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Mahdi Machani
Mustapha Nourelfath
Sophie D'Amours

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Bureaux de Montréal :
Université de Montréal
Pavillon André-Aisenstadt
C.P. 6128, succursale Centre-ville
Montréal (Québec)
Canada H3C 3J7
Téléphone : 514 343-7575
Télécopie : 514 343-7121

Bureaux de Québec :
Université Laval
Pavillon Palasis-Prince
2325, de la Terrasse, bureau 2642
Québec (Québec)
Canada G1V 0A6
Téléphone : 418 656-2073
Télécopie : 418 656-2624

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Mahdi Machani*, Mustapha Nourelfath, Sophie D'Amours

Interuniversity Research Centre on Enterprise Networks, Logistics and Transportation (CIRRELT) and Department of Mechanical Engineering, 1065, avenue de la Médecine, Université Laval, Québec (Québec), G1V 0A6

Abstract. Faced with increasingly declining conventional markets and low-cost competition, Canadian forest companies, particularly pulp and paper companies, are struggling to maintain their competitiveness. The design of a new business model, reinventing the way the company does business, is seen as one of the most promising avenues to provide a sustainable future to pulp and paper companies. Transforming the business model should be supported by a vision outlining the general direction of the company, a clear strategy defining a set of long-term objectives, and a business plan supporting the implementation of the business model through the company value creation network. Therefore, a multi-level decisional approach has been developed to design a new business model for pulp and paper companies. The Integrated Forest Biorefinery business model, based on the integration of bioproducts within the company product portfolio, has been suggested as an effective pathway to help these companies overcome the crisis and continuously adapt to the major shifts affecting their business environment. In order to align all the decision levels with such a transformation, the design of a new business model is integrated with a holistic approach encompassing the definition of a common vision, a corporate strategy, the business model itself, and a business plan. Our aim is to propose a decision-support framework for decision makers in pulp and paper companies, allowing them to understand the opportunities and the challenges associated with the transformation of the business model and move towards a competitive business while aligning all the decision levels.

Keywords. Vision, strategy, business model, biorefinery, pulp and paper.

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* Corresponding author: Mahdi.Machani@cirrelt.ca

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1. Introduction

The Canadian forest industry is confronted with serious challenges due to emerging low-cost competition, the rising Canadian dollar and the declining demand for several conventional forest products (Government of Canada, 2012a). In particular, pulp and paper (*P&P*) companies are experiencing a stalemate situation because of increasingly saturated *P&P* markets and inefficient cost-structure, amplified by global competition and higher energy costs (Marinova et al., 2010). More than ever, *P&P* companies are then seeking for viable solutions to overcome the crisis and adapt to the major shifts affecting their competiveness.

Over the last decades, the companies that have successfully thrived in spite of successive crises in several sectors, have fully grasped the hidden opportunities (Collins and Hansen, 2011). Forest sector stakeholders should then identify and seize new opportunities to overcome the crisis and achieve a sustainable competitive advantage. As for the Canadian forest industry, profiting from the growing global bioeconomy, based on innovative and high value-added bioproducts, is conceived as one of the most promising opportunities for forest companies to diversify their markets and hedge against conventional demand uncertainties (Government of Canada, 2007). Bioproducts are high-value products extracted from several biomass types, including forest and agriculture biomass, industrial residuals and urban waste residues. Bioproducts encompass a variety of products including bioenergy (such as electricity, heat, and biofuels), biochemicals (such as adhesives, pharmaceutical products and essential oils), and biocomposites (such as biopolymers and nanocellulose) (Brunette, 2011). In fact, several Canadian forest companies, mainly *P&P* companies, have already undertaken a range of efforts towards integrating bioproducts within their product portfolio. However, the bioproducts considered are essentially bioenergy produced to meet internal energy needs (Bradley, 2010) and there are still huge bioproduct-related market opportunities which are already largely unrealized (Sparling et al., 2011). Moreover, when Canadian companies have sought to invest in bioproducts, they have mainly focused on cost-saving strategies requiring little change to products and processes. Among the number of firms producing bioproducts in Canada, bioenergy arrives in first position, while contributing only 3,5% to all bioproduct gross revenues. Those companies investing in bioproducts have considered mainly Bioethanol, which contributes 68% of total bioindustry revenues (Sparling et al., 2011). Yet, an increasing number of practitioners claim that low-innovation strategies based only on operational cost restructuring and energy efficiency would not be sufficient for struggling companies to achieve a long-term competitive advantage. Value innovation, based on creating and delivering an innovative value proposition, would then be crucial for those companies seeking sustainable transformation (Kim and Mauborgne, 2005).

For Canadian forest companies, transforming their business models is seen as one of the most effective ways to innovate their value, leading to a competitive and sustainable business (Conseil de l'industrie forestière du Québec, 2010; Marinova et al., 2010; Johnson et al., 2008; Wising and Stuart, 2006). Nevertheless, value innovation is only achieved when all components of the value chains are aligned, including the buyers, the company itself and the suppliers (Kim and Mauborgne, 2005). As business models describe the relationship the company builds with its different partners, involving suppliers and customers, throughout the value chain, designing a well-defined business model would be vital for decision makers to successfully deliver that value innovation (Teece, 2010).

Furthermore, when the issues related to the transformation and implementation of business model are treated, they are usually associated with a vision that defines the general direction of a company and a strategy to achieve the sustainable competitive advantage ensuring that future vision (Conseil de l'industrie forestière du Québec, 2010; Government of Canada, 2012a; Smith et al., 2010). Thus, transforming the business model needs to be integrated into a holistic methodology involving the reinvention of the vision, the strategy as well as the issues related to the implementation of the business model.

However, struggling companies, while generally convinced that value innovation is vital to thrive, lack design tools to achieve that innovation (Kim and Mauborgne, 1999a). Therefore, there is a need to develop approaches to guide these companies throughout the value innovation processes, leading to a competitive business model. While all the decision levels, from the top strategic level to the value network level, are aligned with that innovation. Regarding literature dealing with forest industry including *P&P* companies, all the researches emphasising the integrated forest biorefinery business model, have assumed the viability of the associated business model and have ignored business model design matters.

Our contribution is then to develop a decision-support approach helping Canadian *P&P* companies transform their business models, while integrating all the strategic decision processes including vision, strategy, business model and design of the value creation network. The proposed approach aims to allow companies to well assess their current competitive position, identify the potential opportunities of value innovation, adapt the different strategic decisional levels to maximise the defined value innovation, design a new business model optimising the creation and delivery of that new value, and develop conceptual tools to validate and implement the designed business model. The objective is to design a holistic approach that helps those companies continually adapt to the economic, socio-political and technological challenges they are facing, in order to react to the shifts occurring within their competitive environment as quickly as possible.

The remainder of the paper is organised as follows. In Section 2, we review the literature dealing with the development of strategic decision support methodologies. In Section 3, we present a multi-level decisional approach to design new business models in the case of the Canadian *P&P* companies. In conclusion, the obtained results are discussed and future research avenues are presented.

2. Literature review

In this section, we review the contributions that have focused on developing methodologies to help companies rethink a range of strategic decisions involving several decision levels from strategic vision to value creation network in order to achieve a sustainable business. To well assess the literature dealing with these questions, we have classified the reviewed contributions according to the following issues addressed: competitive position analysing, identifying the opportunities to grasp, vision definition, strategy formulation, business model design, business model validation, and business model implementation. In **Table 1**, we present a survey of the main contributions according to that classification.

When reviewing the literature, one should note the growing emphasis on proposing strategic decision support approaches to allow companies to adapt to the major shifts they are facing. From presenting studies to understand and manage the current challenges and identify the opportunities, to developing frameworks evaluating the profitability of several transformation options, and through proposing a range of tools to help stakeholders align the different decision levels with the planned transformation, theoreticians and practitioners are increasingly addressing strategic issues about the most viable pathways to achieve a sustainable business.

A number of reports have assessed the current competitive position of forest companies by pointing to their strengths and weaknesses, and highlighting the opportunities to grasp, in order to identify successful ways of change (Benjamin et al., 2009; FPAC Forest Products Association of Canada, 2010; Martel et al., 2005; Towers et al., 2007; Wising and Stuart, 2006). In addition, national task forces addressing the challenges of the forest industry have resulted in a number of key assessments and a set of recommendations useful for identifying a new common vision for the forest industry as well as a set of potential high value strategies. (Biomass Research and Development Technical Advisory Committee, 2007; FPAC Forest Products Association of Canada, 2011; Ministère des Ressources naturelles et de la Faune MRNF, 2008; Ministère des Ressources naturelles et de la Faune MRNF, 2012). Other contributions have focused on proposing a set of transformation strategies to allow forest companies to seize the opportunities offered and achieve a competitive advantage (FPInnovations and Ministère des Ressources naturelles et de la Faune MRNF, 2009; Pätäri et al., 2011; Stuart, 2006).

Business model, a conceptual tool to depict the way the company would do business (Osterwalder and Pigneur, 2010), has been increasingly attracting the interest of researchers and practitioners as a powerful decision-support approach to optimally manage how the company would create, deliver and capture value while interacting with its different partners. However, all the works we have found, dealing with assessing and designing tools to reinvent business models, mainly belong to the strategy and management literature (Caisse and Benoit Montreuil, 2007; Kim and Mauborgne, 1999a; Magretta, 2002; Johnson et al., 2008; Osterwalder et al., 2005; Osterwalder and Pigneur, 2010). To our knowledge, there is no literature where business model design methodologies are applied to economic issues related to forest industry. Such finding is confirmed in (Teece, 2010), where the author argues that when it comes to economic literature, business models are frequently mentioned but rarely analysed. In fact, a major part of the reviewed works dealing with integrated forest biorefineries have mentioned the importance of business models and the need to design new business models for the forest industry, but none of these works have developed clear approaches to design business models. These contributions have focused on testing the profitability of such business models and proposing decision-support tools to support their implementation. In fact, a few researches have suggested quantitative approaches to assess and validate the profitability of integrated forest biorefinery business models, while focusing on optimising a number of decisions about supply chain design including the choice of feedstock, technologies, products, processes and plant locations, in order to maximise the financial value of bioproduct integration (Feng et al., 2012; Huang et al., 2009; Mansoornejad et al., 2010; Martel et al., 2005; Tay et al., 2011). Nevertheless, none of these works have tackled business model design issues.

Regarding the business model implementation phase, it has recently attracted a number of researchers. The concept of business plan, a step in which the business model design is translated into concrete elements over the supply chain, has been developed in (Osterwalder et al., 2005; Osterwalder and Pigneur, 2010). As for *IFBR*-related works, research efforts have been concentrated on developing strategic approaches to support the implementation of *IFBR* business models (Chambost et al., 2009; Moshkelani et al., 2012; Stuart, 2006) without, however, pointing out the link between the business model and its translation over the value creation network involving the organisation structure and the processes.

The literature review raises the need for global approaches to transform business models, encompassing the different strategic decision levels from competitive position analysis to business model implementation. The contributions focusing on vision and strategy definition have just highlighted the importance of business model innovation without providing tools to manage such an issue. Those treating business model implementation strategies and efficiency-assessing approaches have assumed the effectiveness of the business model considered, while ignoring design concerns. As for researches proposing decision-support methodologies to help transform *P&P* companies into *IFBRs*, efforts have emphasised assessing the effectiveness of such a transformation without discussing the design process issues of the associated business models.

This brings us to the main contribution of this paper: developing a holistic approach to support the transformation of struggling forest companies, particularly the *P&P* companies, into competitive *IFBR*s, while involving all the decision levels from the top strategic to the implementation level. We provide a set of tools to design, validate and implement a new business model for *P&P* companies, supported by a global vision underlining the future direction of the company and a clear strategy formulating the long-term objectives arising from the vision and ensuring that the business model design would achieve a sustainable competitive advantage. Our primary goal is to offer a decision-support methodology for decision-makers, helping them assess the company's competitive position, identify the potential opportunities to seize, transform the business model to create an innovative value proposition from these opportunities, propose a set of tools to validate the design and translate it into a business plan, and continually reiterate the whole process to adapt the company to an increasingly changing environment.

