FPInnovations ARCTIC Forest Inventory Remote Sensing Challenge – Request for Responses from Innovators

Response Due Date: September 2, 2016

Opportunity and Financials: $610,000 for 2 to 5 Challenge "Sprints"

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***Only non-confidential information should be included in the response ***

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FPInnovations

FPInnovations is a not-for-profit world leader that specializes in the creation of scientific solutions in support of the Canadian forest sector's global competitiveness and responds to the priority needs of its industry members and government partners.

FPInnovations *Strategic Action Plan (2015-2020)* was developed with broad consultation of members. The Forest Industry Innovation Framework identified a series of key target areas and methods to achieve success, as depicted in Figure 1.
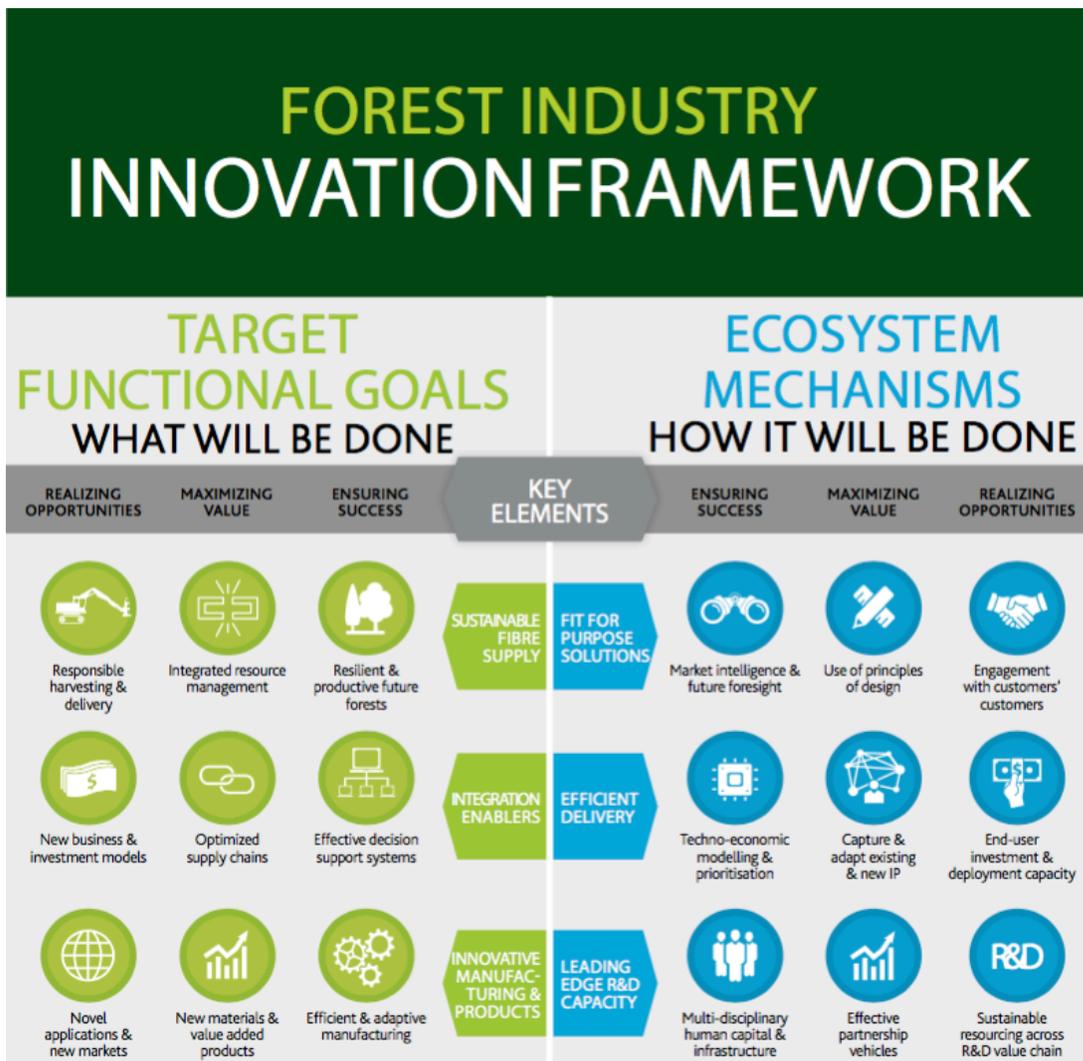

