

Article

Risk Analysis in International Construction Projects: A Look at the Prefabricated Wood Construction Sector in the Province of Quebec

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Abstract: Construction projects that are completed abroad involve not only the typical risks that are faced at home but also various complex risks that are specific to international transactions. However, little research has been conducted on the risks that exist in prefabricated construction projects, but they need to be discussed. This paper aims to analyze the operational and financial risks associated with the internationalization of small and medium-sized enterprises (SMEs) in the province of Quebec operating in the prefabricated wood construction sector in the American market. Firstly, a literature review was carried out on operational and financial risks in overseas construction projects. This research identified 36 risks, including 21 operational and 15 financial. Next, the risks identified were divided into eight categories: design, standards, coordination, resources, internal to the alliance, partner, customer, and market. Professionals from different types of wood prefabrication companies were then asked to identify the probability of occurrence and magnitude of the impact of each identified risk. This information was used to calculate the criticality of each risk using Monte Carlo simulation to generate scenarios for use as a decision-making tool in risk assessment. The results show that highly critical operational risks are concentrated in the operational risk categories of coordination and resources. It should be noted that the most critical risk is that of ineffective communication and coordination, which is linked to project governance. On the other hand, financial risks with high criticality are spread across the four financial risk categories. A comparison of the criticality of the operational and financial risks identified revealed that the financial risks were the most critical.

Keywords: risk; Monte Carlo simulation; risk analysis; prefabricated wood construction; international construction projects



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1. Introduction

The construction industry is considered a highly risky sector in which to conduct business. This is explained by its characteristics and complexity, the strategic nature of its products, the large number of actors involved, the production timeline, and the type of production system used, which involves the expressive interaction between the internal and external environments [1,2]. Latam [3] (p. 14) corroborated this assertion, stating that “no construction project is without risk. Risk can be managed, minimized, shared, transferred, or accepted. It cannot be ignored”.

In addition, it is assumed that international construction projects involve more risk than local ones because the former faces risks that are very similar to those faced by local construction projects, as well as the risks that are characteristically associated with the host country and its market conditions [4–6]. Since risks are inherent in construction projects

and negatively impact project performance criteria [6], risk management is considered fundamental to achieving a good outcome on complex projects [7–9]. However, little research has been conducted on the risks that exist in prefabricated construction projects, but they need to be discussed [10].

“Prefabricated construction”, “industrialized building”, “offsite construction”, “offsite production”, “preassembly”, “system building”, and “non-traditional construction” are the terms used when buildings, entire houses, and building elements or modules are manufactured and preassembled in a factory environment before being installed at the job site [11–14].

Prefabricated construction can be classified by the type(s) of materials used (wood, steel, concrete, or hybrid) [11]. In this article, we consider wood prefabrication, as there are some benefits to using more wood than other materials, such as having a lower built-in global warming potential, as wood is a potentially CO₂-neutral material if produced sustainably. A characteristic of wood is that it absorbs as much CO₂ during growth as it releases during decomposition or combustion. In addition, wood can be considered a “low-energy material” because its production needs relatively little energy for forestry and wood processing. Finally, wood is a renewable material, which is not the case for all its substitute products [15,16].

The construction industry is highly fragmented, and the large number of small companies that make up the supply chain on most construction projects can make better supplier integration, process compliance, and alignment difficult [17]. Even though it is relevant in the construction industry, there are not many empirical studies dealing with collaborative relationships between SMEs and their different stakeholders [18–20].

The context presented above is corroborated by the fact that the construction sector in Quebec is largely composed of SMEs—the Commission de la construction du Québec [21] has indicated that 81% of companies in the industry are SMEs. As a result, these companies face limitations when it comes to expanding their consumer market. However, they have found that participating in cooperative relationships is one way they can overcome the size-related constraints they face. This research’s main contribution is that it analyzes the operational and financial risks associated with the internationalization of Canadian small and medium-sized enterprises (SMEs) in the prefabricated wood construction sector in the American market.

The remainder of this paper is organized into four sections. The next section details our review of the literature on risk and risk management and summarizes the operational and financial risk factors we found in the literature. The following section presents all the steps of the method we used. The penultimate section discusses our findings. Finally, the last section concludes the paper and provides recommendations for future research and guidance for construction professionals.