Literature	Competitive position analysing	Opportunities to grasp	Vision definition	Strategy definition	Business model design	Business model validation	Business model Implementation
(Benjamin et al., 2009)	X	X					
(Martel et al., 2005)		X					X
(Caisse and Benoit Montreuil, 2007)					X		
(Osterwalder et al., 2005)				X	X		X
(Osterwalder and Pigneur, 2010)					X	X	X
(Magretta, 2002)				X	X	X	
(Chambost et al., 2009)					X		X
(Moshkelani et al., 2012)		X					X
(Biomass Research and Development Technical Advisory Committee, 2007)			X	X			
(FPAC Forest Products Association of Canada, 2010)	X	X					
(FPAC Forest Products Association of Canada, 2011)		X	X	X			
(Stuart, 2006)	X	X		X			X
(Wising and Stuart, 2006)	X	X					
(Towers et al., 2007)		X					
(FPInnovations and Ministère des Ressources naturelles et de la Faune MRNF, 2009)	X	X		X			
(Ministère des Ressources naturelles et de la Faune MRNF, 2008)	X	X	X	X			

(Ministère des Ressources naturelles et de la Faune MRNF, 2012)	X	X	X	X		
(Pätäri et al., 2011)	X	X		X		
(Johnson et al., 2008)					X	
(Kim and Mauborgne, 1999a)					X	
(Tay et al., 2011)						X
(Feng et al., 2012)						X
(Huang et al., 2009)						X
(Mansoornejad et al., 2010)						X

Table 1: literature review on strategic decision support methodologies

3. The approach

The approach we present in this section (**Figure 1**), is a decision-support framework aiming to help stakeholders transform their business models while considering an integrated methodology involving all the decisional levels dealing with the design of business models. The objective of the developed approach is to support the transformation of struggling companies into competitive companies that continually adapt to the substantial shifts occurring within their competitive environment.

The first step of the approach is to analyse the current state of the company business environment by assessing the existing strengths and weaknesses characterising the sector. After that, the second step is to identify the opportunities to seize, by assessing a number of socio-political, economic, technological and market-related incentives. These first two steps are essential to review the competitive position of a given company in depth and underline the promising transformation avenues, thus helping the decision-makers identify the successful pathways of change. The first step to achieve that sustainable transformation is to define a global vision for the company highlighting its general direction and giving a snapshot of the projected future image. The governmental vision and the forest industry stakeholders' vision are crucial parameters to consider when defining the company vision. Once a vision has been stated, a strategy should be expressed to translate the vision into a set of long-term objectives and achieve a competitive advantage. The strategies of the considered industry's leaders should be reviewed to identify the best strategic practices to implement. To underpin the implementation of the settled strategy, a new business model should be designed to optimise the logic the company would create, deliver and to capture value. The business model would be an efficient way to optimally manage the value proposition, the customer interface, the network configuration, as well as the financial issues. The business model design would allow the company to thrive despite future turbulences affecting its business environment. It should then be aligned with several driving forces, including technological, economic, socio-political and market forces, affecting the competitiveness of the company. The business model would support the implementation of the corporate strategy to successfully cope with these future changes.

Before implementing the business model throughout the company value chain, a validation step is critical to test the viability of the design without directly incurring the risks associated with implementation. We propose a set of quantitative and qualitative analysis tools to help stakeholders simulate the efficiency of the designed business model. At the end of this validation step, the design is validated if the analysis results meet the decision makers' requirements. Otherwise, the business model design should be reviewed. Even the strategy and the vision could be revised, in order to align the business model with the design requirements.

After being implemented, the business model should be continuously adapted to future changes occurring within the industry. Such "closed-loop" process would be essential to allow the company to achieve a sustainable value innovation that meets an increasingly changing business environment.
In this paper, the developed approach is applied to the case of the Canadian forest industry, particularly the *P&P* sector. Our objective is to suggest a strategic decision-support methodology to help Canadian *P&P* companies move towards a sustainable business.

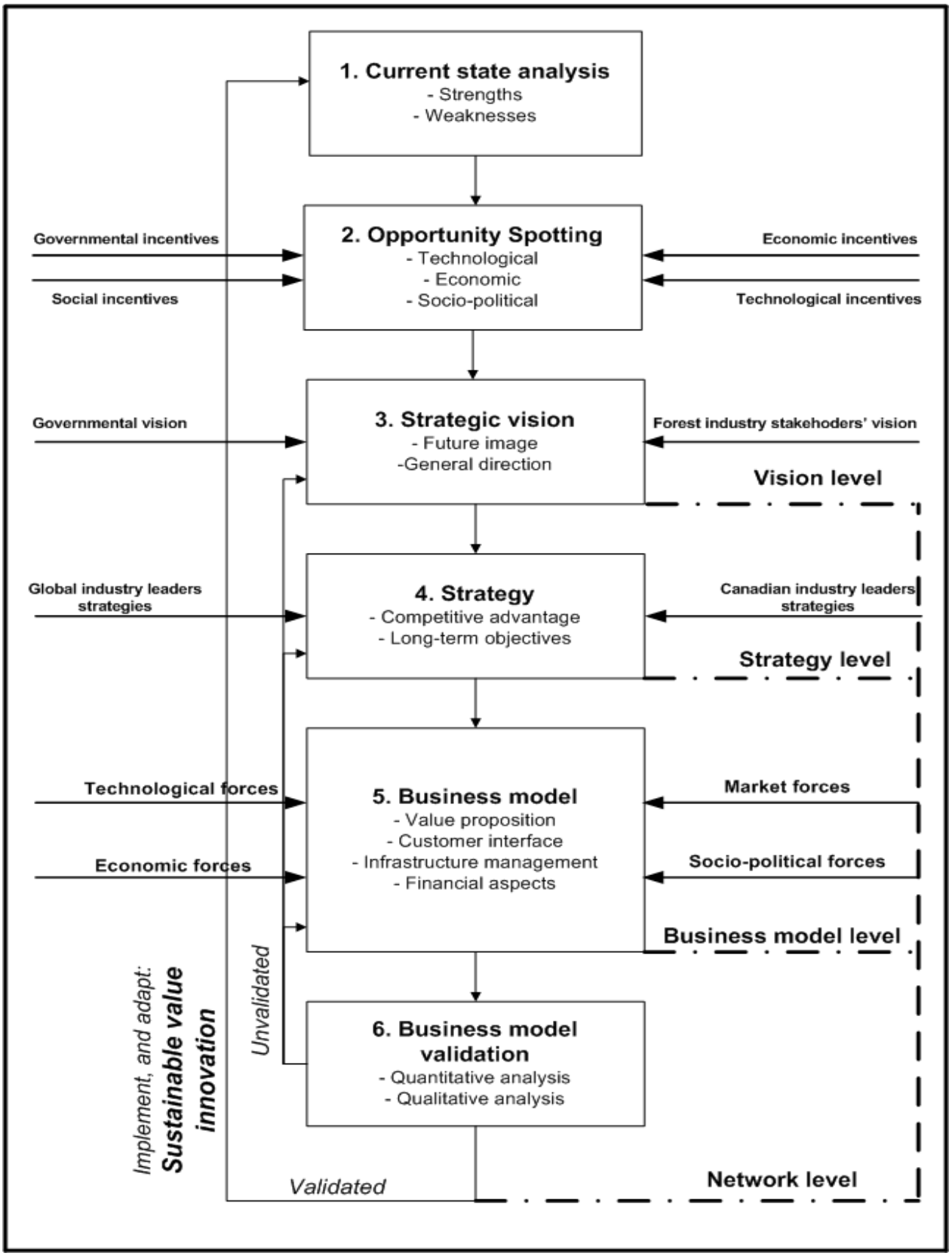

Figure 1: Multi-level decisional approach to design business models

3.1. Current state analysis

The current state analysis of the Canadian forest industry, the *P&P* sector in particular, is an essential step towards the transformation of the sector. During this step, we have assessed the weaknesses as well as the strengths of the forest industry.

In **Table 2**, we summarise the two components of the conducted analysis.

Weaknesses	**Strengths**
-Structural demand decline in some conventional forest products, such as newsprint and printing paper, due to substitution products (Ministère des Ressources naturelles et de la Faune MRNF, 2012) - Cyclical demand decline in almost all conventional forest products including lumber, pulp and paper, due to a rising Canadian dollar, low-cost competition and high operating costs (FPInnovations, 2011). - Low capital returns for *P&P* sector, driving away investments (Conseil de l'industrie forestière du Québec, 2010) - Low *P&P* margin profits due to overcapacity and operational inefficiency (Government of Canada, 2012a) - Substantial employment decline (more than 30% in the last 10 years), principally in the *P&P* sector (Government of Canada, 2012a) - High energy consumption for *P&P* sector (30% of the Canadian industry energy consumption), representing 25% of operating costs (Marinova et al., 2010) - High GHG emissions, representing 15% of total Canadian industry emissions (Martin et al., 2009) - The *P&P* sector is the largest water-consuming industry (Martin et al., 2009) - An obsolete business model due to low-value product portfolio and inefficient cost structure (Conseil de l'industrie forestière du Québec, 2010)	- Vast sustainably managed forests: Quebec is world leader regarding sustainable forest management practices, having 75% of its forests certified (Ministère des Ressources naturelles et de la Faune MRNF, 2012). - High-quality universities and research centres providing innovation and technology transfer (Ministère des Ressources naturelles et de la Faune MRNF, 2012). - Substantial amounts of available biomass which could be converted into high value products (Government of Canada, 2012b). - Highly-qualified labour (Government of Canada, 2012b) - Almost all Canadian *P&P* companies already convert a set of biomass sources into cogenerated electricity and steam, having then the adapted supply chain to use biomass (Stuart, 2006). -Canadian *P&P* companies have been reinventing their business models to adapt to ulterior changes, making them ready to transform again their way of doing business (Ministère des Ressources naturelles et de la Faune MRNF, 2012).

Table 2: strengths and weaknesses of the Canadian *P&P* sector

3.2. Opportunity spotting

Canadian forest companies, particularly the *P&P* companies, are confronted by serious challenges regarding their competitiveness. As shown above, in **Table 2**, these challenges hide a number of weaknesses and strengths that companies should manage to achieve a sustainable transformation.

Therefore, there is a need to transform the way the company does business, in order to further enhance the strengths and eliminate the weaknesses. In fact, a major part of forest industry executives, mainly in mature markets like in Canada, believe there is a need for fundamental change in the sector to remain competitive (PricewaterhouseCoopers PwC, 2010a). Among the possible avenues for change, diversifying the product portfolio by integrating bioproducts is considered as a promising opportunity to create new revenue sources and access a set of growing

markets (FPAC Forest Products Association of Canada, 2010; Ministère des Ressources naturelles et de la Faune MRNF, 2012).

To well assess the bioproduct-related opportunities for Canadian *P&P* companies, we have grouped them into socio-political opportunities, technological opportunities, and economic opportunities.

3.2.1. Socio-political opportunities

The forest industry contributes 12% to the Canadian manufacturing Gross Domestic Product (GDP) and employs directly and indirectly nearly 600.000 persons (FPAC Forest Products Association of Canada, 2012). Because of their considerable weight in the Canadian economy, the Canadian government supports forest companies both financially and politically and is helping them achieve a long-term competitive advantage. Governmental support actively promotes the transformation of the forest sector to integrate bioproducts. A set of programs, such *as Investments in Forest Industry Transformation*, *Forest Innovation Program*, and *Pulp and Paper Green Transformation* have been launched to support the integration of new technologies to enhance the energy efficiency of the sector, produce a set of high-value bioproducts, and access new markets (Bradley, 2009; Canadian Forest Service, Natural Resources Canada, 2012).

At the social level, investing in bioproducts represents a great opportunity for forest companies to enhance their environmental image, as the forest industry is still perceived as a poor environmental performer (Conseil de l'industrie forestière du Québec, 2010). In fact, an increasing part of the community requires that forest companies further consider the environment in their core strategies, in order to reduce their carbon footprint and offer eco-responsible products. Bioproducts would then be a viable solution to address these new social challenges and transform them into a source of competitive advantage.

3.2.2. Technological opportunities

Bioproducts, ranging from cogenerated electricity, heat and steam to biochemicals, biofuels and biomaterials, offer a huge opportunity for the Canadian forest industry to overcome its stalemate situation and achieve long-term competitiveness (FPAC Forest Products Association of Canada, 2010).

In fact, integrating bioproducts within forest companies would be an effective way to maximise economic results and employability for both conventional and new activities (FPAC Forest Products Association of Canada, 2011).

