Inter-firm Collaboration in the Forest Products Industry: A Literature Review

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Abstract

International competition, particularly in the forest products industry, is constantly increasing; even the largest companies have had to adapt to keep their market share. A successful strategy, for enterprises to remain competitive, is to establish collaborations with other business entities in order to access new markets and satisfy customer demand. The goal of this paper is to investigate the relevance of collaboration in the forest products industry via a systematic literature review method and explore the proposed collaboration mechanisms, main drivers, benefits, facilitators, and challenges of collaboration. A total of 70 articles were reviewed and results demonstrate the importance of collaboration in the forest products industry. Joint practices and contractual and economic practices are among the most popular collaboration mechanisms identified. Furthermore, lack of trust and developing a win–win collaboration condition seem to be the key challenges in this industry. On the other hand, cost based strategy, sustainability and environmental performance, and competition are among the principal drivers and benefits faced by the sector. Finally, financial incentives, bonuses and subsidies are the most important facilitators. A framework for inter-firm collaboration in the forest products supply chain is proposed in order to help firms identify the best-fit collaborative mechanisms for their particular collaborative initiative.

Keywords
Forest products industry; inter-firm collaboration; systematic literature review.

1. Introduction

Canada, with its 347 million hectares of forest, which represent 9 % of the world forests, is the third- most forested country in the world. In 2018, the forest sector in Canada employed 204,555 people. In 2019, it contributed $23.7 billion to Canada's nominal gross domestic product while the export value was about $33 billion (Natural Resources Canada, 2020). According to Natural Resources Canada's 2020 annual report, challenges in Canada's forest sector are uncertainty in global trade, changes in consumer demand, and increasing international competition. Due to such challenges the forest products industry needs to revise its current business strategies and policies and implement new models capturing new opportunities to stay competitive on the market (Vahid et al., 2014; Mobtaker, 2018).

The forest products supply chain (FPSC) is defined as the processing steps starting with harvesting operations and ending with logistics and sales activities (Müller et al., 2019). It consists of a series of activities including forest harvesting and management, deployment and maintenance of the forest road network, transportation of the trees and logs, forest products manufacturing, and distribution of the products to customers. There is no clear boundary between different entities and interactions such as sharing resources, cost allocation, and risks between these independent agents lead to complex interdependencies. To solve such a problem, collaboration is considered as a potential approach to resolving difficulties arising from the interdependencies between the members involved (Azouzi & D'Amours, 2012; Gilabert, 2014). Inter-firm collaboration in the FPSC could lead to new opportunities while achieving higher profit for their businesses that was not possible to achieve individually (Azouzi & D'Amours, 2012).

In this research, a systematic literature review (SLR) identified how collaboration is present for the forest products industry. It should be noted that, in this research, references from 2010 to 2020 were considered. For this SLR, a set of keyword combinations relating to the forest products industry, forest supply chain, collaboration, and collaborative strategy were systemically searched in specific fields of selected search engines. A total of 70 articles respecting the search criteria were found and analyzed in order to identify the different collaboration forms and collaboration

mechanisms used in the research as well as benefits, challenges, drivers, and facilitators for this collaboration. Based on this knowledge, a framework for FPSC inter-firm collaboration was then developed, summarizing the collaboration dynamic for this specific industry.

This paper is structured as follows. The following section presents the methodology used for the SLR. Section 3 details the analytical results obtained for different collaborating mechanisms, drivers, facilitators, challenges, and benefits. Section 4 discusses the findings and presents the framework developed to support inter-firm collaborations in the forest products supply chain. A conclusion is given in the last section.

2. SLR Methodology

The objectives of this article are to investigate the role of collaboration in the forest products industry and to identify the collaboration mechanisms, drivers, benefits, challenges, and facilitators related to this sector. To achieve this goal, a systematic literature review was conducted. This method reviews and critically analyzes published academic research on a specific subject, which allows us to identify the scope of the review and specify a set of questions to answer. This SLR applied replicate methods as described by Tranfield et al. (2003). According to the authors, an SLR can be performed in three stages: planning the review, conducting the review, and reporting and release. The following sections detail each of these steps.

