FPInnovations’ industry-driven R&D program in forest operations

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Presentation

- Overview of FPInnovations and program development approach
- Case studies of innovation project development & implementation
  - FPSuite™
  - Road Safety Inspections
- Exciting developments coming from the Forest Operations program
FPInnovations in Brief

Canada’s forest sector research institute
500+ employees
Annual budget: $90 millions CAD
Research across the forest sector value chain
Expertise & innovation programs in
   Forest Resource Assessment
   Forest Operations
   Solid Wood Products
   Pulp, Paper and Bioproducts
100+ patented technologies and processes
FPI - Member Supported Innovation

- A partnership between industry and federal & provincial governments
  - *Pooled investment creates critical mass*
  - *Shared priorities, technical risk and benefit*

- Members/Partners include:
  - *Over 300 forest companies*
  - *10 Provinces*
  - *Federal Government*

- Members set priorities, FPI delivers results
  - *ROI typically 3-7 times after-tax investment for industry member*
FPI Business Model

Members and Customers

Needs ➔ Value ➔ Presentation

Collaborative Research

Business Development

Strategic Research Alliances

Products & Services

Licensing & Ventures

Projects ➔ Deliverables

Research Departments
Managing Product Innovation

- Implemented 5 disciplines of innovations developed by SRI International
- Key elements for high impact research and development
- All projects undergo NABC evaluations

Market Success =

Important customer and market needs x Value creation x Innovation champions x Innovation teams x Organizational alignment
The NABC – cornerstone of projects

Needs
- What issues/needs are we trying to address?
- Who is needs this?

Approach
- Is the approach technically sound?
- Risk & probability of success?

Benefits
- What will be the impact of the project ($)?
- How widely will the results be applicable?

Competition
- Are there alternatives to achieve the same results?
- What is the impact of « not doing »
# Ranking Criteria for projects

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of Success (Risk)</td>
<td></td>
</tr>
<tr>
<td>- Technical Risk</td>
<td>10</td>
</tr>
<tr>
<td>- Fit with skill set &amp; competencies</td>
<td>10</td>
</tr>
<tr>
<td>- Implementation/capital Cost</td>
<td>10</td>
</tr>
<tr>
<td>Potential Reward</td>
<td></td>
</tr>
<tr>
<td>- Potential Benefit</td>
<td>15</td>
</tr>
<tr>
<td>- Potential impact</td>
<td>15</td>
</tr>
<tr>
<td>Resources Required</td>
<td>15</td>
</tr>
<tr>
<td>Urgency</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
Project ranking - Visual Representation

![Project Evaluation Chart]

- **Oyster projects**
- **Pearl projects**
- **Dog projects**
- **Bread & butter projects**

- High urgency
- Medium urgency
- Low urgency
2 Case Studies

FPSuite™

Road Safety Inspections
Case Study No. 1 - FPSuite

The Needs

- Lack of accurate, real-time operational data from forest operations for better process control
- Need to be able to send new work instructions to the job sites
- Poor wood flow tracking systems to facilitate planning and truck scheduling
- No cellular coverage (limited availability in Canada)
FPSuite

The Approach

- Hardware/software development program started in 2009
  - Acquire data on the complete forest supply chain
  - Transmit data automatically to the office
  - Monitor production at different phases
  - Centralize information
  - Facilitate continuous improvement & efficiency gains
FPSuite™

- Data logger for heavy equipment
- High precision GPS specialized for forestry conditions
- GPS navigation and KPI display
- Activities & downtimes tracking
- Basic production tracking

- Automated data download & transfer
- Satellite option
- Cellular option
- Wi-Fi
- Track log exchange between machines

- Web portal and data hosting service
- Tabular, chart & graph reports
- Drill-down capabilities
- Map display of operational progress
- Centralized platform
The Benefits

- Reported 5-10% efficiency gains
- Reductions in lay-out costs
- Elimination of tresspass incidents
- Facilitated planning
- Real-time tracking of operational progress (cut areas)
- Improved truck scheduling
The Competition

- **OEM systems**
  - Specific to brand
  - Mainly cellular-based
  - Variable definitions (PMH)

- **Other commercial systems**
  - Not specialized for forestry
  - Less functionalities
FPSuite™ - Summary

- NABC highly effective to support this project
- Successful innovation with widespread implementation across Canada
- Nearly 500 systems in use, less than 2 years after introduction on the market
- Great feedback & testimonials from users
- Flagship product for FPInnovations
Case Study No. 2 – Road Safety Inspections (RSI)
Road Safety Inspection

The Need

- Increasing collision frequency on resource roads causing serious or fatal injuries because of increased traffic (Forestry + Mining + Oil & Gas)
- Many roads are not designed for a desired travel speed or traffic flow
- Urgent need to assess and increase road safety by reducing accidents and collisions
- A systematic approach to assess road safety and prioritize upgrades and traffic control measures was needed
Road Safety Inspection

The Approach (From R&D to full implementation)

- **2008**
  - Road scanning Pilot Project
  - Sight distance calculation module prototyped in third party software (horizontal and vertical alignment, sight distance, running surface width and pullout locations, signage, etc.)