In particular, bioenergy technologies to produce electricity, heat and biofuels would allow *P&P* companies to meet their energy needs and diversify their revenue sources (FPAC Forest Products Association of Canada, 2010).The viability of a number of these technologies has already been proven, presenting an enormous growth potential in the coming years due to governmental incentives and increasing demand (de Wit et al., 2010).

Therefore, *P&P* companies should consider this technological advent of bioproduct technologies as a promising way to remedy the structural decline of an increasing number of conventional products.

3.2.3. Economic and market-related opportunities

Bioproducts present a substantial opportunity for Canadian *P&P* companies to address issues related to conventional saturated markets, These products offer a set of new growing markets that allow maximising the value extracted from fibre (FPAC Forest Products Association of Canada, 2011). Besides, there would be an increasing demand globally for bioproducts, creating a competitive bioeconomy in which Canadian *P&P* companies should seize the opportunities offered to maximise their share-markets (FPAC Forest Products Association of Canada, 2010).

Integrating bioproducts within *P&P* companies would make it possible for them to diversify their revenue sources by offering high-profit margin products and reduce their dependency on fossil energy.

Furthermore, government policies of financial support including carbon credits, incentives, and tax exemptions (Bradley, 2009) would offer substantial economic opportunities for *P&P* companies.

3.2.4. The need for change

The current state analysis has revealed a set of points of weakness as well as strengths for the *P&P* sector. Assessing them creates a real motivation for fundamental change to allow *P&P* companies to thrive within the crisis. As we have seen, there are a number of opportunities that *P&P* sector stakeholders should spot in order to ensure not only short-term survival solutions, but also a durable competitive advantage through creating an innovative value. In (Kim and Mauborgne, 2005), an analytical tool has been developed, called "*the four action framework*" aiming to explore how to maximise that value innovation. The proposed tool is about assessing the factors affecting the company's business environment and answering four key questions to help the company survive the crisis and create an innovative value: Which factors should be eliminated? Which factors should be reduced? Which factors should be raised? And which factors should be created?

By adapting this tool to the *P&P* sector, we exploit the results of the "*current state analysis*" and "*opportunity spotting*" to respond to the four questions presented above, in order to ensure a competitive business (**Figure 2**).

a. Reduce

A *P&P* company, aiming to be competitive, could reduce its mass-market strategy offering a few varieties of substantial volume commodities to limited markets. Besides, it could reduce its low-margin-product offer to current mature markets due to competition. The crowded current market space of *P&P* products forces companies that are seeking to survive to further lower its cost structure and reduce its energy consumption, in order to ensure an increasingly tight margin.

b. Eliminate

In order to be better adapt to the structural changes affecting the sector, the *P&P* company could consider eliminating its non-profitable assets and get rid of its conventional manufacturing-centric culture which is based on producing a variety of basic *P&P* products and selling them as commodities regardless the changes in customers' needs (Thorp, 2005).

c. Raise

The *P&P* mill could increase its high-margin profit product offer to meet the customer need changes. The by-products generated when producing *P&P* products, such as black liquor and paper sludge, could be further valued by converting them to higher-value products. In addition, the *P&P* company should be agile regarding the short-term shifts all along the supply chain by developing a flexible organisational structure to respond efficiently to these changes. On the other hand, in order to face growing environmental requirements, the company could strengthen its environmental implication by increasing its energy self-sufficiency and further integrating the environmental issues, such as managing greenhouse gas emissions and greening the supply chain.

d. Create

To seize the technological and economic opportunities associated with bioproducts, the *P&P* company could build a number of partnerships from outside the *P&P* sector (Chambost et al., 2009). These partners could be vital to gain access to new markets for *P&P* companies such as chemical markets and energy markets, and to take advantage of the expertise of technological partners to implement and distribute a set of high-value bioenergy products. In fact, diversifying the product portfolio by adding bioenergy products would be beneficial for the company to overcome the declining demand of conventional P&P products.

These new high-value products could serve a number of niche markets, which would overtake the mass market of low-profit margin conventional *P&P* products. Accessing these niche markets would require a fundamental shift in the way of dealing with customers, by moving from a manufacturing-centric thinking towards a demand-driven culture (Thorp, 2005), where the emphasis is on meeting specific-need customers and managing company resources to effectively respond to demand requirements.

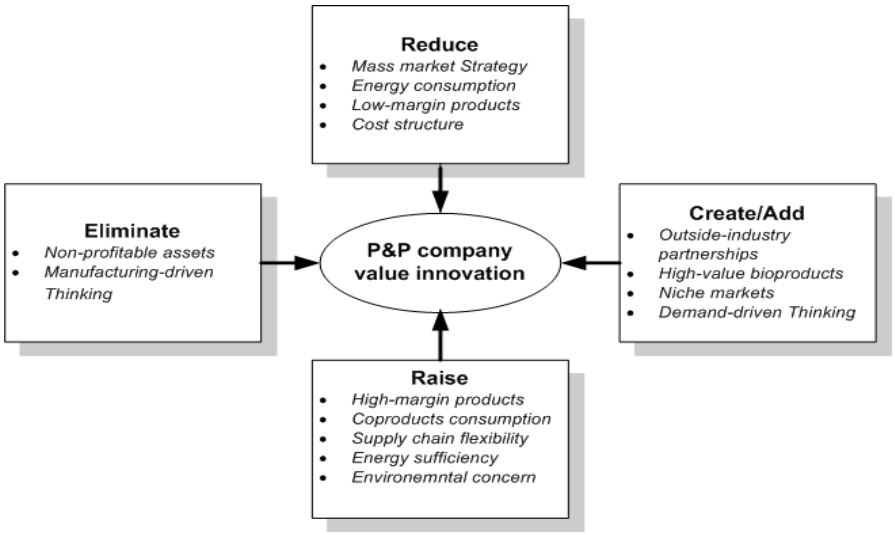

Figure 2: Perspectives for change using the four-action framework

By looking beyond the boundaries of the *P&P* sector, a *P&P* company aims to seize new growth opportunities and create innovative value in order to move from saturated *P&P* mass markets to a set of growing niche markets. When assessing the four required actions to achieve this value

innovation, it is clear that *P&P* companies should undergo a fundamental change from the top-strategic decision level to the operational value network level. Furthermore, as this transformation would seriously affect the logic the company is creating and delivering value, transforming the business model would be a vital step towards achieving that change.

That's why it would be crucial that the design process of the new business model should be integrated into a holistic approach that involves all decisional levels starting by expressing the global vision, then working down to the corporate strategy followed by depicting the principal components of the business model, and finally outlining the most relevant business model implementation mechanisms.

Throughout the following subsections, we present in detail the different decision-level layers of the developed approach.

3.3. Strategic vision

The strategic vision represents a snapshot of the company's future serving as a guiding blueprint, which would be easy to communicate to the customers, the shareholders and the employees (Kotter, 1995). Mainly, the mission of defining a general vision for the company is to align all the incurred transformational actions in the same direction.

For the forest industry, defining a strategic vision would be essential to be able to transform existing opportunities into a sustainable competitive advantage. In the case of Canadian forest companies in particular, a long-term vision should be developed rather than just remain limited to a number of short-term objectives (Chambost et al., 2009). In fact, according to many academics and forest industry stakeholders, the stalemate situation the forest industry is currently facing, could have been avoided if the forest companies had adapted their vision the changing competitive environment in time (Senate Committees, 2011). The company's developed vision should then be well aligned with the vision of all actors dealing with the forest industry, including the government and the major forest industry stakeholders.

As regards the government, a Canadian forest company vision should be aligned with the government's general direction in order to take advantage of supportive governmental policies as well as financial incentives.

In recent years, the Canadian government has been strongly supporting forest industry transformation by providing several financial incentive programs and innovative regulations to reinvent the forest industry and improve its environmental performance (Canadian Forest Service, Natural Resources Canada, 2012).

In **Table 3**, we present a number of federal programs undertaken for the forest industry during recent years.

Program	Objectives
Aboriginal Forestry Initiative	Increasing the participation of aboriginal people in the Canadian economy and improving their economic outcomes
Expanding Market Opportunities Program	Increasing market opportunities for the Canadian forest industry in both offshore and North American markets
Forest Communities Program	Encouraging community-level partnerships to take advantage of emerging forest opportunities
Forest Innovation Program	Supporting Research and Development in forest industry
Investments in Forest Industry Transformation Program	Supporting the Canadian forest companies in becoming more economically competitive and environmentally sustainable
Pulp and Paper Green Transformation Program	Improving the environmental performance of the Canadian P&P sector

Table 3: federal programs to support the Canadian forest industry

The programs presented above reveal the strategic vision the federal government defines for the Canadian forest industry: *A competitive Canadian forest industry economically as well as environmentally, allowing an optimal implication of the local communities and maximising both the economic and social outcomes of the forest industry transformation*.

At the provincial level, a set of nine guidelines have been developed to help the Quebec forest industry overcome the crisis (Ministère des Ressources naturelles et de la Faune MRNF, 2008). These strategic orientations aim to reinvent the way the provincial government manages the forest industry by prioritising sustainable development and creating a competitive industry in harmony with its environment and community. The general directions described throughout that governmental report uncover a long-term provincial vision that translates the guidelines' objectives: *An adapted and profitable Quebec forest industry, while integrating innovation and environmental concerns in its core strategy*.

This vision has been clearly expressed in the Quebec governmental report presenting the Quebec strategy for 2012-2017 to transform the Quebec forest industry (Ministère des Ressources naturelles et de la Faune MRNF, 2012), by defining the three major components of the presented vision: *diversified, innovating and adapting*.

On the forest industry level, several actors are moving towards integrating a bio-industry where forest companies would take full advantage of the new opportunities that present the substantial biomass resources available in Canada. This transformation would involve a product diversification including bioenergy, biochemicals and biomaterials, while adapting the conventional activities to the changing markets by producing innovative and ecofriendly forest products (FPAC Forest Products Association of Canada, 2011). The *Biopathway project*, a multi-partner project involving the Forest Products Association of Canada (FPAC), FPInnovations, Natural Resources Canada and a number of industrial experts and academics, aiming to explore the existing possibilities for the Canadian forest industry and to assess the opportunities to ensure its long-term competitiveness (FPAC Forest Products Association of Canada, 2010), have shown the economic, social and environmental potential of integrating the bioproducts into the forest industry. The Biopathway project represents a strategic roadmap for the Canadian forest industry

to overcome declining markets and ensure long-term competitiveness. The roadmap would support the shift of the forest industry from an energy-dependent and traditional industry, serving saturated markets, to an innovative and energy-efficient industry oriented toward growing worldwide growing markets.

Therefore, there is already a trend among the different forest industry stakeholders to establish a common future vision: *An innovative and ecological bioindustry based on the integration of new bioproducts within the conventional forest product portfolio, which would optimally grasp the new opportunities associated with the new global bioeconomy*.

The strategic vision of a forest company should be aligned with the visions of the different forest industry stakeholders and their partners. In the case of a Canadian *P&P* company, the developed vision should be in harmony with the governmental vision at both the federal and the provincial levels, as well as with the forest industry stakeholders' vision. Besides, as outlined above in the developed framework (**Figure 1**), the company vision must translate the existing technological, economic and socio-political opportunities into a future blueprint aiming to transform these opportunities into sustainable competitive advantage (see **Figure 3**).