2.1. Planning the SLR

To systematize the knowledge about concepts, strategies, and techniques in forest products industry collaborations, the research questions to be addressed are:
Q1: What are the different forms and mechanisms of collaboration that are present in the forest products industry?
Q2: What are the challenges and benefits associated to the different forms of collaboration in the forest products industry?
Q3: What are the drivers and facilitators associated to the different collaboration forms in the forest products industry?

2.2. Conducting the SLR

Concerning the article collection process, different electronic databases were searched: Compendex, Web of Science, ScienceDirect, and Google Scholar. The review focused on collaboration in the forest products industry literature, from 2010 to 2020. In order to narrow down the review field and select the most relevant studies, 15 triads of keywords were searched in the following fields of each database: 'Title', 'Keyword', and 'Abstract'. The keyword 'forest products' was in each triad. The second keyword in the triad was either 'collaboration', 'partnership', 'integrated' or 'collaborative'. The third keyword in the triad was either 'supply chain', 'industry', 'companies' or 'enterprises'. The initial search resulted in 175 articles. Articles relating to forest management and natural resources management only were rejected since they were outside the scope of this study. Hence, a total of 70 articles were selected for this SLR. The results are presented in the next section, which aggregates the findings from reviewed articles and answers the research questions stated above.

3. Analytical results

Each of the 70 papers was carefully analyzed to extract the article title, author(s), journal, publication date, research methods, collaboration models, mechanisms used to perform collaboration, drivers, challenges, benefits, and facilitators associated with this collaboration. These elements were then categorized to identify inter-firm collaboration theories, scopes, and approaches in the forest products industry.

3.1. Mechanisms of inter-firm collaboration in the forest products industry

According to the articles in this SLR, the forest products industry could collaborate based on different mechanisms. The first step to find the categorization for the collaboration mechanisms was to examine all of the collaboration mechanisms presented in the papers. The collaborative mechanisms found in this SLR were classified into five categories, which are inspired by Cloutier et al. (2020) and Kang & Hwang (2017): (a) Joint practices; (b) Technological and information sharing practices; (c) Contractual and economic practices; (d) Governance practices; and (e) Environmental practices.
A description for each category is given below:

- ✓ **Joint practices (JP):** In this SLR, common, bilateral, and mutual activities involved among the parties are labeled as joint practices, inspired by Cloutier et al. (2020) and Mentzer (2001). Monitoring and evaluation of performance often involve a performance reward process, such as ranking, awarding, and provision of monetary incentives. The spectrum of joint practices ranges from joint planning up to joint control activities. This mechanism is the most popular one among other mechanisms in this SLR. For example, Yoshida and Kohroki (2019) mentioned a group of self-employed forest owners in Japan who developed a forestry machine sharing system to improve productivity in collaboration with their local government.
- ✓ **Technological, knowledge and information sharing practices (TI):** According to Kang & Hwang (2017), information and knowledge sharing is one of the most critical collaboration mechanisms, because it can promote the understanding of the partners' goals, values, present status, and activities among others. Montoya-Torres and Ortiz-Vargas (2014) defined technological and information sharing practices in supply chains as the activities, data, and tools used in facilitating the procedure of collaboration among different entities of a supply chain. An example from Dorval et al. (2012) described the Virtual Transportation Manager that allows collaborative planning using the web to help in sharing the transportation requirements for better routing in order to reduce costs. Other examples can also be found in Azouzi & D'Amours (2011) and Düdder & Ross (2017).
- ✓ **Governance practices (GP):** The rules, trends, policies, and administrative laws that control, direct or manage the activities, organizations, and systems are all addressed in this category (Cloutier, et al., 2020). Robitaille et al. (2017), Dockry et al. (2018) and Hayter & Clapp (2020) are authors who mentioned several mechanisms from this category.
- ✓ **Contractual and economic practices (EP):** An oral or written agreement that creates mutual legal obligations among stakeholders is a contract. All parties are obliged to accept their responsibilities and respect their promises within this formal agreement. Economic practices such as incentive alignments and cost-profit sharing are also included in this category (Cloutier et al., 2020). The goal of these mechanisms is to motivate long-term and steady collaboration between firms as well as clearly indicate expectations from each party. These articles gave examples from this category: Beaudoin et al. (2010), Audy et al. (2011), Lehoux et al. (2014, and Palander et al. (2015).
- ✓ **Environmental practices (ENV):** This category is about taking environmental aspects (sustainable timber harvesting, waste reduction, etc.) into consideration for collaboration. Ajao et al. (2018) and Zander et al. (2016) mentioned several mechanisms in this category.