- **2009-10**
  - Demonstrate the application of georeferenced videography and laser scanning
  - Develop methods for analyzing the data and reporting
  - Sight distance module programed in Trimble Trident Analyst

- **2011-12**
  - Full-scale implementation in actual resource road applications using a fee-for-service approach
Road Safety Inspection

Mobile Mapping System (MMS) Technology

- One or Two laser scanners (LiDAR)
- Multiple or one 360 degree high definition video cameras
- High precision GPS
- Navigation: Inertial Measurement Unit (IMU)
- Distance Measurement Instrument (DMI)
- Data collected at speeds up to 50 km/h
- Live video feed for real time monitoring and calibration
- Frames captured at 5-6m intervals in .AVI or .JPG format
Road Safety Inspection
Road Safety Inspection

The Benefits

• Can scan over 100 km per day
• Prioritization of upgrades
• Inventory of assets (signs, bridges, etc.) and LiDAR for other upgrades
• Represents a due diligence for safety and therefore reduces liability
• Methodology is safe with minimal impact on traffic

Before

After
Road Safety Inspection

The Competition

- Old-fashioned surveys!
- Aerial LiDAR may provide adequate point cloud density at a much lower cost and wider land base cover.
- High resolution video cameras may also offer suitable data at a much lower cost than using LiDAR
Road Safety Inspection - Summary

- Since 2008, FPI has performed over 1100 km of RSIs across Canada
- NABC approach provided strong business case for the project at the time (new technology may make obsolete today)
- Post upgrade assessment and interview with users revealed improved road safety
- Success has led to contract-revenue for RSI services
Key Learnings

- The 2 case studies demonstrated the power of SRI’s NABC approach + collaborative research model
- R&D projects that are driven by actual needs have the best chance at rapid implementation
- FPInnovations’ needs-driven research has shown tangible uptake and value delivery with its members
- Does not preclude some “curiosity-based” research to increase the collective knowledge base of the scientific community and generate unplanned innovation
- Approach led to many innovation projects in FPI portfolio
Exciting developments coming from the Forest Operations program

- Harvesting Operations
- Road construction
- Silvicultural Operations
- Precision forestry
- Transportation
- Forest biomass
Unmanned Aerial Systems (UAS)  
Potential applications

- **Needs**
  - Planning, prescriptions, layout, monitoring and compliance
  - Operational planning and reporting at the block level
  - Niches:
    - Timely, low cost info
    - Autonomy
    - Safety

- **Approach**
  - Validation based on total workflow
  - Identify best applications based on ROI
Unmanned Aerial Systems (UAS)

Potential applications

Visual inspections
• Live image, photos and videos for control and planning

Area based assessments
• Ortho mosaic

3-D point cloud analysis
• Volumetric calculations

Multi / Hyper spectral
• Tree health / species

Hot spot detection (IR)
• Fire mop-up
Mapping Stand Volume and Value: Enhanced Inventory by Log Sort

New Compilation and Cruising (NCCruise) model

Lidar tree heights.

Volume (m3/ha) of Sort x over the entire area.

Inventory and Geostatistics Mapping (IGMap)

Volume (m3/ha) of Sort x at each plot (blue bars).
Tool for assessing forest net worth

- New & simple tool for assessing net value of forest blocks
- Integrates results from FPInterface/Optitek to assess the net values
- Could be used for bidding on timber sales
- Will provides many KPIs to decide to bid (or not)
- Currently in testing mode
The Power of On-Board Computers

- Use harvester OBCs to easily get quality data for:
  - Managing harvested volumes by product
  - Analyzing costs relative to forest conditions
  - Better planning
- Use with FPSuite to manage harvesting systems bottlenecks
What’s next?
The Full supply chain

- Trucking phase: **FPDat Transport**
  - Key features: cycle time, geozones, e-logbooks

- Road maintenance: **FPDat Grader**
  - Blade sensor
  - Grading instructions sent to operator by satellite modem

- Leveraging existing onboard computer files with FPDat
  - FPTrak for centralized monitoring
Performance tracking device for manual operations

- Inspired by health/performance devices to monitor personal progress
- GPS position, heart rate, sound level and time tracking
- Treatment specific algorithm development to produce reports on area covered, productivity, work effort and calorie management
Steep Slopes Initiative (Safety/Productivity)

- Mechanize – get workers off the hillside and into protected cabs
- Stability testing to develop a machine rating system for due diligence
- Winch-Assist equipment to permit operations up to 100% slope
- Grapple systems, small mobile yarders, cameras, gps
Innovative Partial Cutting Applications

- Operator-friendly 123 method
- Multi-treatment in heterogeneous stands
- LiDAR maps to help prescription
- Thinning in Ungulate Winter Range
Improved Environmental Performance of Resource Roads

- Wetland road best practices
  - Develop and monitor road designs for bearing and cross-road drainage
  - Develop national BMP guide (2016)
- Practical operations training
  - Erosion & sediment control
  - Water crossing installations
- Supporting members in maintaining SFI/ SFC certification
Infrastructure Analysis for Increased Payloads

- Advanced pavement modeling for winter weights
- Review of winter weight bridge load ratings.
- Extended haul season in NS, ON, MB, BC with TPCS.
- Infrastructure impact analyses for new truck configuration applications.
New innovations for truck-trailer design

- Innovative use of advanced materials to reduce tare weights:
  - Composite Stakes & Bunks
  - Composite panels for chip trailers
  - Composite panel cab protector

- Lightweight trailer of the future
  - Replace standard frame with monocoque composite materials design: 1.5 t reduction

- Advanced Aerodynamics
  - Use CFD analysis, wind tunnel testing and track test to optimize aerodynamic design of truck and trailer components
Innovative tools and methods to improve feedstock quality

- Biomass drying methodologies
- Moisture meter implementation
- Log yard biomass reclamation
- Hog fuel classification
- Biomass sampling guidelines
Thank you!

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