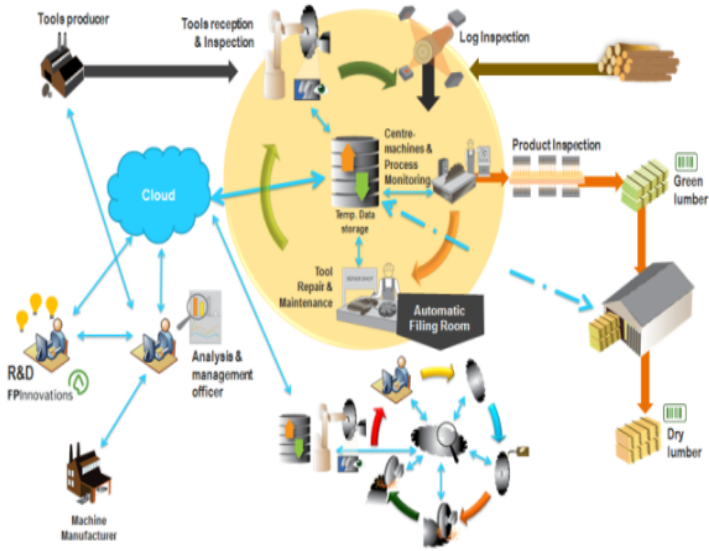
C: AUTOMATED SAW FILING ROOM

Need

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

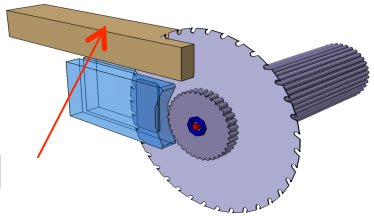


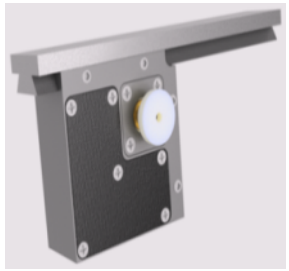
Benefits

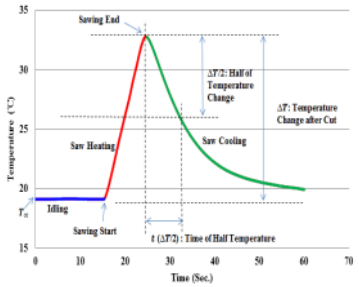
- Reduce sawkerfs (0.075 in.)
- Improve lumber recovery
- Reduce production costs

Partners

- Industrial: Maibec
- OEM: TBD
- Research: FPInnovations, CVRI







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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

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E: “SMART, FLEXIBLE & AGILE” SECONDARY MANUFACTURING

Need

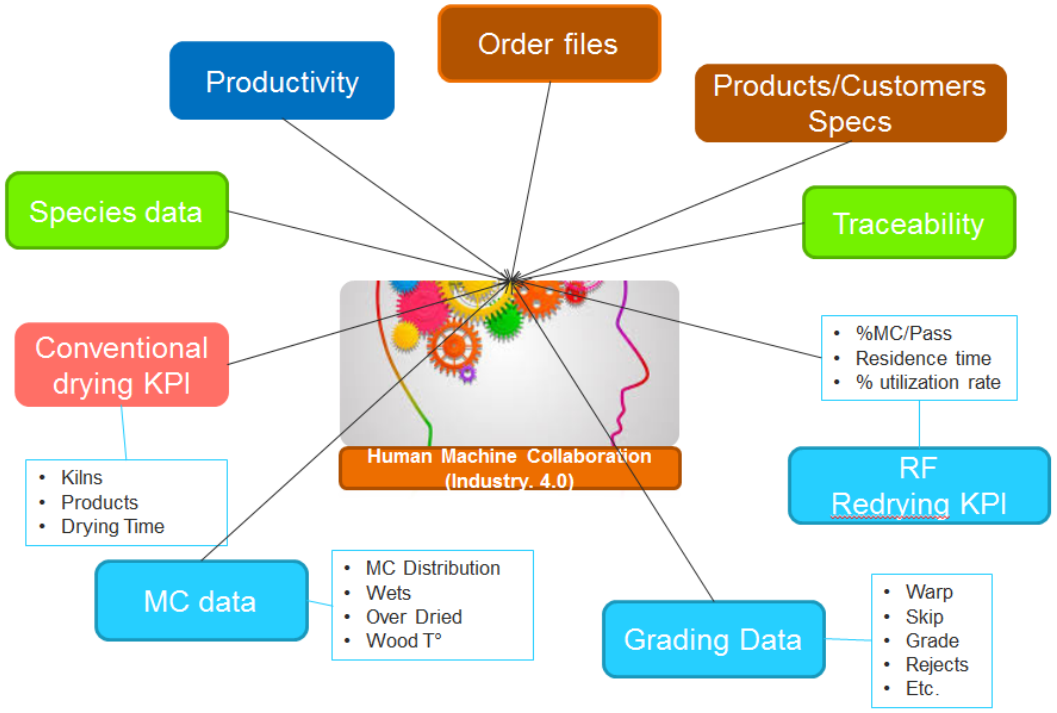
- Improve operational performance combining multi-production lines
- Real-time smart control system to optimize production flow
- Design a framework for an intelligent and smart platform; Industry 4.0