The results in Figure 1a below show that joint practices and contractual and economic practices examples found in 30% and 25% of the contributions, respectively, are the most mentioned in this SLR.

3.2. Drivers of inter-firm collaboration in the forest products industry

For each article, the key drivers for collaboration were identified. According to this SLR, we explored ten different classifications of drivers inspired by Guerrero & Hansen (2018): (1) Cost reduction/ saving, (2) Sustainability and environmental performance, (3) Value creation, (4) FPSC optimization and improvement, (5) New business model, (6) Innovation, (7) Networking, (8) Market development, (9) Corporate social responsibility/ forest governance and (10) Competition. Table S1 in the appendix gives a more detailed description of these ten driver categories with a list of references.

The results in Figure 1b show that cost reduction/saving, FPSC optimization/improvement, and sustainability are the most mentioned drivers in this SLR. The category corresponding to new business model and networking represented the least mentioned.

3.3. Benefits of inter-firm collaboration in the forest products industry

Forest products companies are willing to collaborate if the benefits achieved from the partnership are more satisfying than the benefits obtained individually. In this study, the benefits of collaboration in the forest products industry were classified into two categories: quantitative and qualitative. For example, cost reduction is a quantitative benefit and learning new logistic skills is a qualitative benefit (Audy et al., 2010). Potential cost savings, improvement of total benefits, optimization of operations (e.g. optimize transportation), and delivery time reduction are the most common quantitative benefits according to this SLR (Gaudreault et al., 2011; Lehoux et al., 2014; Yoshida & Kohroki, 2019; Ajayi, 2016). While deepening commitment, long-term relationship, better planning behaviour, and improvement of environmental performance are the most common benefits among the qualitative benefits (Reis-Silva & Carrizo-Moreira, 2018; Robitaille et al., 2017; Hisjam et al., 2015; Ogunwusi & Olife, 2012).

3.4. Challenges and barriers in collaboration

Certain challenges were observed though this SLR. In this section, the challenges to collaboration in the forest products industry were categorized into four different groups:

- ✓ **Relationship, management and communications** in which the partner selection, synchronization of partners (e.g. conflict in mission and responsibilities), leadership role, and power of negotiation are the most significant items (Toppinen et al., 2011; Eriksson et al., 2017; Frisk et al., 2010).
- ✓ **Financial and economical** which contains the challenges such as developing a win-win condition, distributing total cost saving and marketing (Lehoux et al., 2014; Shahriari et al., 2015).
- ✓ **Reliability and risk taking** where lack of trust, opportunistic behavior of the partners, lack of information sharing, and convincing partner to try new things are the most significant examples of the challenges in this category (Eriksson et al., 2017; Bhattarai et al., 2018).
- ✓ **Logistics and transportation** in which maintaining the collaboration, dynamic order arrival process, routing problems, control over inventory (e.g. timber availability) in large forest companies, and synchronization between supply and demand are the most common examples in this SLR (Gaudreault et al., 2011; Farnia et al., 2015; François et al., 2017).

3.5. Facilitators

Finally, the facilitators that can support collaboration and the implementation of the collaborative methods were explored. The most significant facilitators identified by this study include financial incentives, the use of a bonus, and subsidies (Yoshida & Kohroki, 2019; Lehoux et al., 2014). As well, backhauling, integrating operation scheduling, and sharing common routes are examples of supporting factors to the logistics and transportation collaboration (Dorval et al., 2012). Fair and meaningful interaction among the partners, aligning contract and participatory planning, monitoring and good governance are the significant factors supporting collaboration and eliminating the lack of trust (Elleuch et al., 2012; Zurba et al., 2016).