2. Literature Review

This section presents the literature review and the concepts used in this article. Firstly, the concept of risk is discussed. Next, the risk management process is presented. In addition, a gap in the literature was identified, which is that of analyzing risks for the prefabrication sector [10] in international projects. Therefore, operational and financial risks in foreign construction projects were identified and then analyzed.

2.1. Risk

Risk is considered a multidimensional concept as it is composed of three dimensions: 1. probability of occurrence of a certain event; 2. consequences of an event; 3. causal path leading to the event [22]. The probability of occurrence is linked to the frequency of an event. It can be assessed subjectively or using historical data. Consequences refer to the results of the event, mainly in financial terms. Finally, the last dimension of the risk concept to be taken into account in its management is the causal path. It is linked to the roots of the event itself and has an influence on its probability of occurrence and the scale of

its consequences. There are different definitions of risk in the literature [10,23]. Risk is considered a possibility of loss in most definitions. In this document, we consider it in the same way, as it is associated with operational and financial events in a project that could result in financial losses.

Companies can be encouraged to establish cooperative relationships with other companies to reduce risk and uncertainty [24]. One of the main reasons why companies enter into strategic alliances is to reduce risk through collaborative relationships [25–31]. Risk may be reduced due to greater information sharing among alliance members, as the flow of information generates common knowledge that enables better decision-making and planning. However, cooperative relationships can also be a source of new types of risk, such as opportunism risk, financial risk, the risk of loss of relational control, and day-to-day operations risk [24].

In the context of collaboration, where companies act in networks, complexity increases, as one company can generate risks in the other partners that make up its network [32]. Similarly, Gulati [33] argues that the performance of participants in a supply chain is affected by the members that make it up. When this cooperative relationship is established with the objective of enabling participating companies to access foreign markets, the companies involved are exposed to the risks arising from the relationship and the intrinsic risks of the internationalization process. Thus, potential risks and opportunities must be analyzed before entering a new market, as they have a great influence on the expected performance of projects [6].

2.2. Risk Management

Risk management can be achieved through a common network strategy. Risk management, therefore, provides guidance based on risk identification and assessment. The behavior of some risks can be mitigated through collaborative network management. On the other hand, other risks must be managed individually by the various network members. In this case, risk assessment can be a decision-making tool for the company [34].

Deleris and Erhun [35] presented a framework for risk assessment in an enterprise network environment. Their framework is made up of four different stages: (1) definition of the risk management system, (2) risk identification, (3) risk assessment, and finally, (4) risk management itself. In this research, we followed the risk management steps in an international construction project. More specifically, the system that we consider in this paper is an international prefabricated construction project.

Organizations can use risk typologies to identify and classify their risks in order to better manage them. In this research, we study the financial and operational risks construction companies face in international projects, as these types of risks are considered very important in construction projects [6,36,37]. Furthermore, construction companies are notably more exposed to financial risks than companies in other industries due to the type of industry, strong competition, a low barrier to entry, and large fluctuations in construction volume [38].

Thus, for this paper, we carried out an in-depth literature review to identify risk factors that commonly arise in international construction projects. It resulted in the identification of a total of 36 factors that we divided into eight categories: design, standards, coordination, resources, internal, partner, client, and market, as shown in Tables 1 and 2.

Table 1. Summary of operational risks in international construction projects.

Category	Operational Risk	Authors
Design	Design error	[4,39–45]
	Ill-defined project	[4,36,37,42,45,46]
	Design changes	[36,37,39,43–52]

Table 1. Cont.

Category	Operational Risk	Authors
Standards	Different construction standards	[4,43–46]
	Amendments to laws and regulations	[37,39,45,48,50]
	Different measurement systems	[44]
	Strict safety and health requirements	[4,46]
	Strict quality requirements	[4]
	Strict environmental regulations	[4,39,42]
	Quality control difficulty	[4,10,45,51]
Coordination	Damage caused by human error	[4,39]
	Late possession of construction site	[4]
	Ineffective communication and coordination	[4,37,40]
	Tight project schedules	[45,52]
	Unforeseen ground conditions	[4,45,49]
	Lack of proper construction techniques	[4,41,44]
Resources	Lack of subcontractors	[4,41,45,52]
	Unavailability of labor	[4,10,37,43,45]
	Defective materials	[4,40,45]
	Unavailability of materials	[4,36,37,40,42,43,45,49]
	Unavailability of equipment	[4,10,37,40,42,45]

Table 2. Summary of financial risks in international construction projects.