Thus, we define the vision for a Canadian *P&P* company, aiming to specify a general direction, as follows: *An environmentally and economically competitive company, taking full advantage of the growing opportunities associated with the bioproduct development, while optimally managing its conventional activity and maximising the economic and social outcomes for the communities.*

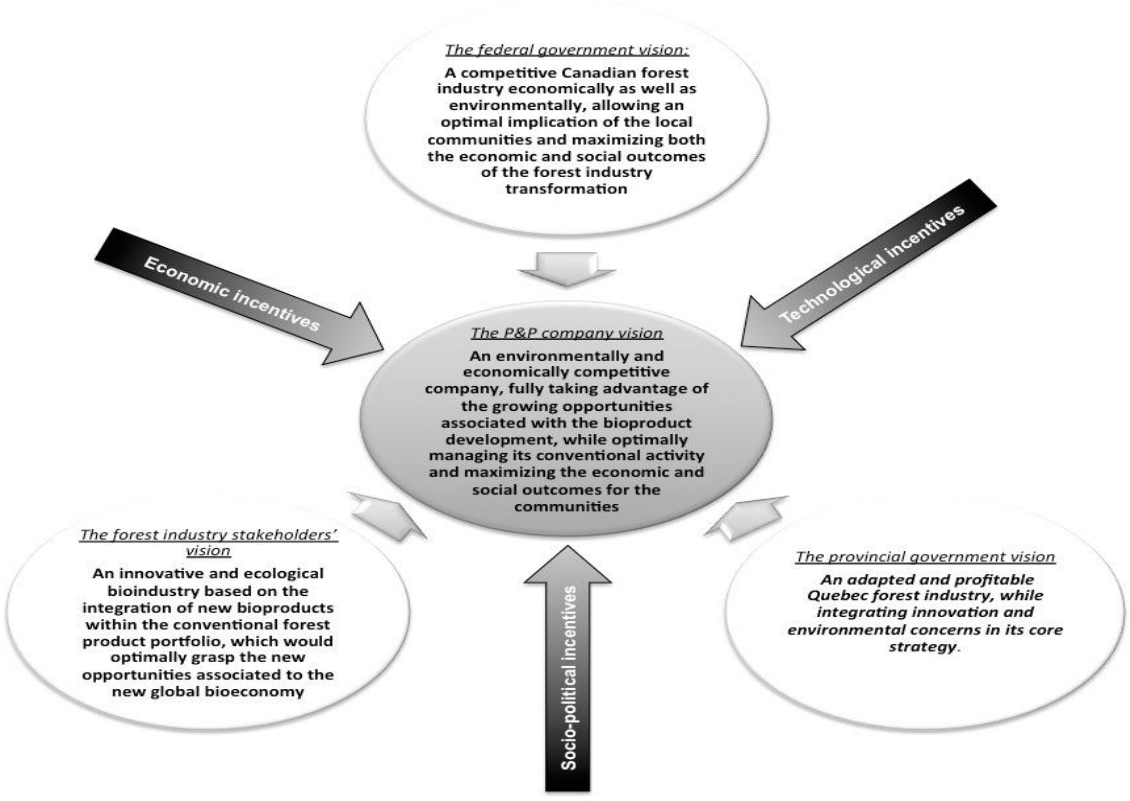

Figure 3: the *P&P* company vision

3.4. Strategy

According to (Porter, 1996), strategy is the creation of a unique and valuable position, involving a set of well-fitted activities. It represents the logic the company would use to achieve the defined vision (Kotter, 1995).

For the developed approach in this paper, the strategy translates the future vision into a set of long-term objectives to ensure a durable competitive advantage.
In order to well define an appropriate strategy for a given Canadian *P&P* company, we have reviewed in detail the principal strategic features for the biggest *P&P* companies both in Canada and worldwide. The conducted analyses have allowed us to reveal a number of common strategies, which have been implemented, to survive the forest industry crisis. This step has been essential to understand why some companies thrive during such an economic stalemate while others do not, and thereafter to identify the most promising strategies to achieve a durable transformation.

Throughout the last two decades, the most common strategy in Canadian *P&P* companies has been a *process-oriented commodity strategy*. The main features of this strategy are the manufacturing of standard *P&P* products using standard processes and selling them as commodities to a number of standard markets (Thorp, 2005). As conventional markets have been shrinking, the economies of scale generated when selling substantial product volumes to substantial markets, have become a handicap because of the low flexibility that is offered. To remedy that issue, an increasing number of academics and industrials support *customer-oriented innovation strategies*, where *P&P* companies offer an innovative value proposition that meets the new customer requirements and sell them in growing new market spaces (Thorp, 2005; Towers et al., 2007; Wising and Stuart, 2006).

In the next subsection, we review in detail how the forest industry leaders in Canada and worldwide are reinventing their strategies to meet the economic, social and environmental challenges.

3.4.1. The strategies of forest industry leaders

In mature markets like in North America, the forest industry, particularly the *P&P* sector, has to deal with an increasingly structural decline in several market segments. The emerging low-cost competition, the technological shifts, and the increasing environmental pressures have profoundly affected conventional markets, forcing companies to transform their strategies to survive (PricewaterhouseCoopers PwC, 2010a). About 63% of 49 CEOs, from leading forest companies around the world interviewed by PriceWaterhouseCoopers [1], confirm that they are already reinventing their strategies. Besides, nearly a full quarter of the interviewed CEOs are convinced that these changes will be fundamental (PricewaterhouseCoopers PwC, 2012).

In the top 100 global forest industry companies, in terms of revenues, ten Canadian forest companies are listed (PricewaterhouseCoopers PwC, 2010b). Among them, we have decided to assess in depth the strategies of five companies, producing *P&P* products, on the basis of their

1 PriceWaterhouseCoopers is the world's largest professional services firm

net earnings in 2010, 2011 (PricewaterhouseCoopers PwC, 2011). We have chosen the company that has realised the best performance, as well as the company that made the worst operational performance. Then we selected three companies whose operational profits fluctuate between loss and earnings. The reason behind our choice is to evaluate how the financial performance of the company affects its transformation strategy.

To well assess the selected companies, we have reviewed their visions in detail, their strategic structures, their product portfolio and their principal partners, by referring to their Internet sites and their periodic reports. Such an evaluation has been essential to retrieve common transformation strategic features for the case of the P&P companies.

To identify the most common features of the selected Canadian *P&P* companies' transformational strategies, we have classified each strategy according to three parameters: The degree of innovation in the strategy, the time-horizon of the strategy and finally whether the strategy is cost-driven or value-driven.

Regarding the degree of innovation, a strategy could range from one that is low innovation, by just making incremental changes to the product portfolio and the served markets, to one that is high innovation and makes disruptive changes to the company business to serve new customer and market needs (Nagji and Tuff, 2012). For a low innovation strategy, the changes could include improving existing product properties such as the environmental and quality certification, producing customised products to meet specific needs, and reducing the fossil energy consumption by optimising the energy efficiency and increasing the use of cogeneration to meet a part of the energy needs. In sum, there would be no major transformation in the products, the processes and all-over supply chain. As for a high innovation strategy, the changes made would profoundly affect the value creation network of the company. At the product level, there would be a substantial diversification in the product portfolio by adding innovative forest products to meet changing customer needs or new high-value products such as bioenergy and biomaterials to serve new growing markets. To manufacture these products, a set of innovating processes would be implemented. For the energy needs, there would be a fundamental transformation regarding the energy sources by aiming to substitute the supplied fossil energy by on-site produced bioenergy and even become an energy supplier. These major changes would require adapting the whole supply chain to optimally manage the transformation while maintaining the conventional activities.

Regarding the time-horizon of the strategy, we consider short-term, mid-term and long-term strategies. Cost-cutting measures, capacity reductions and shutdowns are considered as short-term strategies aiming to maximise cash flows and ensure further financial flexibility without looking at long-term survival issues (Rogers, 2011). Furthermore, we assume that reducing strategic actions aiming to improve the operational performance of the company supply chain are considered as mid-term actions that target acquiring an operationally efficient supply chain. Finally, mill modernisation, product portfolio diversification, and new market access are considered as long-term strategic actions towards ensuring a sustainable business for the company (Minstère des Finances and Ministère des Ressources naturelles, 2000) .

The third parameter that we have considered in classifying the transformation strategies for *P&P* companies is whether the strategy is cost-driven or value-driven. A strategy that focuses on

maximising the productivity and the efficiency throughout the supply chain while minimising resources consumption to outperform the competition is considered as a cost-driven strategy. On the other side, a strategy that emphasises creating a new and superior value by continuously adapting to shifts in customer needs, rather than focusing on outperforming the competition's value proposition, is considered as a value-driven strategy (Kim and Mauborgne, 1999b).

The companies we have analysed above have undertaken different strategic approaches to deal with the new challenges they are facing. The driving forces defined above are used in different degrees within each strategy. Moreover, to well define the different strategies, we consider that each strategy is composed of three building blocks: corporate capabilities, customers and competition (Kim and Mauborgne, 1999b). When formulating a strategy, each block should be clearly defined to achieve a sustainable competitive advantage.

Referring to the considered driving forces, we have been able to identify four major transformation strategies that the assessed companies have undertaken to overcome the forest industry crisis (**Figure 4**). In each strategy, we outline how the corporate capabilities, including the technologies, processes and products, are managed, how the customers and the served markets are handled, and how the company deals with competition.

a Survival strategy

It is based essentially on reducing production capacities and rationalising assets, to adapt to the decline of demand in conventional markets. In this strategy, the company limits its offer to the conventional existing portfolio of products, while making minor changes in their characteristics such as innovating design and environmental certification. In parallel, that strategy aims to maintain the conventional markets by offering cost-competitive products to face competition. On the environmental side, the company's strategy principally consists in reducing fossil energy consumption by producing cogenerated electricity and steam to meet a part of the company's energy needs. We then define the survival strategy as a cost-driven strategy, as it is based on cost restructuring. In addition, it brings a low-innovation degree regarding company capabilities as the product portfolio is slightly changed. Regarding the time frame, the survival strategy is considered as a short-term strategic choice for the company, as it aims only to overcome the short-term financial problems without suggesting sustainable solutions for the shifts occurring within the business environment of the company.

b. Operational efficiency strategy

It complements the survival strategy. Besides capacity adjustment and assets rationalisation, the conventional product portfolio is innovated by offering customised products and a set of superior forest products that meet increasing customer requirements regarding quality and efficiency. That extended product offer aims to expand the conventional forest product markets. In this strategy, the emphasis is on improving the operational efficiency of the value creation network and implementing an effective supply chain management. The improvements in supply chain operations and value proposition help the company offer a competitive offer relative to the increasingly fierce competition. Concerning the energy needs, the operational efficiency strategy would not be limited to meeting a part of the energy needs via cogeneration but would also support diversification of bioenergy sources, in order to improve mill energy efficiency. Thus, this strategy is considered as a mid-term strategy aiming to help the company overcome the crisis and obtain a lean operational structure. The degree of innovation remains

low in this strategy, as the changes wouldn't fundamentally transform the company value proposition. Furthermore, the operational efficiency strategy, as its name suggests, is a cost-driven strategy, though it brings some significant improvements to the value of the product portfolio.

c. *Intra-industry diversification strategy*

It consists in diversifying the product portfolio by producing a set of new high-value forest products presenting innovating features or using advanced technology materials. That product diversification helps the company access new niches within the conventional forest product markets. Different revenue sources from a number of small markets then overtake the traditional mass-market revenues. Therefore, such a strategy aims to outperform the global competition within conventional *P&P* markets by offering a diversified product portfolio encompassing innovative *P&P* products. Still, integrating innovative *P&P* products requires implementation of disruptive technologies, which would deeply transform the value creation network of the company. Building partnerships from inside the forest industry would then be essential to overcome the associated technological barriers and enhance the design, the manufacturing and the commercialisation of such products.

The intra-industry diversification strategy is then a long-term strategy aiming to create new market spaces for the *P&P* companies requiring innovative products. In addition, it presents a high degree of innovation, as it requires the integration of new technologies and processes to diversify the product portfolio. Furthermore, the intra-diversification strategy is considered as a value-driven strategy as it deeply transforms the company's value proposition by integrating a set of innovative *P&P* products and serving new markets.

d. *Bioproduct-based diversification strategy*

It is based on the diversification of the product platform by integrating bioproducts such as biomaterials (NCC, biocomposites) and bioenergy (biofuels, cogeneration) (FPAC Forest Products Association of Canada, 2010). This diversification implies the implementation of new technologies within the company to manufacture the bioproducts. The bioproduct-based strategy is an inter-industry diversification strategy allowing the company to access new markets beyond the conventional *P&P* markets, such as chemical market, fuel market, and construction market. Thus, instead of competing with other *P&P* companies within saturated *P&P* markets, such a diversification allows the company to access new market spaces making the conventional competition irrelevant (Kim and Mauborgne, 1999a).

Still, there is a technological and economic risk associated with the manufacturing and the commercialisation of a number of bioproducts. In this case, building partnerships with partners from outside the forest industry such as oil industry, energy industry, and private and governmental research institutes, mitigates that risk and helps *P&P* companies profit from the substantial growing opportunities associated with a bioproduct-based value proposition (Chambost et al., 2009). Furthermore, bioenergy products would make it possible for companies to acquire energy self-sufficiency by substituting the supplied energy such as natural gas and electricity for on-site manufactured bioenergy such as synthetic gas, cogenerated electricity and steam, while selling the excess part to outdoor customers.