Benefits

- Productivity and grade increase
- Agility and flexibility

Partners

- Industrial: GDS, Maibec
- OEMs: various
- Research: FPInnovations, CRM



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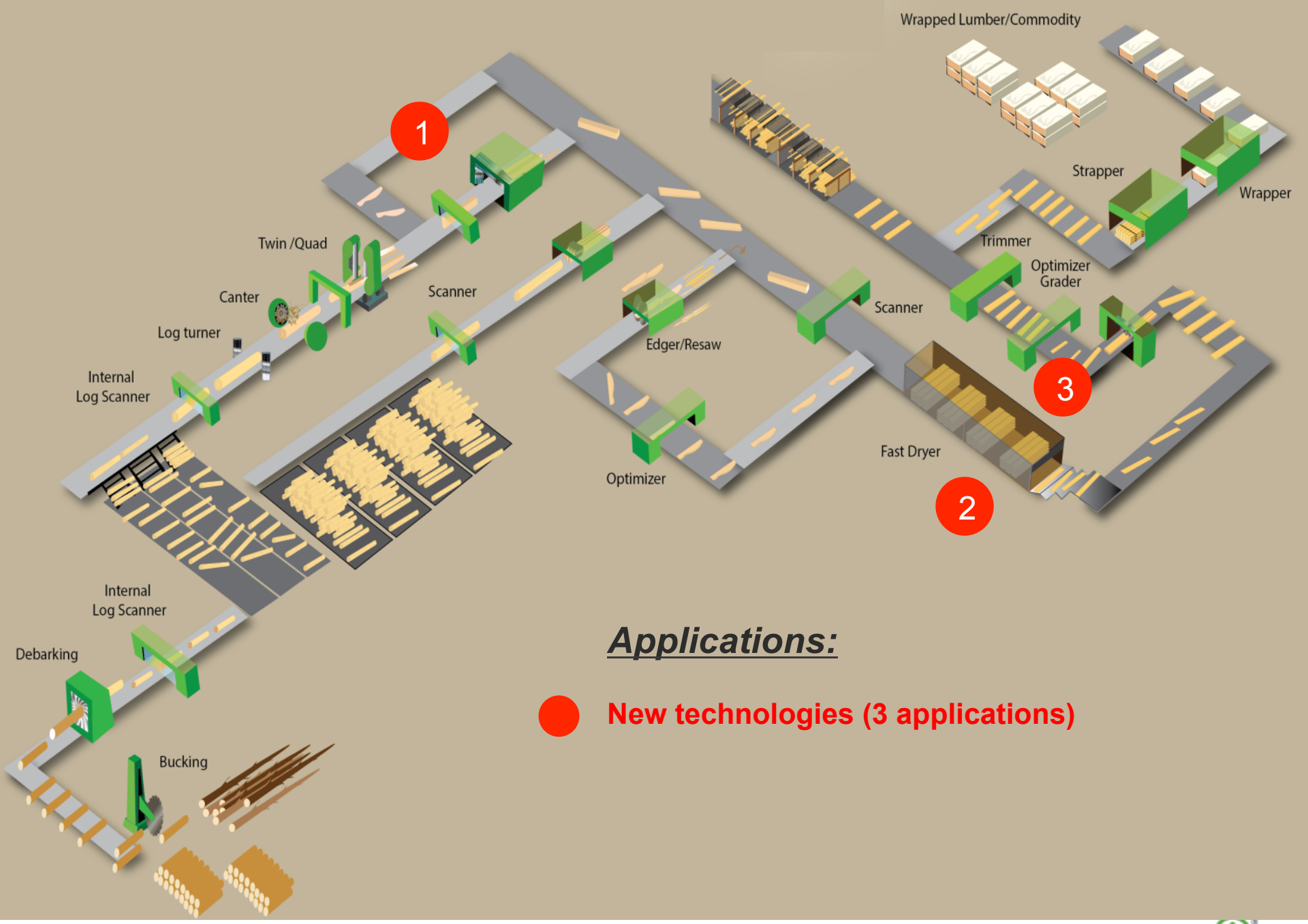

Applications:

- **New technologies (3 applications)**

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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: FPInnovations, Université Laval, CCTT TR

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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

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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

Montée en température planche épinette – *durée et perte de teneur en humidité*

- *Procédé convectif*

Température consigne (°C)	Essence	Durée MT (hres)*	Taux séchage durant MT (%/hre)**	TH moy après MT (%)
140	ÉPB	1,7	66	34
	ÉPN	0,4	20	31
170	ÉPB	0,8	95	56
	ÉPN	0,2	34	32
200	ÉPB	0,5	141	76
	ÉPN	0,2	44	33
280	ÉPB	0,4	197	77
	ÉPN	0,2	64	33

Taux de séchage observé habituellement en procédé conventionnel au-dessus PSF pour aubier d'épinette blanche de l'ordre de 5 à 10 %/hre