Category	Financial Risk	Authors
Internal	Lack of capital to finance export	[4,37,41,42,45,52,53]
	Lower-than-expected project revenue	[40]
Partner	Breach of contract	[36]
	Imprecision regarding the distribution of risks	[41,44,46–48]
	Bankruptcy of the project partner	[36,38,49]
	Partner in financial difficulty	[46,48]
Client	Bankruptcy of the client	[36,37,43,44]
	Late payment by the client	[36,37,39–46,48]
Market	Excessive costs of transporting goods to a foreign market	[46,51,53]
	Rising fuel prices	[38,50]
	Material price fluctuation	[4,37,44,45]
	Inflation rate fluctuation	[4,5,10,36,38–40,43–48,54]
	Interest rate fluctuation	[4,5,10,36,38,44,45,47,48]
	Currency exchange rate fluctuation	[4,5,10,36,38,39,44–48,51–55]
	Insurance risk	[4,36,38]

Liu, Zhao, and Yan [44] studied the risks in international construction projects in the context of Chinese contractors. In their results, the risks related to the contractor's lack of experience and the contractor's lack of managerial skills were quite significant. Bing et al. [48] presented the risks associated with international construction joint ventures

(JVs) in construction projects in East Asia. Their results demonstrate that the most critical risks are in the financial aspects of JVs, economic conditions, and the relationship with the project. On the other hand, some studies [39,41,52] have not focused on a specific market but on the methods of treating risks. Ganbat, Chong, and Liao [50] presented the use of BIM as a way to mitigate risks in international construction projects. Their results show that BIM can effectively facilitate communication management and, thus, reduce the risks generated by language differences between project members.

Safaeian et al. [56] used the PMBOK as a basis for developing a risk management framework for choosing appropriate risk response strategies. Their model was used in a case study of a construction company in Iran. Yousri et al. [57] assessed the probability of occurrence and the consequences of risks in Egyptian construction projects. In their results, the main risks were as follows: contractor financing problems, material price fluctuation, unrealistic project schedules, unavailability of materials, changes in laws and regulations, exchange rates, and changes in material types and specifications during construction.

Risk management aims to address the three dimensions of the risk construct, which, as a reminder, are the probability of occurrence, the consequences of the event, and the causal path to the event [22]. Risk assessment has generally been approached quantitatively despite the difficulties encountered in obtaining objective probabilities and frequencies in the construction industry. This problem stems from the fact that construction projects are often one-off initiatives. This reality means project managers need to rely on subjective probabilities. Therefore, knowledge, experience, intuition, and individual practices must be structured to facilitate risk assessment [2].

Risk assessment includes identifying potential losses, determining their magnitude, knowing their probability, and assessing overall risk [58]. On the other hand, according to [59], each risk has three main characteristics: the probability of occurrence, the impact, and the criticality. To calculate the probability of occurrence of an event, a company can use expert judgment [60]. The event's consequences can be measured in terms of currency or on an expert opinion scale [32,60].

In this context, let j be the number of specialists concerned in risk assessment, and let i be the event. α_{ij} and β_{ij} represent the probability and impact scales, respectively, associated with the risk of the event (R_i) assigned by individual specialists [52]. Variables α_{ij} and β_{ij} can use the Likert scale and vary from 1 to z . In this research, z is equal to 5. The probability of occurrence and impact scales related to risk R_i are represented by P_{Ri} and I_{Ri} , respectively, based on Equations (1) and (3) [52].

$$P_{Ri} = \{\alpha_{i1}, \alpha_{i2}, \alpha_{i3}, \dots, \alpha_{ij}\} \quad (1)$$

$$\alpha_{ij} \in (1, \dots, z) \quad (2)$$

$$I_{Ri} = \{\beta_{i1}, \beta_{i2}, \beta_{i3}, \dots, \beta_{ij}\} \quad (3)$$

$$\beta_{ij} \in (1, \dots, z) \quad (4)$$

Then, a discrete probability distribution is created for the probability and impact of the individual risks, represented by P_{Ri} and I_{Ri} , correspondingly [52], based on Equations (5) and (6).

$$P(P_{Ri}) = \frac{\sum_j \alpha_{ij}}{\sum_j} \quad \forall \alpha_{ij} = k \quad (5)$$

$$P(I_{Ri}) = \frac{\sum_j \beta_{ij}}{\sum_j} \quad \forall \beta_{ij} = k \quad (6)$$