The bioproduct-based strategy is then a long-term strategy as it helps *P&P* companies access new market spaces to diversify their revenues beyond the competition within the *P&P* sector. That strategy lends a high degree of innovation to the *P&P* company as the diversification of the product portfolio would be accompanied by the implementation of innovative processes and technologies, as well as the reinvention of the supply chain from the supplying sources to the served markets. Thus, the strategy described is value-driven as it would transform the whole value creation network of the *P&P* company.

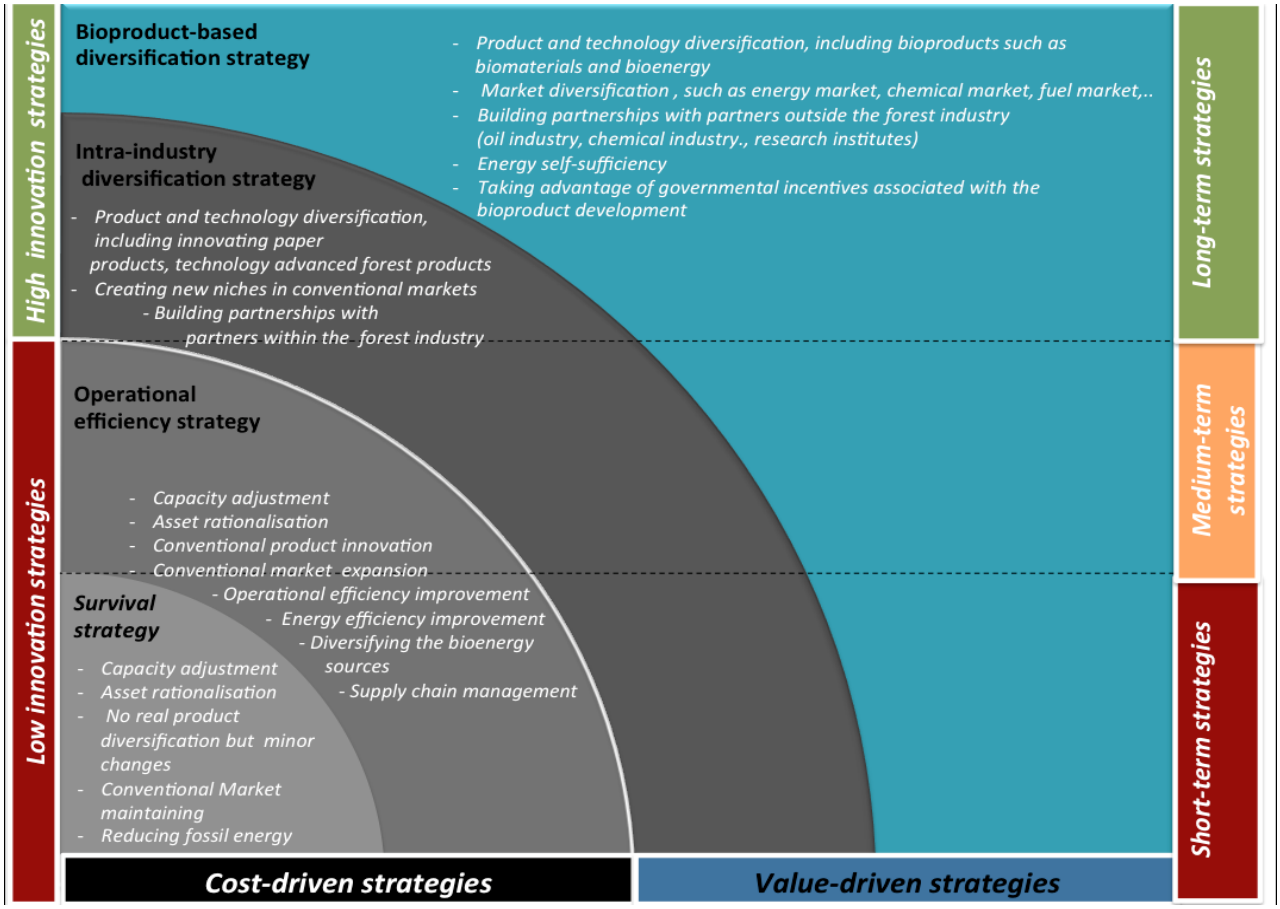

Figure 4: Transformational strategies for Canadian forest companies

To overcome the crisis and achieve a sustainable competitive advantage, the Canadian *P&P* companies, have to transform their strategies. In (PricewaterhouseCoopers PwC, 2010a), most of the interviewed CEO's of companies operating in mature markets such as Europe and North America consider bioenergy diversification as one of the most promising transformation strategies to ensure their sustainability. Nevertheless, operational restructuring strategies based on asset rationalisation and operational performance improvement, which, in this paper, we called survival strategies and operational efficiency strategies, would be essential for those companies to acquire an agile and flexible organisational structure before tackling diversification strategies (PricewaterhouseCoopers PwC, 2010a). Furthermore, the Canadian government recognises the vitality of short-term operational restructuration strategies to get the basics right for long-term transformation strategies (Government of Canada, 2012c)

Canadian *P&P* companies should then manage short-term and long-term strategies to successfully undertake their transformation. As we have seen when analysing Canadian forest companies, those who are moving towards long-term diversification strategies have already undertaken, in parallel, short-term operational efficiency strategies. This finding is reinforced in (Nagji and Tuff, 2012), where it has been shown that companies which have achieved successful transformation strategies have optimally managed three levels of innovation: basic innovation where the competitiveness of the existing products improved to maintain the conventional markets (***survival strategy***, ***operational efficiency strategy***), adjacent innovation where the product portfolio is expanded while serving conventional or adjacent markets (***intra-industry diversification strategy***), and finally transformational innovation where new products are added to the product portfolio to serve new markets beyond the conventional industry boundaries (***inter-industry diversification strategy***).

Nevertheless, the declining demand for several conventional *P&P* products as well as the emergence of low-cost competition make short-term operational restructuring strategies insufficient to ensure a sustainable competitive advantage for *P&P* companies (FPAC Forest Products Association of Canada, 2011). Undertaking diversification strategies to create new market spaces, would be vital to successfully reshape the sector (FPAC Forest Products Association of Canada, 2010).

Furthermore, as highlighted in **Figure 1**, the new formulated strategy has to be aligned with the vision defined. As the vision defined (see previous section) supports the transformation of conventional *P&P* companies into environmentally and economically competitive companies, profiting from the growing bioproduct-based opportunities, the bioproduct-based diversification strategy fits well with that vision. By implementing such a strategy, the general direction outlined in the vision is translated into a set of long-term objectives defining how the *P&P* company would manage its capabilities, customers and competition to achieve a sustainable competitive advantage.

However, the uncertainties associated with the development of diversification strategies, particularly the bioproduct-based diversification strategies, are still high due essentially to the lack of information regarding profitability and the risks associated with strategy implementation (FPAC Forest Products Association of Canada, 2010). Thus, to help *P&P* companies evaluate the profitability of such strategies and understand the challenges of their implementation, the design of a new business model, which represents the link between strategy formulation and business process implementation, represents a vital step in the developed approach (Ammar, 2006). Indeed, according to almost all Canada forest industry stakeholders, developing a new business model would be essential to achieve the aimed strategic transformation for the sector (Natural Resources Canada, 2012).

As shown in **Figure 1**, a new business model would support the implementation of the formulated strategy, while considering a set of driving forces affecting the business environment of the company. Thereby, the strategic thinking about how the company would handle its capabilities, customers, and competition is translated into a plan outlining the logic the company would manage its value proposition, the customer interface, the infrastructure management and the financial aspects.

The next section is devoted to the design of the business model associated to the bioproduct-based diversification strategy.

3.5. Business model design

The business model describes the logic the company creates, delivers and captures the value (Osterwalder and Pigneur, 2010).

While the strategy outlines the operating guidelines of a company to achieve a long-term competitive advantage, the business model is the plan associated with that strategy to implement the organisational structure, the processes and the systems.

As presented above in the previous section, the bioproduct-based diversification strategy is suggested as being a promising transformation strategy to achieve the common vision initially defined. Among the different available bioproducts to integrate within Canadian *P&P* companies, bioenergy products, encompassing a range of bio-based products ranging from electricity and heat to a set of biofuels and biochemicals, would be a viable pathway to achieve a sustainable business for those companies (FPAC Forest Products Association of Canada, 2010).

Therefore, as highlighted in **Figure 1**, there is a need to link the different decisional levels including the vision, the strategy, the business model, and the value network implementation level, in order to achieve a successful transformation. We have listed these decisional levels according to three steps: the planning step where the vision defines the general direction of the company and the strategy outlines the long-term objectives to achieve that vision, the design step where the business model describes the logic the company would earn money, and finally the implementation step where the organisational structure and the business processes are established (**Figure 5**).

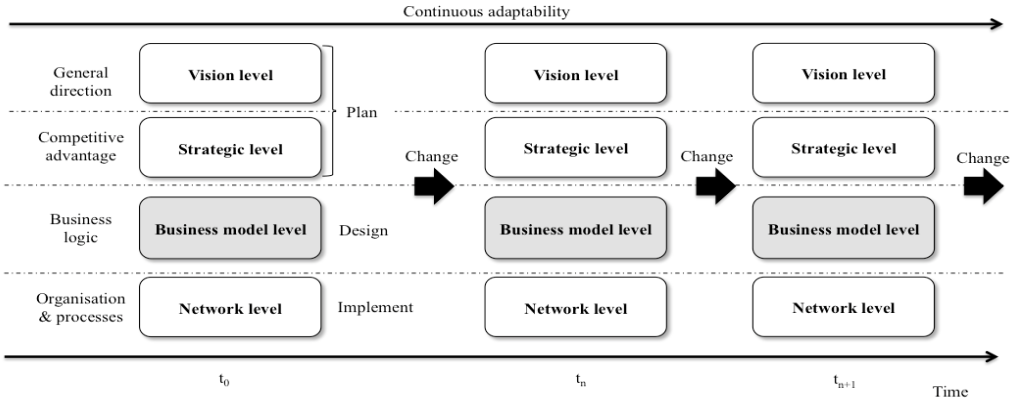

Figure 5: the three-step decisional levels

These three steps should all be reiterated in time to continually adapt the company to the increasingly changing business environment. The business model then depends on a number of external factors that would profoundly affect customer demand and even the need for the products offered (Osterwalder and Pigneur, 2010).

For every external factor, different evolution scenarios might occur in the future, which would lead to a set of appropriate business models for every combination of factor levels.
Therefore, to identify an appropriate business model, we have to decide on the most plausible combination of scenarios. We have then defined four external factors that would affect the business model design.

As we consider the bioenergy pathway, the impact of each external factor on the viability of bioenergy-based diversification strategies is presented.

- *The technological factor*: The development degree of bioenergy technologies is an essential factor in the advent of bioenergy product diversification. Currently, the maturity degree of these technologies varies between demonstration projects and commercial scale status (Bradley, 2009). If the bioenergy technologies become commercially mature during the coming years, it will boost the implementation of these technologies within *P&P* companies. Otherwise, the risk associated with bioenergy investment will remain high, which would promote other diversification pathways such as biomaterials or innovative *P&P* products.
- *The economic factor :* The evolution of bioenergy investment costs would be a key factor to support bioenergy diversification, since capital costs represent 35% to 50% of total bioenergy costs (IEA International Energy Agency, 2011). The current investment costs are still high, presenting a serious barrier to the implementation of bioenergy within *P&P* companies which are already experiencing financial difficulties. Thus, a decline in investment costs would enhance the return on investment of bioenergy diversification. Otherwise, the risk associated with the profitability of such investments would remain high, therefore limiting bioenergy investments within *P&P* mills.
- *The socio-political factor:* As a part of the existing bioenergy technologies is not yet commercially mature and the investment costs are still high, the political regulations and the community environmental pressure would be prominent in the development of bioenergy.
  On the one hand, the governmental financial incentives and the bioenergy investment funds would reduce the financial risk associated with bioenergy investments, thus helping *P&P* companies' stakeholders take that step (Bradley, 2010). On the other hand, the community could promote the integration of bioenergy technologies within forest industry companies, since such an integration would imply the use of biomass, a neutral carbon-cycle energy source (Johnson, 2009), and offer a set of ecofriendly products helping reduce *P&P* companies' carbon footprint and promote their environmental image (Conseil de l'industrie forestière du Québec, 2010).
- *The market factor :* The growth of markets for bioenergy products would be crucial to the development of bioenergy technologies within *P&P* companies (Sparling et al., 2011). In fact, if there were a growing need for bioenergy products within large-scale markets such as energy market and chemical market, it would represent a hedge for *P&P* companies against market entry risk. The development of such markets would be essential for *P&P* companies seeking to diversify their revenue sources by accessing new market spaces beyond the boundaries of conventional *P&P* saturated markets.