3.6. Summary

The percentage of the studies related to each element of inter-firm collaboration studied in this SLR for the forest products industry is shown in Figure 1. The most significant drivers for collaboration in the forest products industry observed in this study are cost-based strategy, FPSC optimization/improvement, as well as sustainability. The benefits obtained from collaboration are categorized as qualitative or quantitative. Cost reduction and faster delivery time are common examples of the quantitative benefits, in contrast, earning new skills and competitive advantage are popular items seen among the qualitative benefits. Finally, creating a win-win collaboration, distributing total cost or saving, routing problems, complete control over timber availability, partner selection, lack of trust, maintaining collaboration, and the opportunistic behaviour of partners are the most significant challenges for collaboration in the forest products industry. Some articles mentioned more than one mechanism, challenge, driver and/or benefit. Each article was analyzed to tally all of the elements present. Hence, the percentage shown in Figure 1a indicates the distribution of the total tallied elements from collaboration mechanisms. Figure 1b shows the distribution of the total elements from collaboration drivers. Figure 1c and Figure 1d show the distribution of the total elements from collaboration challenges and collaboration benefits respectively.

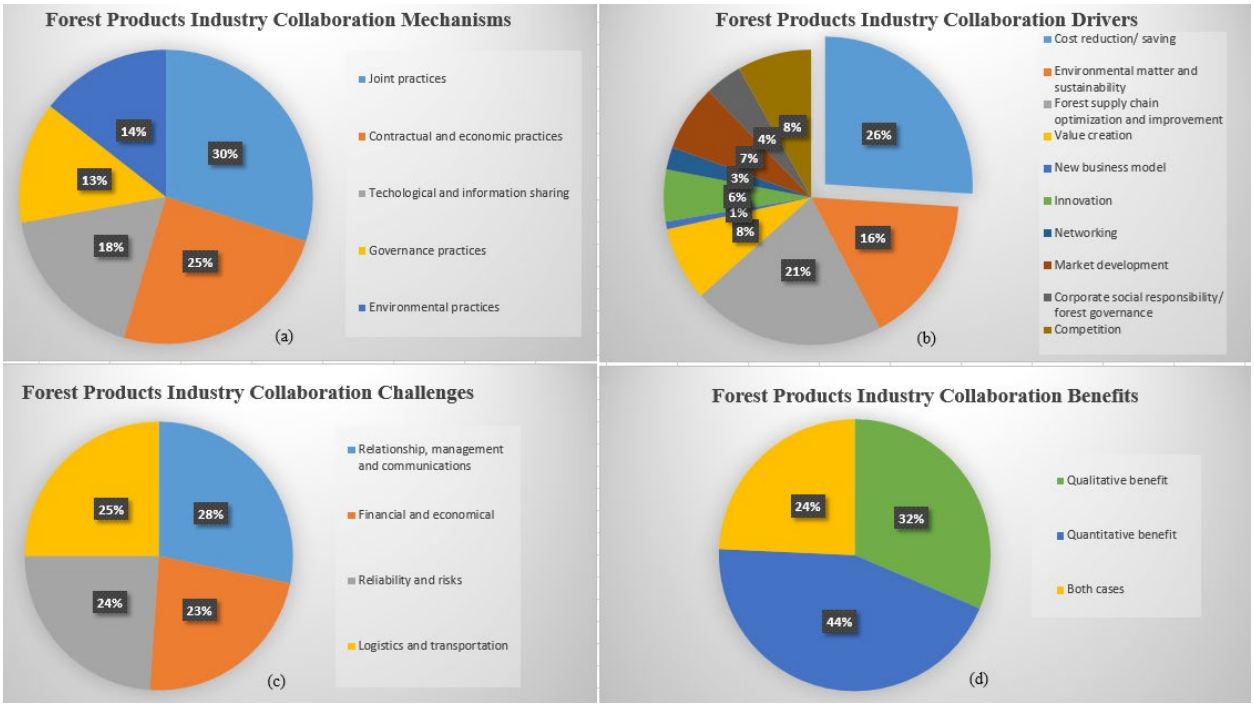


Figure 1. The distribution of the total tallied elements in the SLR from each category: (a) Collaboration mechanisms, (b) Collaboration drivers, (c) Collaboration challenges, and (d) Collaboration benefits.