** Durée pour atteindre 100°C au centre des pièces (Montée en Température)*
*** Taux de perte de teneur en humidité moyenne pendant la montée en température*

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SM^2 outcome: product and coproduct diversification

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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

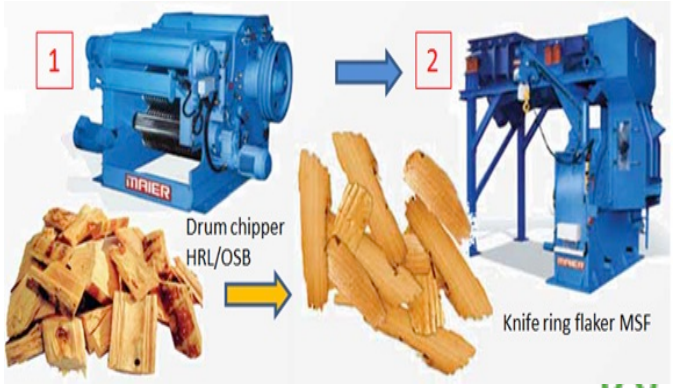
Sawmill intermediate residual materials (SIRMs)

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



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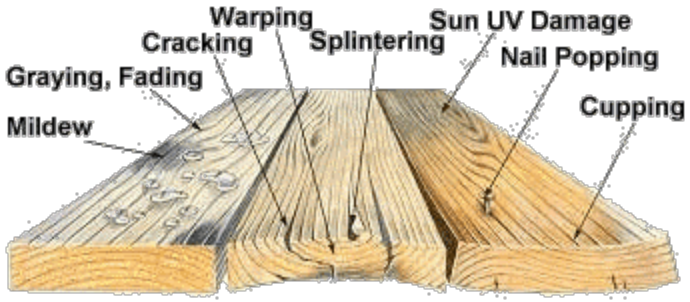
Novel wood impregnability process

- **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.



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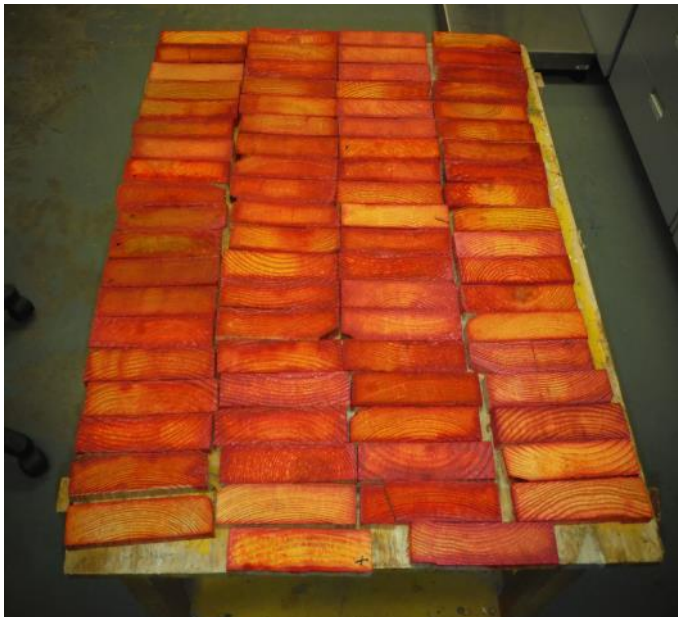
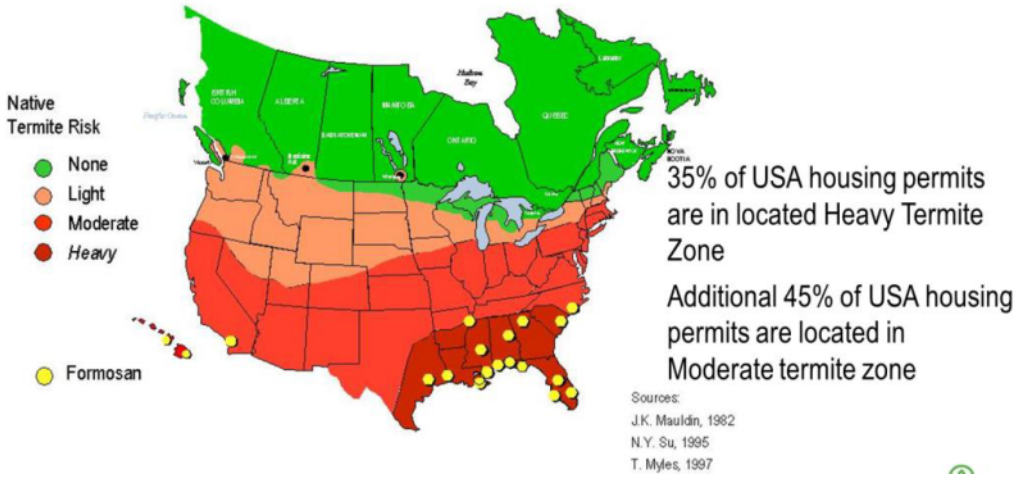
Soluble salt treatment for wood protection

- **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





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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**

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Thank you

For additional information:

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Québec

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