For each of these four factors, there could be different development trends. Moreover, for every possible combination of these factors, there should be a corresponding future scenario (**Figure 6**). For each plausible scenario, there would be an appropriate business model ensuring the competitiveness of the company within that environment (Osterwalder and Pigneur, 2010).

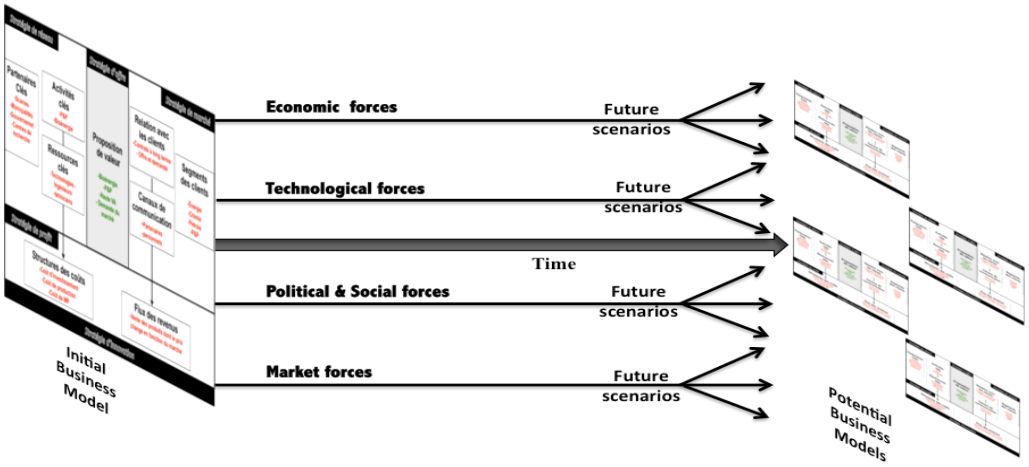

Figure 6: A multi-scenario development for business model

3.5.1. The integrated forest biorefinery business model

A number of reports have been expressed interest in scrutinising the future for the global and North American forest industry (Bradley, 2009; Bradley, 2010; FPAC Forest Products Association of Canada, 2010; FPInnovations, 2011; IEA International Energy Agency, 2010; PricewaterhouseCoopers PwC, 2012). One of the most common findings in these reports is that the bioenergy pathway for the forest industry, particularly for *P&P* companies, would profit from political and social support to achieve the transformation of this industry into a bioindustry, where companies would integrate the manufacturing of high value-added bioproducts in their core strategies. What's more, there would be huge market opportunities for bioenergy products, which are supposed to grow during the coming years (FPAC Forest Products Association of Canada, 2010). As for the technological and economic potential, it has been shown in (de Wit et al., 2010) that there would be substantial development of bioenergy technologies as regards technological maturity and investment cost reduction, enhanced by governmental incentives and increasing global demand.

Thus, the development of the bioenergy pathway, presented as a promising avenue to transform the Canadian *P&P* sector, is considered as one of the most plausible scenarios to occur in the coming years.

The business model that is most appropriate to that scenario is what we have called the *Integrated Forest Biorefinery* (*IFBR)* (A. Van Heiningen, 2006; Chambost et al., 2009; Huang et al., 2009; Stuart, 2006; Thorp, 2005). In **Figure 7**, we present the value creation network of a *P&P* company-based *IFBR*.

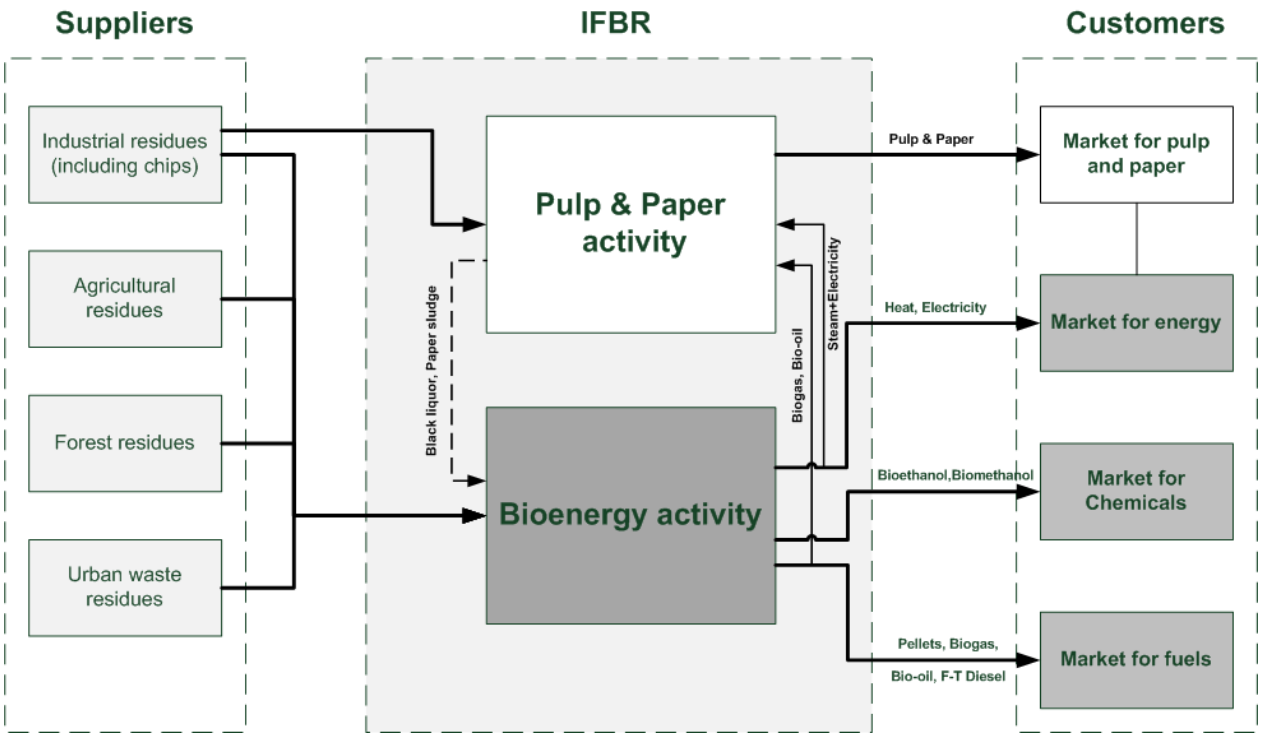

Figure 7: *P&P* company-based IFBR value creation network

An *IFBR*, in the case of a *P&P* company, would integrate bioenergy production to the conventional *P&P* activity, by using supplied and plant-generated biomass and transform it into high-value bioenergy products. The *P&P* activity would produce market-adapted and cost-efficient *P&P* products, and would generate a set of co-products such as black liquor and paper sludge, which could be used to produce bioenergy. To produce bioenergy products, several technologies could be considered in the *IFBR,* such as *Fermentation* to produce *Bioethanol*, *Pelletisation* to produce *Pellets, Pyrolysis* to produce *Pyrolysis Oil*, *Digestion* to produce *Biogas*, *Cogeneration* to produce *Electricity, Heat* and *Steam*, and *Gasification* to produce *Synthetic Gas*. *Synthetic Gas* could be further processed to produce *Fischer-Tropsch Diesel* via *Fischer-Tropsch-Synthesis* technology, *Synthetic Natural Gas* via *Methanation* technology, or *Methanol* via *Methanol-synthesis* technology. The company's energy needs, in natural gas, electricity, heat and steam could be fulfilled by bioenergy production, allowing the *IFBR* to be energy self-sufficient.

The supplied biomass could be industrial residues from other forest mills like sawmills and *P&P* mills, including chips that could be used for both *P&P* or bioenergy production, agricultural residues from farms, forest residues generated by harvesting activity, or even urban waste residues from municipalities. The demand markets would include, besides the conventional *P&P* market, a set of markets such as energy market, chemical market, and power generation distributors.

3.5.2. The nine-block business model canvas

To design the *IFBR* business model, we have used the nine-block business model decomposition introduced in (Osterwalder and Pigneur, 2010) that aims to depict the way the company would do business. The nine components of the business model could be grouped into four strategies.

Each of the four strategies may involve one or several business model components (**Figure 8**).

- *The market strategy*: it controls the relationship between the company and the demand markets. It is based on three elements: *client segments* where the different customer groups that the company aims to serve are defined, *client relationships* that depict the kind of the relationship that the company maintains with each customer segment, and *communication channels* that describe the way the company delivers the created value to each customer segment.
- *The offer strategy*: it presents the centrepiece of the business model and the reason why a customer would choose to deal with that company. The offer strategy portrays the *value proposition* of the company, which defines the value created for each customer segment to meet its specific needs.
- *The network strategy*: it defines the configuration of the value creation network for the offered products. It is composed of three elements: the *key resources* which represent the most important physical, financial and human resources, helping the company create the value, the *key activities* which involve the essential activities to optimise the operational structure of the company such as supply chain management, and finally the *key partners* which present the most strategic collaborators to reduce investment risks or to acquire specific resources or activities.
- *The profit strategy:* it outlines the way the company generates money from its value proposition, as well as how it manages its operating costs. The profit strategy is composed of two elements: the *revenue flows*, which define how the company gets money from each customer segment, and which are the applied pricing mechanisms, and the *cost structure* which describes all operating expenses incurred by the company in order to create and deliver the value proposition to the customers.

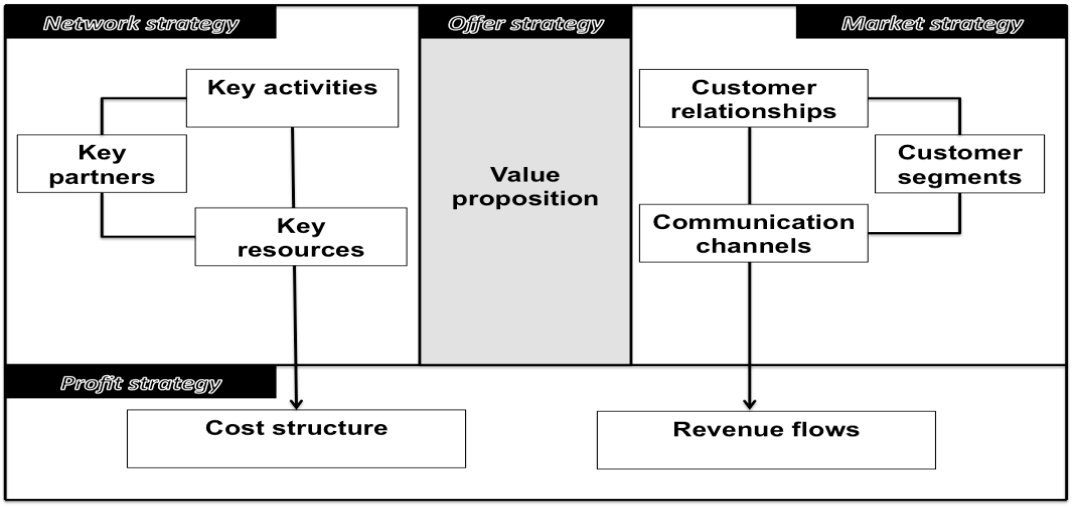

Figure 8: Business model canvas

3.5.3. Case study: The *P&P* company-based *IFBR*

We have applied the nine-block business model decomposition in the case of a *P&P* company-based *IFBR*. Several reports and research works treating the issue of integrating bioenergy into *P&P* companies (Bradley, 2009; Bradley, 2010; Chambost et al., 2008; FPAC Forest Products Association of Canada, 2010; FPAC Forest Products Association of Canada, 2011; FPInnovations, 2011; Ministère des Ressources naturelles et de la Faune MRNF, 2012; Pätäri et al., 2011; Stuart, 2006; Wising and Stuart, 2006) have been useful to gather the different elements composing the business model.