4. Discussion

In-depth analysis of the data extracted from this SLR showed that for FPSCs, some collaborative mechanisms were associated more closely to specific drivers, challenges, benefits or even particular activities within the supply chain. Figure 2 provides an overview of the inter-firm collaboration model for FPSCs. It summarizes the activities, drivers, mechanisms, challenges, facilitators, and outcomes specific to collaboration in this industry. It highlights for which drivers and activities, the collaborations mechanisms that were observed in this SLR are implemented. It also illustrates the different collaboration challenge categories and the facilitators that help address them. Finally, the framework presents the outcomes that emphasize the value of these collaborations.

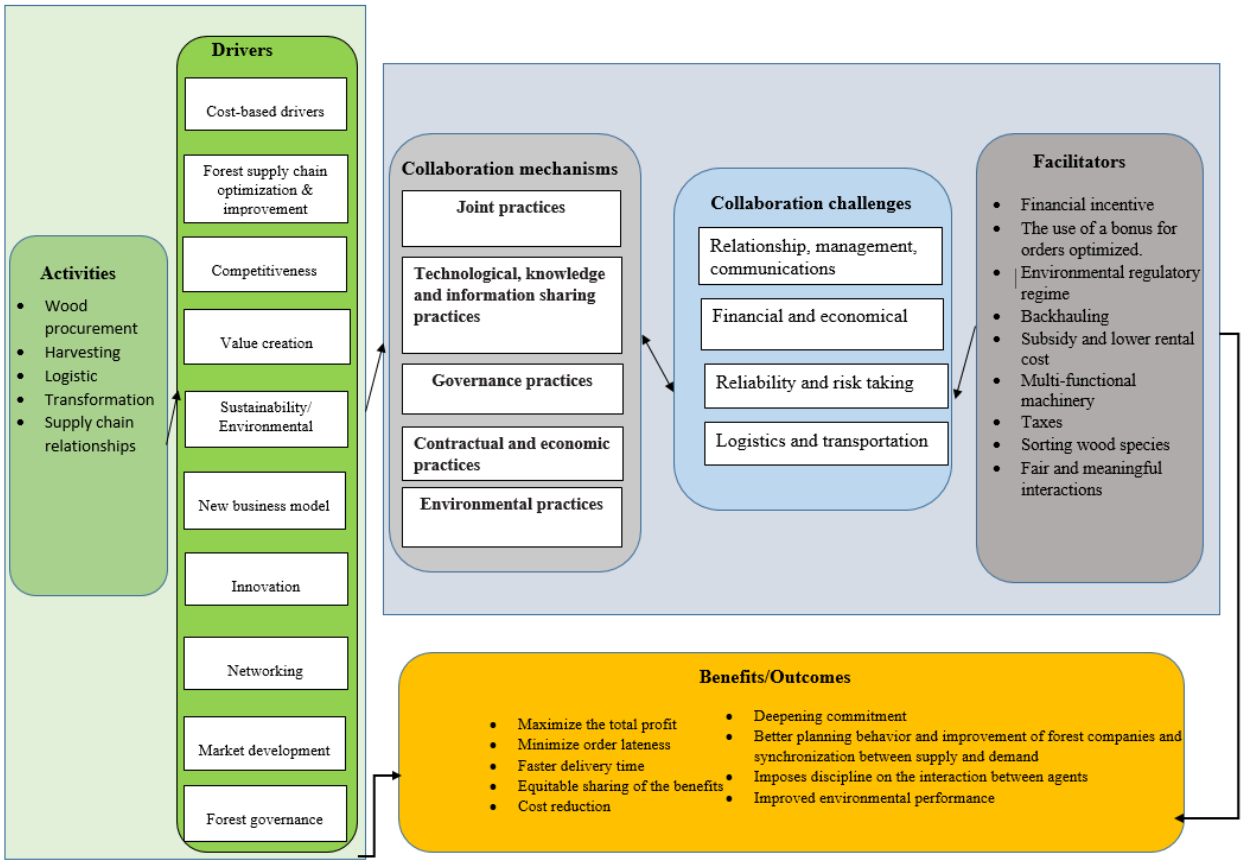
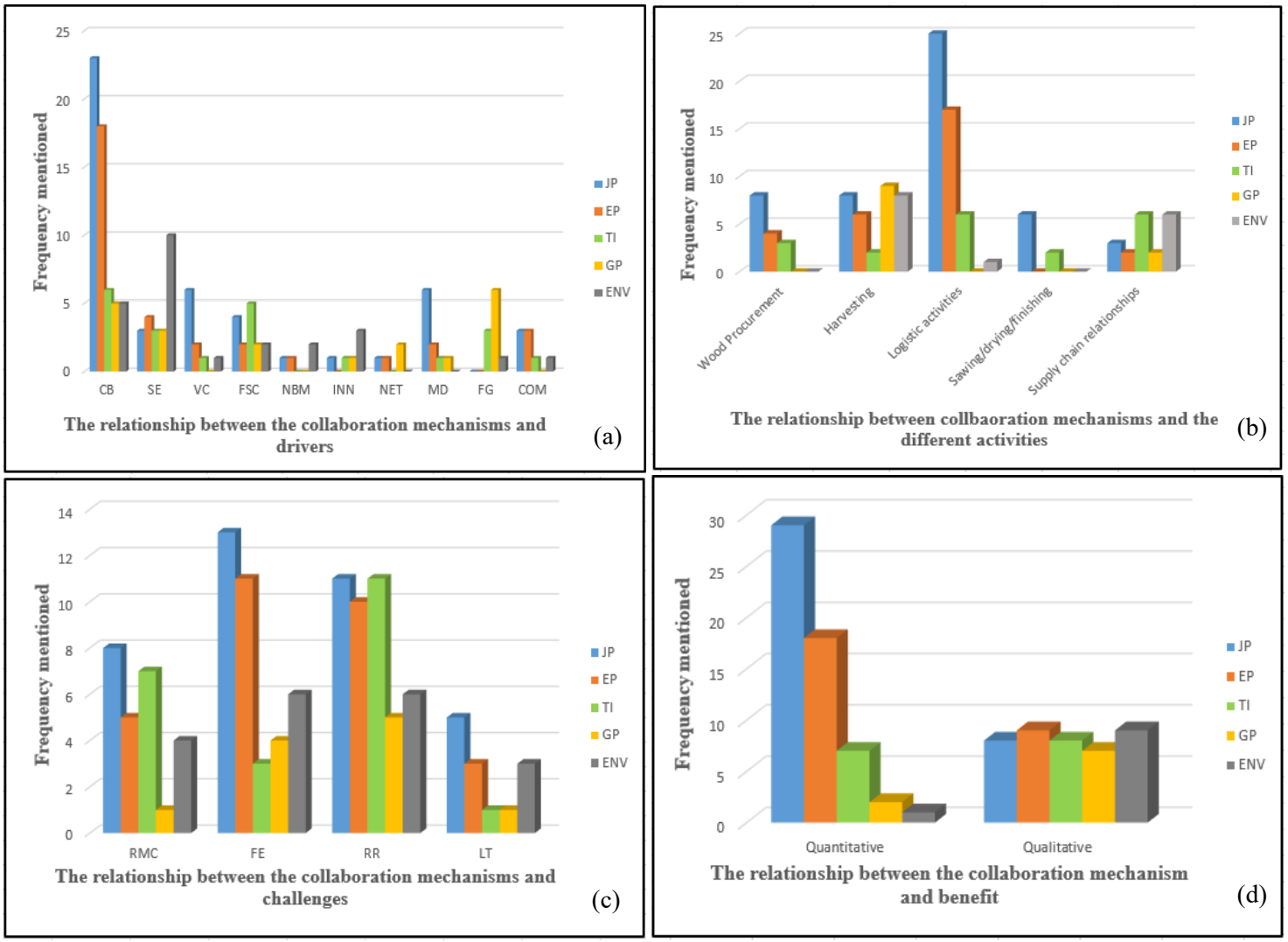