It is also essential to identify the most critical risks in order to focus on them. This is where criticality comes into play. Criticality is the combination of a risk's impact and probability of occurrence. In other words, criticality is related to the intensity of the event when it occurs and can be calculated. Based on probability α_{ij} and impact β_{ij} , the criticality level (C_{Ri}) can be obtained for each risk using Equation (7) as follows, according

to Ouabouch and Amri [59] (p. 37), where the C_{Ri} is the result of multiplying its probability of occurrence (P_{Ri}) by its impact (I_{Ri}):

$$C_{Ri} = P_{Ri} \times I_{Ri} \quad (7)$$

With these results obtained, the next step is to develop a matrix, which can be called a “risk matrix” or “criticality matrix”. From this matrix, we can classify the risks according to different criticality scales. The construction industry frequently uses the risk matrix as a tool [9,52], which serves as a two-dimensional representation of risks in terms of the impact of the event and the probability of occurrence. Combining these two measures generates a general criticality of the risk. A Likert scale is typically used to assess probability and impact to generate a risk matrix. Although this is a widely used tool, it has limitations, such as the fact it uses average probability and impact values to represent individual risks. Using averages to prioritize risks weakens the risks’ individual importance, which can lead to less-than-ideal decision-making when it comes to selecting adequate risk mitigation strategies [52].

In the risk literature, different techniques are used for risk assessment. Some examples of these techniques are probability and impact (P&I), Monte Carlo simulation (MCS), analytical hierarchical process (AHP), probability of occurrence of risk, etc. If we compare the frequency of risk assessment techniques used in the literature, most studies used AHP, MCS, and probability of occurrence of risk. Although the models proposed in the literature that used these three techniques have shown good results when it came to assessing risk in construction projects [1], MCS was the most adequate of the techniques mentioned when it comes to analyzing risks linked to network size and complexity [35,61].

MCS is a powerful risk analysis technique because it helps identify robust solutions. Two important properties of MCS are its simultaneous consideration of threats and opportunities and its probability of selecting several criteria. MCS is a statistical technique that may become increasingly important for quantifying risk. Although it has been in use since the 1940s, computer data processing has become accessible in recent decades, and new applications have been developed for its implementation. In addition, there has been an increase in dissatisfaction with the use of deterministic calculations and the point estimates that are often used in quantitative risk assessment. As a result, MCS is increasingly considered the preferred method for generating risk exposure probability distributions [61].

MCS has been widely used to assess the risks associated with construction projects. MCS with n simulation iterations generates a distribution of risk criticalities and, therefore, makes it possible to create dynamic scenarios to analyze risks [52].

3. Methods

A first draft of the questionnaire was developed with the risk factors identified during the literature review. The questionnaire was revised based on the comments received during the pilot study when interviews were conducted with 4 professionals to solicit feedback on the preliminary questionnaire’s readability, comprehensiveness, and accuracy.

The questionnaire was divided into three sections. The first section was composed of seven questions to characterize respondents. The second section asked respondents to assess the probability of occurrence (PO) and the magnitude of the impact (MI) of each financial risk and operational risk mentioned. Five-point Likert scales were used to measure PO and MI, as shown in Table 3. Finally, the questionnaire had a question that asked what the average value of a wood construction project abroad is.

Table 3. Likert scales for PO and MI.

Probability of Occurrence (PO), %			Magnitude of the Impact (MI)	
1	Rarely	<20	1	Very small
2	Somewhat likely	20–40	2	Small
3	Likely	40–60	3	Medium
4	Very likely	60–80	4	Large
5	Almost definite	>80	5	Very large

Source: Adapted from Liu et al. [44].

The questionnaire was sent electronically via Google Forms to professionals from companies exporting products that are part of the wood construction chain in the province of Quebec. These professionals are members of Manufacturiers de Structures de Bois du Québec (MSBQ), a trade association representing Quebec manufacturers of light-frame wood structural components, and members of the Industrialized Construction Initiative (ICI) of the Chaire industrielle de recherche sur la construction éco-responsable en bois (CIRCERB). The sample was non-probabilistic. In total, 30 prefabricated wooden construction companies received the Google Forms questionnaire by email, such as 26 structural component companies, 2 prefabricated construction companies, and 2 solid wood companies. A total of 7 companies responded to the questionnaire, representing a response rate of 23%.