The business model design has been an iterative process of generating ideas; through which the different designed elements have been discussed and improved within the research team in order to converge to a better design.

The question dealing with the starting element when designing business models has been discussed in (Osterwalder and Pigneur, 2010) where the choice of one particular element among the developed nine elements affects the design of the business model. The starting element drives the design of the other elements. In our case, the *IFBR* business model is essentially based on a new value proposition, which is the bioenergy integration. Then, based on the classification presented in (Osterwalder and Pigneur, 2010), the *IFBR* business model is an offer-driven designed business model, where the new value proposition affects the design of the eight remaining elements.

In the following, we propose a number of elements to design the nine business model components.

a. Value proposition

Adding new activities is considered as one of the most viable means to reinvent business models (Amit and Zott, 2012). The developed *IFBR* business model is essentially based on a new value proposition: diversifying the product portfolio by integrating bioenergy products. Besides conventional *P&P* products serving saturated markets, the *IFBR* would offer a number of high-value bioenergy products for new growing markets (FPAC Forest Products Association of Canada, 2011). Such a diversification would allow the company to generate new revenue sources and gain access to a set of high-margin profit markets, beyond the boundaries of the *P&P* industry.

b. Client segments

The *IFBR* customers would be categorised in two groups: the *P&P* product customers composing mass markets, and the bioenergy product customers composing a set of niche markets.
These two customer segments have different requirements: The *P&P* product customers claim innovative *P&P* products, which would be both eco-efficient and cost-competitive.
As for the bioenergy product customers, they would require high-value products that would make it possible to substitute fossil energy and offer a low environmental impact alternative. The challenge would then be to maintain a saturated mass market as well as to gain market shares within growing niche-markets.

c. Distribution channels

To deliver the products to the customers, a company could deploy its own distribution network (direct mode), exploit a partner distribution network (indirect mode), or implement a mixed distribution strategy combining the two modes. For bioenergy products, building partnerships to deliver the products to the markets may be a key factor to reduce the risk of accessing these markets (FPAC Forest Products Association of Canada, 2011).

To implement an efficient distribution network, the different combinations should be well evaluated by considering all related issues. The direct mode requires substantial investment, while allowing the company to generate high profit margins and operate an agile supply chain close to the customers. On the other hand, the indirect mode limits company profit margins but doesn't require initial investments and, for the company, avoids managing the distribution issues and the risks of penetrating such markets (Osterwalder and Pigneur, 2010).

d. Customer relationships

The *IFBR* relationship with its customers would be different for the two principal customer segments. For the *P&P* product customers, the relationship would be essentially based on customer retention mechanisms and revenue maximisation per customer, due to saturated *P&P* markets (Osterwalder and Pigneur, 2010). Forest certification and the offer of ecofriendly products present one of the most efficient strategies to retain customers and even get access to niche *P&P* markets where the environmental criteria represent an essential accessing condition (Chen et al., 2010).

For the bioproduct customers, where the markets are still in their early growth stage, the customer relationship would consist in acquiring market shares. Partnerships and contracts could help the company gain market shares and reduce the risk of market entry. Besides, the company implication within the local communities to develop bioenergy projects would convince them of the social, economic and environmental benefits of bioenergy integration within *P&P* companies and would represent a substantial marketing tool for bioenergy product development (Mangoyana and Smith, 2011).

e. Revenue Streams

In the case of the *IFBR*, the revenue streams would be mainly generated from both *P&P* products and bioenergy products. That revenue source diversification represents a key factor in the *IFBR* business model, as it would reduce the risk of investing in bioenergy by having different revenue sources. One of the most important issues associated with revenue stream management is the pricing mechanism to set the market-selling price of products (Osterwalder and Pigneur, 2010). For *P&P* products, the markets set the price, due essentially to the low-cost competition. As for bioenergy products, the prices rely essentially on the fossil energy product equivalents, by considering, for example, the ratio of their low heating values (National Energy Technology Laboratory NETL, 2009), or by referring to the low heating value of a mix of fossil energy products (Okkonen and Suhonen, 2010).

f. Key resources

To create value, the *IFBR* would require a set of physical, human and financial resources.
For the physical resources, besides the existing *P&P* manufacturing facilities, there would be a need for bioenergy technologies to manufacture the bioenergy products. With respect to human

resources, high-qualified human resources would be required to support the reinvention of the company (BioTalent Canada, 2009). In (Rothwell et al., 2011), the research & development people, engineers, laboratory technicians, and commercialisation staff, are presented as being the key human resources to achieve such a bio-based transformation. As for the financial resources, they would be essential to invest in bioenergy, which requires substantial financial funds, up to several tens of millions of dollars (FPInnovations, 2011). The government contribution would be crucial to provide financial support in the form of incentives and tax exemptions for companies aiming to invest in bioenergy, in order to reduce the investment risks and help these companies take the plunge (Rothwell et al., 2011).

g. Key activities

For the *IFBR*, the key activities would be manufacturing and supply chain management. Since the *IFBR* is essentially based on integrating bioenergy products into the value proposition, manufacturing constitutes a vital activity within the new business model. The production activity consists in manufacturing *P&P* products as well as bioenergy products. It would be crucial to jointly manage the production for both product families, as the *P&P* activity generates a set of co-products that could be converted into bioenergy products and the bioenergy activity allows the mill to meet the energy needs of the *P&P* activity (**Figure 7**).

Besides, the management of feedstock and the distribution of the finished products represent key activities to allow the company to optimise its supplying costs and deliver the right product at the right time in the right place. The complexity of the logistic operations is considered to be one of the main barriers to bioenergy integration within the forest companies (Iakovou et al., 2010). Therefore, a well defined supply chain management jointly optimising the key activities from material supplying to product distribution would be essential to successfully reinvent the business model.

h. Key partnerships

Building partnerships would be crucial for the transformation of the *P&P* Company into an *IFBR*, in order to reduce the investment risks and achieve a successful implementation (Chambost et al., 2009). In fact, there are several uncertainties associated with bioenergy market development, requiring the establishment of partnerships to hedge against these uncertainties and increase the chances of success (Conseil de l'industrie forestière du Québec, 2010). In (Chambost et al., 2009), four principal categories of partnerships to build have been identified when implementing integrated forest biorefineries. We have adapted and developed this classification to the case of the proposed *P&P* company-based *IFBR*.

- *The supplying partnerships*: they allow the company to ensure a steady availability of biomass to hedge against the periodic fluctuations, and to minimise supplying costs due to economies of scale.
- *The commercial partnerships*: they help the *IFBR*s enhance the commercialisation of the bioenergy products and gain access to the associated markets. There are several sectors such as oil, chemicals, automobile, aerospace and agriculture that could be strategic commercial partners for the *P&P* companies to achieve their transformation (FPAC Forest Products Association of Canada, 2011).
- *The technological partnerships*: they accelerate company access to the bioenergy market by profiting from the partners' technological expertise in developing and implementing

bioenergy technologies. The *IFBR*s should also build partnerships with research and development organisms such as universities, and private and public research organisms to assess the feasibility and profitability of bioenergy investment (Rothwell et al., 2011).

- *The financial partnerships*: they are vital to provide the required financial funds to invest in bioenergy. The financial funds represent a key factor in the development of bioenergy within the *P&P* sector, as the lack of such funds represents one of the main barriers to the advent of bioenergy integration within *P&P* companies (FPInnovations, 2011).
  The government is currently the principal source of financing for bioenergy investments in the Canadian forest industry. The remaining funds come essentially from private venture capital (Rothwell et al., 2011). Having a clear business model highlighting the logic the company would create value and earn money would be a substantial step to convince private capital to financially support the biotransformation of the sector.

In **Figure 9**, we illustrate the potential partnerships the *IFBR* could build throughout the value creation network, from the research and development stage to the finished product distribution, in order to maximise its chances for a successful transformation.

Research & Development	Supplying	Manufacturing	Distribution
IFBR Value creation network			
Technological partners Universities Public research organisms Private research organisms	Supplying partners Municipalities Farmers Forest companies Industrial residues generating companies	Technological partners Bioenergy technology vendors Other P&P companies Financial partners Government Private venture capital	Commercial partners Forest industry Chemical industry Oil industry Aerospace industry Automotive industry

Figure 9: potential partnerships for IFBR

i. Cost structure

The operating cost reduction remains a priority for most *P&P* companies to support their transformation into *IFBRs* (PricewaterhouseCoopers PwC, 2010a). For the North American *P&P* companies, saturated markets and the highly competitive environment they are facing make it essential to maintain a flexible and cost-efficient operational structure to allow them to thrive.

The cost structure could be defined once the key activities, the key resources and the key partnerships have been defined. In the case of the *IFBR*, the operating costs are associated with the supplying, manufacturing and distribution activities (**Figure 10**). For the supplying activity, the costs would be principally feedstock supplying. Regarding the manufacturing activity grouping the bioenergy and the *P&P* product manufacturing, the operating costs are composed of fixed costs, such as the annualised investment costs and the fixed operating costs including staff remuneration and maintenance costs, and variable costs that mainly consist of direct labour costs. As for the distribution costs, they include the finished product transportation costs as well as the commercialisation-related costs.

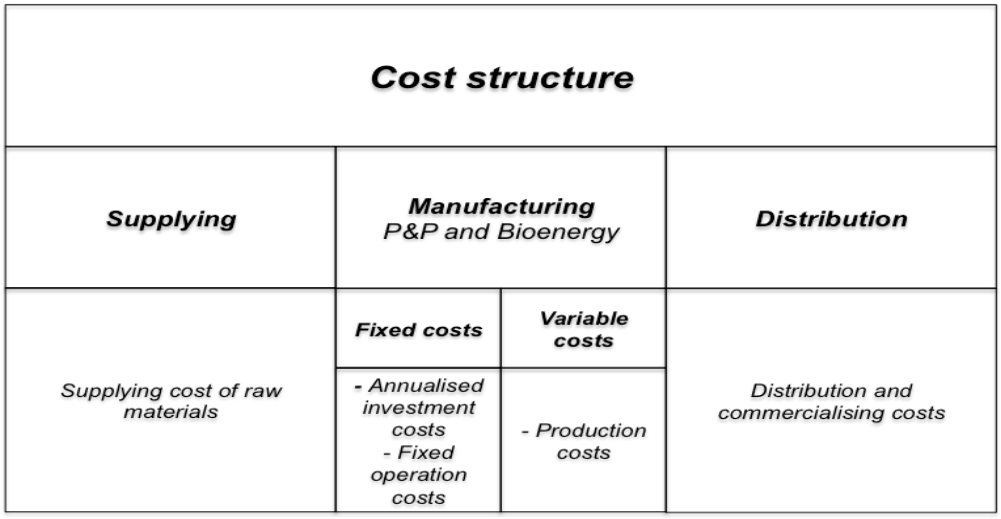

Figure 10: cost structure for the *IFBR*

In fact, optimising the process efficiency all along the *IFBR* supply chain would be crucial to achieve long-term competitiveness, as the companies would not decide about feedstock and finished product prices, which would be set by the market (PricewaterhouseCoopers PwC, 2010a).

In **Figure 11**, we summarise the entire nine elements described above that compose the *IFBR* business model. The different elements we present aim to help *P&P* decision makers within *P&P* companies design an efficient business model translating the formulated transformation strategy throughout the company value chain.