Figure 1: Forest Industry Innovation Framework

Within this framework, FPInnovations seeks to incent innovation and develop new partnerships to address its priorities. As part of this effort, FPInnovations is partnering with Foresight Cleantech Accelerator Centre and its ARCTIC Program to launch this Remote Sensing Challenge Request for Responses.

Foresight ARCTIC

Foresight is a catalyst and connector, providing Canadian and international innovators with access to resources, expertise, talent and partners to mature and implement innovative solutions quickly. Advanced Resource Clean Technology Innovation Centre (ARCTIC) is a Foresight program designed to fulfill the need for a demand-pull approach while identifying both specific environmental, operational and environmental challenges in the resource sector and potential sources of innovation from across Canada, and connecting them to drive performance improvements and accelerate the commercialization of new technologies. The ARCTIC program is funded with support from BCIC and Western Economic Diversification (WD). In this Challenge, the ARCTIC program is working with FPInnovations to search for remote sensing technologies that target a key component of the forest sector's competitiveness– forest inventories.

Challenge Overview

FPInnovations' Strategy has established targets for forest inventory remote sensing costs. Traditionally in British Columbia (BC), forest inventory information is collected infrequently, through photo interpretation and ground-based surveys. It tends to present accuracy and timing challenges for operational planning and it is unsuitable for timber inventory (block or stand and landscape levels). By contrast, timber inventory at the block level (i.e., timber cruising) is conducted based on more intensely field sampling and typically does not include remotely sensed information. It's main objective is to provide detailed information on the distribution of wood volume in the block by species, quality and dimension (usually summarized in the log grades). Remotely sensed timber inventory information for operational or tactical purposes, provides an opportunity to transform current practices and later adapt and extend them elsewhere in Canada.

Today, ground-based survey for timber appraisal and for forest inventory costs range between $25-100 per ha, depending on access and on the type of data acquired.

FPInnovations members are seeking to identify and commercialize innovations that can dramatically reduce the costs associated with this process, while maintaining or improving accuracy. This challenge is designed to provide improvements to the **Timber Inventory**.

It is assumed that
1. Solutions will involve a combination of tools, technologies and innovations and that resulting data products that support timber inventory in this Challenge process will have multiple applications and end users; and
2. Designs addressing this challenge in coastal forest environments can be more easily adapted for inland applications.

Target Outcomes and Benefits from this Challenge

This Challenge is seeking innovation in applying remote sensing technology to achieve one or more of the following four goals:
1. Reduction in timber inventory costs and associated benefits whilst meeting government requirements
2. Reduction in the cost of and improvement in the quality data for landscape level planning,
3. Improvements to the design, calibration and verification of models for timber inventory.
4. Increase in effectiveness through high certainty species identification with remote sensing technologies.

The Challenge

FPInnovations is seeking innovations that would result in the following performance improvements:

1) **Data Acquisition Cost Reduction –**
   a) The improved accuracy of remote sensing solutions fully realized would be worth a targeted industry savings of an estimated $100m annually in British Columbia;
   b) In the near term, the reduction targeted in this challenge is a 60% in cruising costs;
   c) Be inspired by British Columbia Cruising manual quality indicators but not be constrained by human-centered methods for timber inventory management;
2) **Data Analysis Improvements –**
   a) Provide foresters with the ability to roll up block/stand level data to the landscape level to improve tactical landscape planning;
   b) Data products created as an outcome of the approach should include but not necessarily be limited to the following parameters:

Most important factors / parameters:	Secondary factors / parameters:
•Diameter Distribution •Net Volume (m3) •Species •Species volume •Log grade	•Tree count •Height •Taper •Health

3) **Secondary Benefits –**
   a) FPInnovations is interested in solutions that will have benefits that are secondary to the primary technology focus of this Challenge. These secondary benefits include positive contributions in the areas of:
      i)   (above-ground) carbon sequestration,
      ii) water management,
      iii) wildfire management,
      iv) better fibre utilization in the forest sector, and/or
      v) the ability to use the data for biodiversity and cumulative effects assessments.

