Background

The demand for biomass is expected to increase in the coming years, and forest sector decision makers are faced with critical uncertainties regarding wood supply policies, allocation guarantees, and emerging biomass processing technology – especially in the context of corporate transformation. More specifically, corporations that are currently operating mills (i.e. forestry, pulp & paper) must make biomass-related decisions in the relatively short term which will allow for transformation of their company. These corporations must secure and manifest their competitive advantage related to access to fibre resources and harvesting/logistics know-how, in order to increase the potential for successful transformation to the bio-economy in the longer-term. At the same time, some may argue that existing corporations should be hesitant to depart from their historical business model for various reasons: significant capital investment, know-how, labor issues, etc. – and biomass strategy must also address this possible outcome with their biomass strategy.

A systematic analysis and examination of potential redesign of the biomass supply chain will be carried out in this project, considering biomass handling and conversion facilities at the scale of a large forest corporation. It will be critical to work directly with an existing company to obtain real data and specific business information related to transformation decisions. The forestry company Kruger has agreed to participate in this project, and in particular at their Corner Brook pulp and paper mill in Newfoundland.

In the project, we will seek to identify potential changes within the current value chain for optimization of operational level activities such as harvesting and transportation of biomass of different qualities. Additionally new feedstocks will be identified and included in the redesigned supply chain to increase raw material availability. All potential feedstocks (sugars, starches, lignocellulosic and waste materials) will be considered, to determine the best feedstock procurement strategies according to product/process needs that will result in reduced delivered biomass costs, such that different biorefinery strategies are more likely to be economically viable.
Objectives
The overall objective of this project is to develop a systematic methodology to establish future biomass procurement strategies for transformation to the biorefinery, considering the current procurement supply chain.

Specific issues to be addressed include the following:

- To evaluate innovative biomass harvesting and procurement technologies and logistic strategies that can potentially lower procurement costs, and thereby secure feedstock availability for the long-term.
- To calculate the procurement conditions under which biomass procurement strategies result in significantly reduced costs such that the biorefinery strategy becomes economically viable and allows for securement of biomass supply in a competitive market.
- To illustrate the methodology in a case study where pathways to transform its pulp & paper operations into a biorefinery will be addressed for the Kruger pulp and paper mill in Newfoundland.
- To examine the extent to which flexibility in the use of multiple feedstocks for production of biorefinery commodity products allows for procurement of biomass with reduced costs.
- To calculate the comparative costs for lower amounts of biomass to be used for the production of value-added biorefinery products, and illustrate the extent to which procurement of lower biomass quantities of the appropriate quality can potentially reduce feedstock costs and secure supply.

Proposed Approach
Using the case study context of the integrated forestry company Kruger, this project along with a second project led by Luc LeBel seek to examine biomass procurement practices for the cases where (a) they are optimized for the core traditional business areas including state-of-the-art harvesting and transport techniques, and (b) other biomass procurement strategies which consider the case where the company transforms to the forest biorefinery. There are several essential questions that this body of work should address such as (a) how Kruger should modify its harvesting practices and equipment/suppliers mix in the coming years, (b) under each of the two scenarios (traditional business, biorefinery business), whether Kruger will be able to significantly reduce biomass costs in order to remain competitive, and (c) important changes in biomass procurement practices needed in the coming years. Dr. LeBel may or may not involve the same case study.

Specific synergies with Dr. LeBel's Project are as follows:

1. Integration with Dr. LeBel's student on basic data gathering and approach:
   - Characterization of the integrated wood products value chain for the case study context,
   - Characterization of the biomass procurement practices and costs in the existing operations,
• Identification and characterization of biomass harvesting technologies suitable for the existing value chain.
2. Definition of biorefinery process-product strategy(s) to be considered,
3. Linkage of biomass feedstock quality with biorefinery process requirements and yields,
4. Identification and characterization of new biomass harvesting technologies suitable for the future
5. Value chain augmented by the biorefinery strategy,
6. Development of markets and demand scenarios for the company’s products and corresponding
7. Biomass requirements, when the product portfolio is augmented by the biorefinery strategy,
8. Formulation of biomass procurement problem,
9. Optimization of biomass procurement,
10. Interpretation of results and recommendations,
11. Sensitivity and uncertainty analyses,
12. Interpretation of results and recommendations.

Fit within VCO Network Program

This project fits in well in with the VCO theme 2: Agile Logistics and Manufacturing Systems, and Focus Area 1: Design of agile value chain. There is a direct link with the project carried out by Dr. LeBel and his group at Laval University. However these projects have been carefully coordinated with several others. Both of these projects will benefit from and contribute to the the MSc student proposed by Dr. Nadia Lehoux: “Collaboration and rivalry: how to ensure collaboration when partners compete for the same resource?” There are further synergies with work outlined by Eldon Gunn in the proposal “Concepts of a Simple Biomass Supply Chain Model”.

Anticipated results and application
Main deliverables from this project include a model which will optimize biomass procurement in future forestry operations when a biorefinery strategy is taken into account. Additionally the project will look at the biorefinery implementation strategies from a raw material (biomass) perspective. From the case study, the project will assist Kruger in evaluating their current forestry and pulp & paper operations relative to possible future ones, to transition into a biorefinery. Specifically the results will indicate to Kruger what options they should not implement due to incorrect quality or un-available quantities of biomass, at a low cost.

Link to FPInnovations
It is expected that this work will rely on synergies and close collaboration with the team of Denis Cormier of FPInnovations. The two projects (this one and that of Dr. Lebel) will complement several initiatives being conducted by FPInnovations. For example, FPI Key Issue - Reduce Cost of Logistics: What are decision support tools to examine facilities location relative to log supplies, logistics and customers? More specifically, we believe that “Determine the conditions under which new products and processes are viable, product mixes generate the greatest return, fibre flows and processing conditions which
deliver the required products at minimum cost (Gail Sherson) may offer opportunities for collaboration.

**Schedule Milestones and Deliverables**

It is expected that Melendez will deliver at least 3 publications and a book chapter.

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<thead>
<tr>
<th>Year</th>
<th>Milestones/Deliverable</th>
<th>Expected Delivery Date</th>
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<tbody>
<tr>
<td>2012</td>
<td>Optimization of Biomass procurement model Sensitivity analyses &amp; interpretation of results Defined biomass procurement strategy for Kruger Presentation of final results</td>
<td>December 2012</td>
</tr>
<tr>
<td>2013</td>
<td>Final thesis and publications</td>
<td>December 2013</td>
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