Figure 2: A framework for FPSC inter-firm collaboration

Figure 2 summarizes the various elements that influence collaboration in the FPSC and illustrates the relations between them. Indeed, a company could identify the outcomes they are looking for and the drivers that are pushing them toward collaboration with other companies. As discussed previously, these outcomes and drivers have an impact on the best collaboration mechanisms to apply. On the other hand, if companies have already initiated the collaboration, they could use Figure 2 to target the challenges that seem more problematic from the four listed. Figure 3 can then be used to identify which collaborative mechanisms are most often used given these drivers or challenges.

The elements shown in Figure 3 indicate the relationship between the collaboration mechanisms and the drivers, challenges, FPSC activities, and benefits. For example, Figure 3(a) shows that the cost-based driver (CB) was often mentioned in the literature and that the best collaboration mechanism choices in this case seem to be in the joint practices and economical practices categories. Rijal & Lussier (2017) constructed six business models to improve the sustainability of value added forest supply chain through coordinated production planning policy between forests and mills. Although new business models (NBM) were not discussed as much in the literature according to Figure 3(a), environmental practices (ENV), joint practices (JP), and economical practices (EP) were the most frequently mentioned collaboration mechanisms in this case. However, since the SLR search was limited, other collaboration mechanism categories could be used if the company saw a fit in their particular situation. All other drivers and their best choice for collaboration mechanisms are defined in Figure 3.



LEGEND:

Collaboration mechanism categories: **JP**: Joint Practice, **EP**: Economical practices, **TI**: Technological and information sharing, **GP**: Governance practices, **ENV**: Environmental practices

Challenges categories: **RMC**: Relationship, management and communications, **FE**: Financial and economical, **RR**: Reliability and risk taking, **LT**: Logistics and transportation

Driver categories: **CB**: Cost-based drivers, **SE**: Sustainability and environmental performance, **VC**: Value creation, **FPSC**: Forest supply chain optimization and improvement, **NBM**: New business model, **INN**: Innovation, **NET**: Networking, **MD**: Market development, **FG**: Forest governance, **COM**: Competition

Figure 3. The relationship between the collaboration mechanisms (CMs) and each factor: (a) relationship between the CMs and the drivers; (b) relationship between the CMs and the activities; (c) relationship between the CMs and the challenges; (d) relationship between the CMs and the benefits.

Figure 3b shows the relationship with FPSC activities. For example, if companies are willing to collaborate in the harvesting activity, they could focus on JP, EP, GP, or ENV. However, if they know that the particular initiative targets more sustainable harvesting processes (SE driver from figure 3a), then their best choice would be mechanisms from the ENV category.

Figure 3(c) clearly shows the relationship between the collaboration mechanisms and challenges. For example, for a reliability and risk (RR) challenge, all of the CMs seem to be useful. However, if the company is focusing on lowering costs (CB driver from figure 3(a)), then they could be more specific and target JP and EP categories.

Based on Figure 3(d), if a company is aiming for quantitative benefits such as lowering costs or increasing profits, collaborative mechanisms from the JP and EP categories would seem more appropriate. However, for qualitative benefits, all of the mechanism categories were used rather equally in the literature. Identifying the specific driver for collaboration in this case and the FPSC activity could then help the company focus on the most promising categories by using figures 3(a) and 3(b).

Overall, firms could use the information in Figure 2 and Figure 3 to better understand inter-firm collaborations in the forest products industry. These figures shed light on the activities, factors, and conditions that are needed to implement a successful inter-firm collaboration in the FPSC. The challenges, drivers, and facilitators shown in Figure 2 and Figure 3 could help forest products industries who are willing to collaborate, to understand how to develop effective collaboration able to produce maximum benefits and reduce failure or uneven results (Bryson et al. 2015; Guerrero & Hansen, 2018). In other words, the results shown in Figure 2 and Figure 3 could help improve the likelihood of success before taking the initial steps to implement inter-firm collaboration for FPSCs.