The results of the probability of occurrence and the impact (Equations (1) and (3)) of each risk were used to calculate its criticality (Equation (7)) and, thus, create its risk matrix by type of prefabrication. The same PO and MI data were used to feed the MCS model. Microsoft Excel software was used to carry out the simulations. The Likert scale values for PO and MI for each risk each had an associated cumulative frequency. In this way, a new scale was developed from the accumulated frequencies of PO and MI so that the MCS could draw random numbers, look for them on the new scale, and then associate them with a value. This final PO and MI value was then used to calculate the criticalities. These iterations were carried out 50,000 times for each PO and MI. This resulted in 50,000 random criticality scenarios for the financial and operational risks [62].

The results were gathered and analyzed according to their probabilities to obtain a probability distribution of the potential results associated with the wood construction project abroad and to consider several measures of project risk [62]. To validate the results obtained qualitatively, we conducted a focus group. Focus groups are carefully planned discussions aimed at eliciting group members' perceptions of a specific area of interest. The number of participants is generally set between 3 and 12, and the discussion is guided by a moderator who follows a predefined structure so that it remains on topic. The group setting allows participants to draw on the responses and ideas of others, which increases the wealth of information obtained [63]. Focus group participants were deliberately selected to meet various criteria in terms of their professional role and experience as specialists in the prefabricated construction sector.

Focus groups can be used to understand people's perceptions and attitudes and, most importantly, how people can have different points of view and change their point of view in the process of speaking with others [64]. Focus group members may change their opinions or at least their statements on the topic at hand, depending on the exchange of ideas as a session progresses [65]. The target audience was experts in prefabricated wooden construction with experience in exporting their products.

Lead questions were used during the focus group session to guide the discussion of the participating specialists. A panel of 3 prefabricated construction specialists was responsible for evaluating the simulation scenarios for validation purposes. Participants gave their opinions on the scenarios generated by the MCS, and if they were contrary, they suggested changes and justified the reason.

4. Results and Discussion

This section presents the results and discussion of the risk analysis using a case study in the province of Quebec, Canada. First, we present the case study with some information about the prefabricated wood buildings in the province of Quebec, and then we present the characterization of the interviewees. Next, we present the risk measurement based on the type of prefabrication. We also analyze the financial risks and operational risks based on the analysis carried out using Monte Carlo simulation. We then validated these results using a focus group. Finally, we present some managerial insights and recommendations.

4.1. Case Study

Exports of prefabricated wood buildings from the province of Quebec accounted for 18.6% of Canadian exports in 2019, 92% of which went to the United States [66]. In relation to the Canadian market, more specifically the Quebec provincial market, companies in the prefabricated wood construction sector have seen the opportunity of the Northeast American export market due to these growth rates [67] and geographic proximity [68]. In addition, increasing product exports is a strategy encouraged by the Quebec government, as the goal of increasing exports of prefabricated buildings, mainly made of wood, has been set to rise from CAD 390 million in 2016 to CAD 3 billion by 2030 [69].

The Quebec government also supports this industry as the use of wood in construction brings environmental benefits through the reduction of greenhouse gas production [70–72]. Combined with this, the US market is favorable to the entry of new construction companies with green technology [73]. However, the prefabricated construction sector in the province of Quebec is made up of small and medium-sized enterprises (SMEs), and this limits their ability to get involved in international-scale projects [74]. In addition, there are different prefabricated wood construction companies in the province of Quebec, such as kit homes, wood wall panel companies, prefabricated wood structures (beams, trusses, roof, etc.), glued laminated timber (GLT), and modular wood construction. In this way, companies want to collaborate to achieve the scale and scope of projects to enter and compete in the North American market. An analysis of the operational and financial risks in international construction projects from the different prefabrication companies is therefore necessary.

4.2. Characterization of Respondents

All seven respondents (100%) out of thirty had previously worked on construction projects outside Quebec, with 43% having 11 to 15 years of experience and 43% having more than 15 years of experience. In terms of their role, respondents were directors (86%) or presidents (14%) in their respective companies. Most (86%) of the respondents were members of prefabrication associations. In addition, 43% of respondents had a background in engineering, architecture, or management.