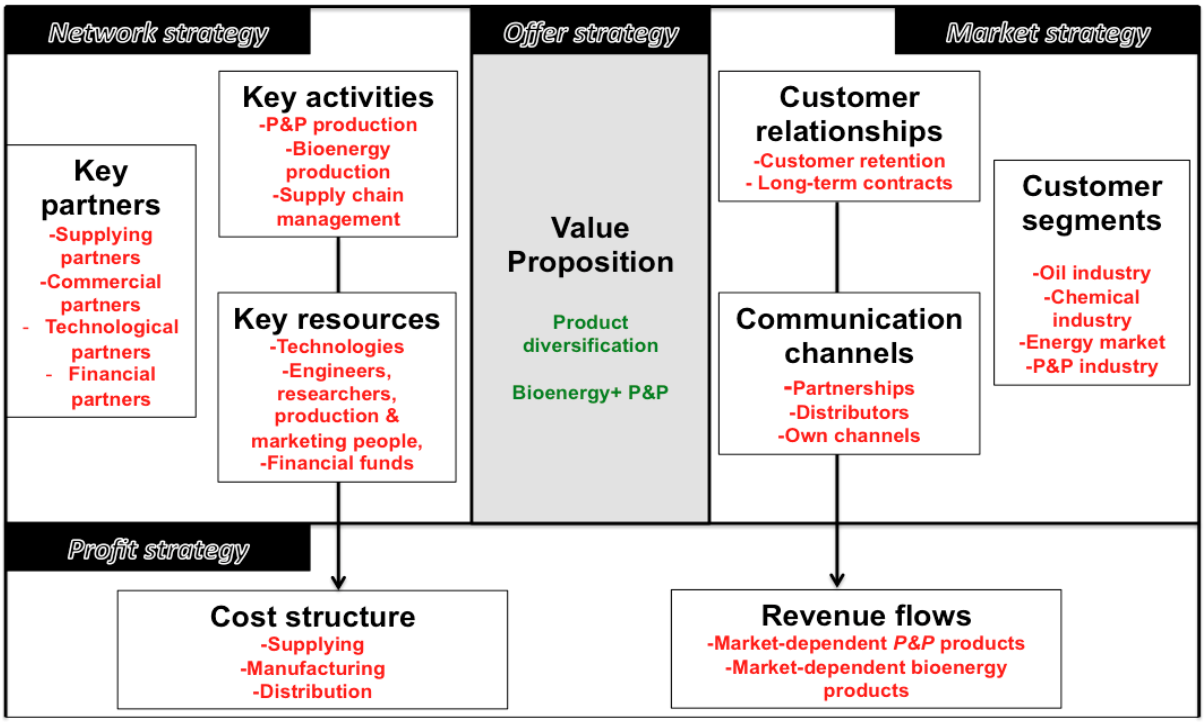

Figure 11: The business model canvas for a *P&P* company-based *IFBR*

3.6. Business model validation

Once the business model has been designed, its validation before being implemented is an important step that aims to simulate the business model performance via a set of low-risk experiments, without exposing the company to the real investment risks (Osterwalder et al., 2005). In (Magretta, 2002), the business model development process is likened to the scientific method design process, in which one starts with a hypothesis, tests it, and revises it when necessary.

The uncertainty associated with the viability of bioenergy investments is one of the main barriers to their integration within the forest industry. Thus, simulating the business model would help anticipate its profitability and possibly rectify the design before its implementation.

In the literature dealing with the design of business models, a few works have been interested in raising the issue of simulating business models before implementation. Some studies have argued that testing viability is an essential step when designing business models (Chesbrough, 2010; Magretta, 2002; Osterwalder and Pigneur, 2010), without explicitly detailing that testing step.

To our knowledge, only two contributions have focused on developing explicit methods to simulate business models before their implementation. In (McGrath and MacMillan, 1995), a five-step approach, called *discovery-driven planning*, has been developed that allows modelling the economic profitability of a new business model, by formulating a set of hypotheses, testing their effect on the business model profitability, and adjusting them according to the test results. In (Hamel, 2000), three criteria have been suggested to assess the potential of a designed business model: *efficiency* which measures the profit margins relative to the operating costs, *uniqueness*

which evaluates the originality of the business model compared to those of competitors, and *profit accelerating* which estimates the capacity of the business model to rapidly grasp the new market opportunities.

In this paper, we propose four performance indicators to test the potential of the designed business model before its implementation. We distinguish the quantitative indicators, of which the measure is compared relative to predefined thresholds, and the qualitative indicators, of which the measure depends on the evaluation of the stakeholders. For the latter ones, the evaluation would be done by determining whether or not the business model meets the required evaluation of that indicator.

3.6.1. Quantitative indicators

The quantitative indicators that we have defined aim to assess the economic profitability as well as the environmental impact of the *P&P* company-based *IFBR* business model. In fact, *P&P* companies should now consider the environmental aspect when reinventing their business model to meet the growing social and political requirements regarding fossil energy consumption and carbon emissions (Chaabane et al., 2012).

a. Net present value (NPV)

It measures the long-term profitability of the *IFBR*, by evaluating the financial investment returns during a given planning horizon. For *T* periods, the *NPV* is the sum of future discounted cash flows, taking into account the investment costs and the operational profits, and the *IFBR* salvage value discounted at the end of the planning horizon. The salvage value is the estimated financial value of the company, once the assets' accounting depreciation and the debts have been deduced (**Equation 1**).

$$NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+r)^t} + SVT \qquad \textbf{(1)}$$

Where

- CF_t : Future periodic cash flow;
- r : Discount rate;
- SVT : Discounted salvage value estimated by the end of planning horizon.

If the obtained *NPV* is greater than the predefined threshold, the designed business model would likely be profitable. Otherwise, the design process should be reviewed.

b. Greenhouse gas emission reduction (R_{GHG})

It quantifies the environmental of the *IFBR*. In fact, several elements of the transformed business model, such as the embedded bioenergy technologies, the network configuration as well as some built partnerships would affect carbon emissions throughout the value creation network. The reduction rate of *GHG* emissions, by a future period *t*, relative to the initial emissions of the conventional *P&P* company, is given by **equation 2**.

$$R_{GHG}^{t} = 100\% \times \left(\frac{GHG_{IFBR}^{t} - GHG_{P\&P}^{0}}{GHG_{P\&P}^{0}} \right) \qquad \textbf{(2)}$$

Where

- GHG^{t}_{IFBR}: *GHG* emissions of the *IFBR* over a given future period *t*;
- $GHG^{0}_{P\&P}$: Initial *GHG* emissions of the conventional *P&P* company.

A reduction threshold could be set for a given term, aiming to allow the *IFBR* to meet the future environmental requirements or to fulfil a predefined internal commitment. If the measure of the anticipated reduction rate meets the required threshold, the business model would then be aligned with the environmental commitments the company would face in the coming years. Otherwise, the environmental impact of the designed business model has to be re-evaluated to further support the sustainable transformation of the company.

3.6.2. Qualitative performance indicators

The presented qualitative indicators help the stakeholders scrutinise the adaptability of the business model to the changing business environment as well as its acceptability by the community. We believe that the adaptability and the acceptability of the business model would be crucial criteria to ensure a sustainable competitive advantage for the *IFBR*.

a. Adaptability

It assesses the capacity of the designed business model to adapt to the economic, technological and socio-political changes that would occur within the *P&P* companies' business environment during the coming years.

To remain competitive within a tough economic context, struggling companies should adapt their business models at the right time to the changes occurring in technologies and markets (Bower and Christensen, 1995). At the economic level, there would be several changes regarding market prices and demand levels for both conventional and bioenergy products. The *IFBR* should be able to continuously adapt its business model to these changes, in order to maintain a sustainable business.

With respect to the socio-political aspect, governmental legislations and community requirements would likely change in the coming years regarding the environmental requirements and the financial and social incentives to invest in bioenergy. The business model should be easily adapted to these major shifts, to transform them into sources of competitive advantage.

As for the technological level, several bioenergy technologies would experience a substantial advent during the next years, regarding the investment costs and the conversion yields (IEA International Energy Agency, 2009). The *IFBR* business model should then be flexible enough to invest in these technologies in the right capacity and at the right moment.

Thus, the stakeholders should evaluate whether the business model would be easily adapted to the technological, economic and social-political changes that would affect the *P&P* sector in the coming years.

b. Acceptability

It evaluates the social acceptability of the community concerning the developed business model. In the coming years, the pressure of the community will be important, requiring eco-responsible products which would make it possible to substitute fossil energy products and enhance the environmental commitment of the *P&P* sector (Brunette, 2011). Thus, convincing the community

about the environmental and economic advantages associated with the *IFBR* business model would be essential for the transformation to be successful.
In Quebec, members of the civil community participate in redesigning forest management strategies in order to meet the new environmental requirements. This participation remains insufficient and should be involved when designing business strategies (Bouthillier and Roberge, 2007).
One of the reasons for the Quebec forest industry crisis is that the community no longer believes in the environmental and social commitment of the forest industry (Ministère des Ressources naturelles et de la Faune MRNF, 2008). Therefore, integrating the civil community in the validation process of the designed business model would be profitable for P&P companies to promote the environmental and social potential of the *IFBR*.
The four performance indicators described above would be crucial to simulate the viability of the *IFBR* business model before its implementation. Once each indicator has been evaluated, two decisions could be made: validating the business model design, or invalidating it.

3.6.3. Invalidation

If the evaluation of one or several performance indicators is considered unfavourable, reviewing the company's decisional choices is essential. The revision could be limited to reviewing one or several components of the designed business model, changing some elements in the defined strategy, or even adjusting the strategic vision (**Figure 1**).

This reviewing process could be repeated until the expected levels for the defined performance indicators have been obtained, or a consensus reached among the stakeholders on the required performance levels for the designed business model.

3.6.4. Validation

If the indicators evaluation is positive, the designed business model is estimated as being viable and ready to be implemented. In the implementation step, the business model would be transformed into a detailed business plan (Osterwalder et al., 2005). The business plan translates the business model into concrete elements including the organisational structure, the business processes, and the infrastructure and systems (Osterwalder et al., 2005).

3.6.5. Continuos adaptation

After being implemented, the business model should undergo a continuous process of adaptation, which includes revision and refinement (Morris et al., 2005). In fact, business models are considered as perishable (Govindarajan and Trimble, 2011) and have to be reinvented after a period of time. As we have mentioned in the "*opportunity spotting*" step of the developed approach, a number of external incentives (technological, economic and sociopolitical) would emerge in the future, requiring an iterative transformation of the company business model. The business model design approach should then consider a business model life cycle, involving a closed loop of planning, design, validation, revision and adaptation (**Figure 1**).

The presented business model, the *P&P* company-based *IFBR*, is an example of that adaptation cycle, by making it possible for *P&P* companies to offer an innovative value proposition by

integrating bioenergy products within the *P&P* mill product portfolio, therefore allowing the company to access new market spaces. That value innovation would be crucial for the *P&P* sector to evolve towards a competitive business model. Still, the business model reinvention process has to be continually adapted to the major shifts within the company's business environment, allowing it to achieve a sustainable business.

4. Conclusion

To overcome the economic stalemate, Canadian forest companies, particularly the *P&P* companies, are seeking long-term solutions to regain their competitiveness. Value innovation is conceived as a viable avenue for those companies to diversify their revenues and create new market spaces. Bioproducts, especially bioenergy products, are considered to be a promising pathway for *P&P* companies to achieve a sustainable business.

The decision-support approach presented in this paper aims to propose a practical framework to help *P&P* companies' decision-makers to plan, design and implement a new business model underlining that value innovation.

To successfully reinvent the *P&P* companies' business model, a multi-level transformation process has been developed to align all the decisional levels with the proposed new value, involving a global vision depicting the general direction of the company, a strategy translating that vision into long-term objectives, and a business plan ensuring an effective implementation of the designed business model.

Starting by analysing the competitive situation of *P&P* companies and identifying the potential opportunities for change, a four-action framework has then been applied to define sources to create an innovative value for those companies. Next, a series of analyses adapted to the Canadian *P&P* sector have been conducted to identify a new vision as well as an adapted strategy to support the transformation. Through a scenario analysis, the integrated forest biorefinery *IFBR* is identified as a promising business model for the most plausible changes which would occur within the business environment of Canadian *P&P* companies. After that, a nine-component business model canvas has been adapted to design a *P&P* company-based *IFBR* business model. Before being implemented, a validation step, where a set of performance indicators have been presented, has been suggested to simulate the viability of the designed business model without directly incurring the implementation risks. Via a closed-loop adaptation process, the aim of the approach is to continuously adapt the *P&P* companies' business models to the major economic, socio-political and technological shifts affecting the *P&P* competitive environment.

Our contribution has been to propose a decision-support framework to help *P&P* companies understand and manage the challenges they are confronted with as well as the business opportunities that lie open to them, and then adapt their different strategic levels to the future trends that would occur within their business environment. Our primary goal has been to propose a set of strategic tools to support those companies in reinventing their business models, in order to transform those opportunities into a source of sustainable value innovation.

The *P&P* company-based *IFBR* business model is presented as a promising business model to respond to the increasing challenges affecting the competitiveness of the *P&P* sector. Therefore,

further analyses are required to assess its long-term profitability while considering the future trends associated with such a transformation. In our future work, we will focus on developing a decision-support methodology to allow *P&P* companies to achieve roadmap to a viable transformation.

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