4) **Specific Deliverables expected from the successful innovator will include:**
   a) A dataset (shapefile, etc.) of timber attributes addressing the stand and tree attributes/metrics usually included in a cruise compilation report (http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/docs/timber-pricing/timber-cruising/practical_guide_to_timber_measurement_process.pdf or as Appendix 2)
      i)   Incomplete solutions are welcome;
      ii) Resolution of the data set is not pre-defined, but the data set must be aggregable to a higher level (e.g. block or landscape level)
   b) A tool or visualization application for data interpretation, management and aggregation (ArcGIS toolbox for example)
   c) A summary report of the validation procedures and results
   d) Demonstration of scale-up or aggregation of block level into landscape summaries.

5) **Differences between the tasks for the Challenge Sprint and the Field Trial**
   a) At the Challenge Sprint Phase, the deliverables will be produced with support from a common base LiDAR data set on lands that have been timber cruised already to enable comparability. Applicants will also be provided with a LiDAR-derived Digital Elevation Model (DEM) with specifications for a prescribed test landscape environment during the Sprint Phase.

b) Though the Sprint is scheduled to commence early October, a coastal test area with low-likelihood of snow cover through the winter will be selected to enable additional data acquisition by proponents.

c) In the Field Trial, the aforementioned deliverables will be expected on a larger area of land with the data acquisition costs needing to be included in the costs of the field trial. The evaluation areas will include coastal and inland areas.

Additional information:

1. A sample of a current block summary report is included in Appendix 2.
2. FPInnovations is open to solutions broader than LiDAR remote sensing and would include interest in other technologies and techniques to enhance information and reduce the frequency and costs of refreshing LiDAR data (e.g., ground-based, Unmanned Aerial Systems (UAS), satellite-based, or other activities).
3. Some of the financial benchmarks used in the forestry industry are shared here as a guide for addressing the payback for proposed solutions:
    a. The assumed cost of capital is 12% (the pre-low interest rate period historical average).
    b. The target for Return on Capital Employed (ROCE) is assumed at 12% for a going concern business with regular business risk. If you add in technology risk (scale up, new tech, etc.) or new market risk (new products) you would target a higher rate of return (closer to 30%).
    c. For project based finance you would target a 20-24% return in the current environment.
    d. For a Venture Capital (VC) investment you would be looking closer to 30-50% return - assume 30%.
4. Consortium proposals are permitted, and we reserve the right to recommend consortium opportunities where applicants are open to potential partnerships.

Evaluation of Proposals

The evaluation criteria used for selecting innovators for Phase 3 (Challenge Sprint) of this Challenge are:

‣ **Performance (30%)**
    ‣ Parameters / attributes (refer to list above in terms of diameter, volume, species, quality) – should be tested against cruise summary outputs
    ‣ Precision / data quality / frequency

- Secondary benefits (Water, greenhouse gas emissions, fire management, value-add to other industries, etc.)
- **Payback (20%)**
  - Cost per M^3 (both cost for participation in the Challenge program and the longer term adoption / end cost for the solution and overall impact on industry) – must be tested for acceptability with forest industry users
- **Readiness (30%)**
  - Demonstration, proof-of-concept, experience, sector fit
  - Delivery time / product readiness
  - Technology Readiness Level (TRL)
  - Landscape scalability
- **Execution (10%)**
  - Ease of application and adoption by industry
  - Capital required by industry to adopt the solution
  - Data management approach
- **Proponent (10%)**
  - Proponent experience, projects, clients, understanding of the challenge

Phase 4 (Field Trial) evaluation criteria will include these same factors again, with a greater emphasis on the scalability of the technology solution, the business case and proponent.

Opportunity and Financials

The ARCTIC Program

ARCTIC is designed to model a new approach for industry and innovator collaboration. There are four critical phases of activity designed to produce relevant field trials that will validate solutions to resource sector-defined challenges.