As for the type of prefabrication, we had respondents from several areas of wooden prefabrication; one represented a company that makes kit homes, one represented a (2D) wood wall panel company, two worked in prefabricated wood structures (beams, trusses, roof, etc.), one worked in glued laminated timber (GLT), and two represented companies that make (3D) modular wood construction. Figure 1 shows the regions where they carry out prefabricated wood construction projects. Most companies (six in the study) export to the American market. The European, Asian, and African markets are part of the export market of only two companies in the study.

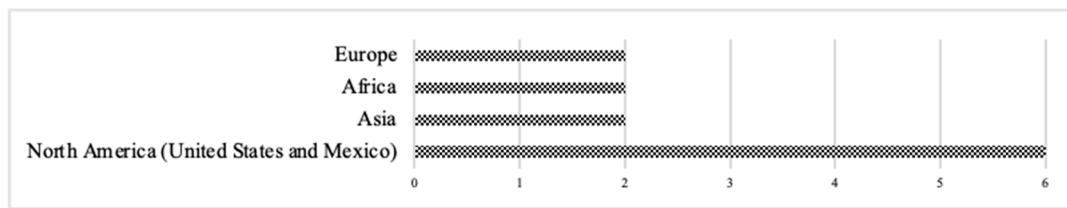


Figure 1. Export regions.

Kit homes are sent to customers in packages with pre-cut materials for them to assemble on their property. GLT is an engineered structural timber product that is comprised of multiple layers of laminated timber glued together. Wood wall panels are sections of wood-framed exterior and prefabricated interior walls. Prefabricated wood structures are used to form preassembled components for walls, floors, and roof systems. Modular wood construction consists of volumetric units comprising walls, floors, and ceilings.

Regarding the value of construction projects completed outside Quebec by each respondent, the highest-valued project (exceeding CAD 1 million) was undertaken by the wood wall panel (2D) construction company. On the other hand, the lowest-valued project (less than CAD 200 thousand) was conducted by the kit home company, as shown in Figure 2. Two companies that manufacture modular wooden constructions have construction project values abroad that are close to each other.

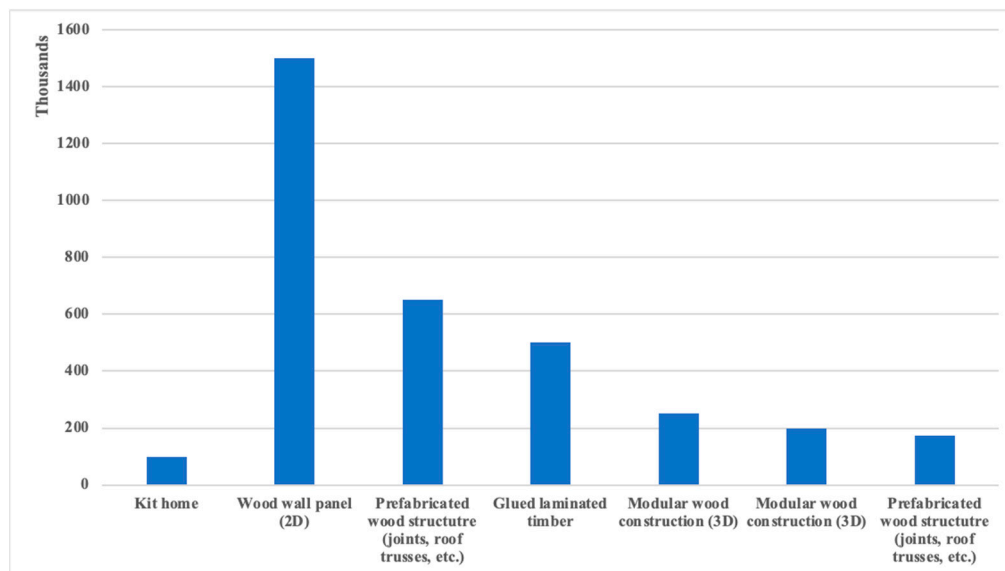


Figure 2. Value (CAD) of a construction project abroad.

4.3. Risk Measurement

The PO and MI values were obtained from different types of prefabrication companies. These values were used to calculate the criticality of the risks identified in the literature. Tables 4 and 5 show criticality by type of prefabrication. Each color represents a level of criticality. Green represents low criticality, yellow represents moderate criticality and red represents high criticality. There is no homogeneity of criticality for the different prefabrications in most of the risks. Table 4 shows that the criticality of operational risks for the “wood wall panel” company (2D) is concentrated in the high criticality range. The “glued laminated timber” and “modular” construction companies are concentrated in the moderate to high range. On the other hand, the criticality of “kit home” and “prefabricated wood structure” are concentrated in the low and moderate levels.