5. Conclusion

Due to the global and highly competitive market in the forest products industry, the FPSCs need to implement successful inter-firm collaborations to remain competitive and avoid being left behind. In this article, a systematic literature review on inter-firm collaborations in the forest products industry between 2010 and 2020 was conducted. All relevant articles were analyzed and classified based on the different collaboration mechanisms, drivers, challenges, benefits, and facilitators associated to each collaboration mechanism.

Among the studied articles, five collaboration mechanism categories were identified: joint practices (30%), contractual and economic practices (25%), technological and information sharing (18%), environmental practices (14%), and Governance practices (13%). The importance of collaboration among actors, in particular in the forest products industry, seems well perceived due to global competition and international marketing growth. The mechanisms identified in this study and the drivers, challenges, benefits, and facilitators associated to them can certainly be seen as an important step to facilitate inter-firm collaboration implementation in the sector. Hence, a framework for FPSC inter-firm collaboration was presented in order to summarize the various factors that influence collaboration and illustrate the links between them. Furthermore, detailed analysis of the collaboration mechanisms according the each factor revealed tendencies in the use of the mechanisms. Indeed, detailed graphs indicate which collaborative mechanisms are more frequently mentioned in the literature according to a specific driver, FPSC activity, challenge or benefit. Firms may use these graphs to identify the best-fit mechanisms for their particular collaborative initiative. In order to further validate this SLR, future research could include the implementation of collaboration mechanisms in a case study in order to measure the potential benefits. It should also be noted that the keywords, search engines, and time span covered may have limited the results of this SLR.

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7. Appendix

Table 1. Description of the driver categorization for collaboration in the forest products industry

Driver Category	Description	Author (year)
Cost-based drivers	Potential money saving cost reduction, profit allocation, increase profit of network, reduce operational cost, reduce transportation cost.	(Frisk, et al., 2010) (Lehoux, et al., 2011) (Lehoux, et al., 2014) (Eriksson, et al., 2017) (Palander, et al., 2015)
Sustainability and environmental performance	Waste reduction, environmental sustainability, reduce environmental effect and sustainable timber harvesting.	(Zander, et al., 2016) (Hisjam, et al., 2015) (Robitaille, et al., 2017) (Hyytia, 2019)
Value creation	Benefits created through collaboration for firms, stakeholders and communities.	(Christians, 2016) (Hanna, et al., 2017) (Toppinen, et al., 2011)
Forest supply chain optimization and improvement	Firm's procurement interdependencies, optimize logistics activities, optimization of transportation and harvesting.	(Lehoux, et al., 2010) (Audy, et al., 2010) (Palander, 2015) (François, et al., 2017)
New business model	Business models of enterprises offering new products and services. Tactical planning, harvesting and production planning models are also placed in this category.	(Rijal & Lussier, 2017)
Innovation	Internal R&D projects, working with third parties, mainly universities and start-up companies. As well as emphasizing novel knowledge and expertise.	(Hayter & Clapp, 2020) (Düdder & Ross, 2017)
Networking	Information sharing between network members, providing common knowledge that leads to better decisions.	(Patari, 2010) (Azouzi & D'Amours, 2011) (Toppinen, et al., 2011)
Market development	Poor market condition, expand forest products market and fulfilling market demand.	(Dumetz, et al., 2019) (Alayet, et al., 2013)
Forest governance	Public and private actors, including formal and informal institutions, smallholder and indigenous organizations, small, medium-sized and large enterprises, civil-society organizations and other stakeholders negotiate, make and enforce binding decisions about the management, use and conservation of forest resources.	(Düdder & Ross, 2017) (Bhattarai, et al., 2018) (Lebedys & Yanshu, 2014)
Competition	Forest companies collaborate to remain competitive.	(Christians, 2016) (Shahriari, et al., 2015)

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