Phase 1: Challenge Definition (3 months) - Completed

In conjunction with resource sector partners/ARCTIC participants, Foresight will define challenges in order to focus innovators on the most promising market opportunities.

Outcomes:

- Resource sector consultation events delivered in conjunction with communications or industry partners.
- Definition of resource sector challenges to focus innovators.
- Development of a broad community of industry and cleantech innovators.

Phase 2: Innovator Selection

Foresight and FPInnovations are launching this Timber Inventory Remote Sensing Challenge and inviting potential solution providers to respond by filling out the attached Response Template (Appendix 1). A panel of industry, investors, and selected experts will select 2 to 5 solutions from the pool of innovators that responded to the Challenge for a six to nine month development Sprint.

Phase 3: Challenge Sprint (6 months)

This Challenge Sprint will be sponsored by resource sector industry partners and will leverage the Foresight Accelerator and its mentorship program to:

- Further advance the development of the proposed solutions through activities that advance the solution – such as developing a prototype or performing a feasibility study of the technology. Latter stage technologies are preferred, but earlier stage will be considered given sufficient operating data; (and)/or
- Further advance the development of proposed solutions through testing in a laboratory or other environment. Latter stage technologies are preferred, but earlier stage will be considered given sufficient operating data
- Move the companies to a point where they can seek first funding
- Deliver a focused stream of companies to operate within Foresight/ARCTIC's facilities. The ARCTIC program has access to specialized facilities in Alberta, BC and Saskatchewan that can respond to the needs of the selected innovators and solutions, if required. Alternatively, selected solution providers can use their own facilities for the Sprint.

Expected Outcomes:

- 2 to 5 promising solutions identified and evaluated.
- 1 technology/solution selected for field trial.
- 1 industry showcase event delivered with a marketing partner.

Phase 4: Field Trial Preparation (12 months)

Following the Challenge Sprint, one solution could be selected for field-testing, or for the next appropriate level of development.

The field trial phase will focus on getting the technology field trial-ready, including equipment specification requirements. Foresight will co-ordinate with the industrial partner(s) existing stage-gating process to determine the test parameters the technology must meet to achieve field trial readiness. The process will include

quarterly progress reviews with the industry partner to ensure the development remains on track.

The Size of the Opportunity (for Innovators)

The total funding available for projects supported through this call for proposals is up to **$610,000** Canadian Dollars (CAD), subject to the discretion of Foresight Cleantech Accelerator Centre/ARCTIC and FPINNOVATIONS, and the availability of funds.

The range of funding available per Challenge Sprint project is **$87,000 to $305,000**, with a requirement for proponents to commit a minimum of **$50,000** per project as an in kind contribution. The per project costs can go up or down based on the final number of projects in the sprint. The maximum contribution includes provision for lab space and overheads, marketing, a lab manager, equipment, materials, accelerator mentoring and cash.

The winner(s) of the Challenge Sprint will be invited to undertake the next step in the development of the innovation/field trial (or equivalent). This phase will have a maximum contribution from ARCTIC and FPInnovations at **$175,000**, with a requirement for proponents to commit **$100,000** as an in kind contribution. The maximum contribution from ARCTIC and FPInnovations to this phase includes support for a test site, test support, equipment, materials and cash.

Market Applications

Over 60% of the industry costs for forest inventory referenced in this Challenge Statement relate to timber cruise practices. However, the addressable market opportunity for the techniques and technologies applied here can be used to other parts of forestry operations, such as road design, habitat monitoring, and the other secondary benefits mentioned earlier. The forestry industry will be interested in adoption for both natural forest management and plantation operations. This makes this challenge one shared by operations across Canada, and any plantation forest in the United States, Chile, Brazil, New Zealand and Australia. There is also high relevance for this solution in wildfire management and parks and recreation.

SME Resources

In kind resources, such as time for a technical person, as well as potentially senior management, are a necessary contribution to participation in ARCTIC.

Schedule

The following table outlines the anticipated timeline for the Innovator Selection phase. Please refer to the ARCTIC website for updated information.

Table 1 – Innovator Selection Schedule

Action	By Whom	Dates
Innovation partners (e.g. SDTC etc.) program briefing webinar	ARCTIC	July X?, 2016
Potential applicants/innovators program briefing webinar	ARCTIC	July 26, 2016
Proposal Submitted	Proponents	September 2, 2016
Shortlisted proponents contacted for presentations	ARCTIC Review Team	October 3, 2016
Final Sprint Decisions and Start Sprint (prototype or test, or equivalent)	Proponents and ARCTIC/FPInnovations	October 17, 2016
Wrap up Sprint, choose Field trial winner	Proponents and ARCTIC/ FPInnovations	May 19, 2017

Leveraging Other Opportunities

The ARCTIC program and FPInnovations do not have restrictions on leveraging other sources of external funding, provided this works with the timelines of the Challenge Sprint. Other financing opportunities could include Export Development Canada, Sustainable Development Technology Canada, or others. The ARCTIC program evaluation process could be leveraged to support accessing other investment[1].

ARCTIC/FPInnovations Non-Financial Support

FPInnovations technical experts will be involved in the evaluation process and will be available to the Sprint winners for technical support. Foresight will also provide access to executives in residence on business and commercial support, and exposure to financing experts.

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[1] Western Economic Development, a funder of the ARCTIC program, might have conditions with regards to other federal funding applied to this program. It is the responsibility of the applicant to understand and abide by those restrictions.

Appendix 1: Response Template

ONLY NON-CONFIDENTIAL INFORMATION SHOULD BE INCLUDED IN THIS RESPONSE

This response template has two main sections: one that focuses on your technology and the other on your business.

1. Candidate Info

Name:	
Company:	
Address 1:	
City/Town:	
Province:	
Postal Code:	
Email Address:	
Phone Number:	

2. Solution and Technology Requirements:

2.1. Overview of solution including where applicable the tool(s), technology(ies) and innovations to processes, practices or technologies involved.

2.2. If proposing only a component of an entire solution, indicate remaining requirements in order to fully address the challenge

2.3. Information on capital and operating costs and all associated assumptions. The program has assumed financial constraints as outlined on page 6 above.

2.4. Clear articulation of benefits as they relate to the target outcomes and benefits for this Challenge, listed on page 4 and secondary benefits listed on page 5, as well as any other potential benefits.

2.5. Technology Readiness Levels 4 through 7 are of interest in this Challenge. Technology Readiness Level, and next steps required to advance the solution and/or technology to the subsequent level

2.6. Potential challenges to implementation at commercial scale

2.7. Process, site, infrastructure and analysis considerations – including data acquisition, data processing, integration challenges, scalability, training etc.

2.8. Any information on independent technical reviews

2.9. IP status

2.10. Experience of management team

2.11. Key performance indicators:

2.11.1. Lower cost of operations in $ value

2.11.2. Total Cost of Ownership (TCO) $ value

Business Description

Please answer the following questions, for your business in general, as applicable:

3. Technology Offering (if there are non-technical aspects of your technology offering not covered in the above technical questions that you would like to share)

4. Technology is... (Check all that apply)
   o Strategic
   o Scalable
   o Ability to create jobs
   o Generate revenue through sales
   o Attract investment
   o Benefit society
   o Make a profit

5. Market Description: (who is your target market, how big is it, etc.)

6. Do you have current customers?
   o Yes, paying
   o Yes, no revenue
   o Commitments to purchase
   o None

7. Will your business create new jobs?
   o Unknown
   o Low Paying
   o High Paying

8. Business Model Description: (pricing strategy, sales strategy, etc.)

9. Is your business incorporated?
   o Yes - Incorporation Date:
   o No

10. List 2 or 3 specific technical and business goals for the next 12 months:

11. Current annual revenue

12. Has your company received IRAP funding?
   o   Yes
   o   No

13. How much money is invested in your company currently?

14. Who has invested in your company?

Appendix 2: Sample Block Summary Briefing

See next page

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*** FOR MPS PURPOSES ***                          Block Summary        10-Feb-2010  02:01:26PM
Average Line Method              Grades: Cruiser Called Alpha  FIZ: A           Filename: uchd003(2008).ccp
                                 Cruiser Est Decay             PSYU: Kingcome    Compiled by: Ministry of Forests
Licence Number: A84765  CP: PLM  Cruiser Est Waste            Region: 1 - Coastal  Cruised by: MECREDY CRUISI
Project:                         CGNF Breakage Table           District: 6 - N. Island-C. Coast  Version: 2009.00
```

Net Area: Block : (M) - 003:, Plots in Block: 19, TUs: [A : 17.2]

		Total	Conifer	C	H	B	CY	PL
Utilization Limits								
Min DBH cm (M)				17.5	17.5	17.5	17.5	17.5
Stump Ht cm (M)				30.0	30.0	30.0	30.0	30.0
Top Dia cm (M)				15.0	15.0	15.0	15.0	15.0
Log Len m				13.0	13.0	13.0	13.0	13.0
Volume and Size Data								
Gross Merchantable	m3	18779	18779	10968	3880	1079	2187	666
Net Merchantable	m3	15457	15457	9071	3158	898	1724	607
Net Merch - All	m3/ha	899	899	527	184	52	100	35
Distribution	%	100	100	59	20	6	11	4
Decay	%	10	10	10	9	11	14	5
Waste	%	1	1	0	4		0	1
Waste(billing)	%	1	1	1	5		1	2
Breakage	%	6	6	7	6	6	7	2
Total Cull (DWB)	%	18	18	17	19	17	21	9
Stems/Ha (Live & DP)		624.1	624.1	215.0	239.0	61.3	77.3	31.4
Avg DBH (Live & DP)	cm	50.2	50.2	67.8	34.7	36.0	45.9	41.3
Snags/Ha		0.9	0.9		0.9			
Avg Snag DBH	cm	120.0	120.0		120.0			
Gross Merch Vol/Tree	m3	1.75	1.75	2.97	0.94	1.02	1.64	1.23
Net Merch Vol/Tree	m3	1.44	1.44	2.45	0.77	0.85	1.30	1.12
Avg Weight Total Ht	m	31.8	31.8	32.8	34.0	27.7	27.0	25.1
Avg Weight Merch Ht	m	26.4	26.4	27.6	28.1	21.5	21.9	18.9
Avg 13.0 m Log Net	m3	1.06	1.06	1.69	0.64	0.58	0.88	0.74
Avg 13.0 m Log Gross	m3	1.19	1.19	1.89	0.73	0.65	1.03	0.80
Avg # of 13.0 m Logs/Tree		1.46	1.46	1.57	1.29	1.57	1.60	1.55
Net Immature	%							
Average Slope	%	49						
Cruiser Call Variable Length Grades %								
#2 Lum/#1 Lum	F	1	1		3			
#2 Sawlog	H	20	20	23	22		22	
#3 Sawlog	I	9	9	9	11		10	
#4 Sawlog	J	21	21	12	21	78	21	64
#2 Shingle	K	2	2	4				
#3 Shingle	L	1	1	1				
#4 Shingle	M	12	12	20				
#5 Utility	U	19	19	16	27	19	24	16
#6 Utility	X	2	2	2	1	3	2	20
#7 Chipper	Y	13	13	13	15		21	
Statistical Summary								
Coeff. of Variation	%	50.1	50.1	49.8	142.8	180.8	141.2	371.4
Two Standard Error	%	24.5	24.5	24.3	69.8	88.4	69.0	181.6
Number and Type of Plots		MP = 19						
Number of Potential Trees		121						
Plots/Ha		1.1						
Cruised Trees/Plot		5.8						
Slope % Statistics								

Min= 25,   Max= 74,   CV=32.0,   Std Error of Mean=3.5,   2SE%=15.4

*** 1 tree(s) changed to tree class 4:because only log was less then 3.00 m ***
FLAGS: Full Volumes, Normal Cruise, All Trees Compiled, Measure Plots Only, Damage,

CruiseComp Copyright© 1996-2009, Timberline Natural Resource Group Ltd.