Table 4. Criticality of operational risks by type of prefabrication.

Category	Operational Risk	Prefabricated Wood Structure	Glued Laminated Timber	Wood Wall Panel	Modular	Kit Home
Design	Design error					
	Ill-defined project					
Standards	Design changes					
	Different construction standards					
	Amendments to laws and regulations					
	Different measurement systems					
	Strict safety and health requirements					
	Strict quality requirements					
	Strict environmental regulations					
	Quality control difficulty					
	Damage caused by human error					
Coordination	Late possession of construction site					
	Ineffective communication and coordination					
	Tight project schedules					
	Unforeseen ground conditions					
	Lack of proper construction techniques					
	Lack of subcontractors					
Resources	Unavailability of labor					
	Defective materials					
	Unavailability of materials					
	Unavailability of equipment					

Table 5. Criticality of financial risks by type of prefabrication.

Category	Financial Risk	Prefabricated Wood Structure	Glued Laminated Timber	Wood Wall Panel	Modular	Kit Home
Internal	Lack of capital to finance export					
	Lower-than-expected project revenue					
Partner	Breach of contract					
	Imprecision regarding the distribution of risks					
	Bankruptcy of the project partner					
	Partner in financial difficulty					

Table 5. Cont.

Category	Financial Risk	Prefabricated Wood Structure	Glued Laminated Timber	Wood Wall Panel	Modular	Kit Home
Client	Bankruptcy of the client					
	Late payment by the client					
Market	Excessive costs of transporting goods to a foreign market					
	Rising fuel prices					
	Material price fluctuation					
	Inflation rate fluctuation					
	Interest rate fluctuation					
	Currency exchange rate fluctuation					
	Insurance risk					

Table 5 shows that the criticality levels of the financial risks of the “modular” and “wood wall panel” construction companies are concentrated in the moderate to high range. The levels of criticality of the financial risks of the “glued laminated timber” construction company are concentrated in the moderate to high range. On the other hand, the criticality of “prefabricated wood structure” projects is concentrated at the low and moderate levels. All types of prefabrication are considered simultaneously in the MCS. Furthermore, there is no final criticality value but rather a distribution of criticality values, which allows for a dynamic analysis of risks.

4.3.1. Operational Risks

From the MCS, operational risks had most of their criticality distributions at moderate and low levels. Table 6 shows the operational risks that fall into each criticality level according to their cumulative frequencies. Thus, the risks with high criticality are the risks “ineffective communication and coordination”, “tight project schedules”, “damage caused by human error”, and “unavailability of labor”. There are risks that have close cumulative criticality distributions, which can be explained by the type of prefabrication, such as “ill-defined project”, which had 45% moderate criticality and 43% high criticality, and “lack of proper construction techniques”, which had 45% low criticality and 43% moderate criticality.

Table 6. Operational risk criticality levels.

High Criticality	Moderate Criticality	Low Criticality
Ineffective communication and coordination 78%	Amendments to laws and regulations 58%	Different measurement systems 69%
Tight project schedules 59%	Strict quality requirements 53%	Strict safety and health requirements 57%
Damage caused by human error 48%	Design changes 51%	Defective materials 57%
Unavailability of labor 40%	Design error 51%	Unavailability of equipment 53%
	Late possession of the site 51%	Lack of subcontractors 47%
	Different construction standards 50%	Quality control difficulty 46%
	Strict environmental regulations 50%	Lack of proper construction techniques 45%
	Unforeseen ground conditions 47%	Unavailability of materials 43%
	Ill-defined project 45%	

In addition, Figure 3 presents the criticality scale for each operational risk factor. Each color represents a level of criticality. Green represents low criticality, yellow represents moderate criticality and red represents high criticality. The values from 0 to 100 in Figure 3 are the frequency percentage of each criticality level for each risk. We can visualize all risks, along with their critical levels. It is important to highlight that a risk can have a frequency in the three levels of criticality and that this distribution of criticality is due to differences in risk assessments for different types of prefabrications. “Ineffective communication and coordination” was the risk with the highest critical level of high criticality; however, there was a small portion of low and moderate criticality.

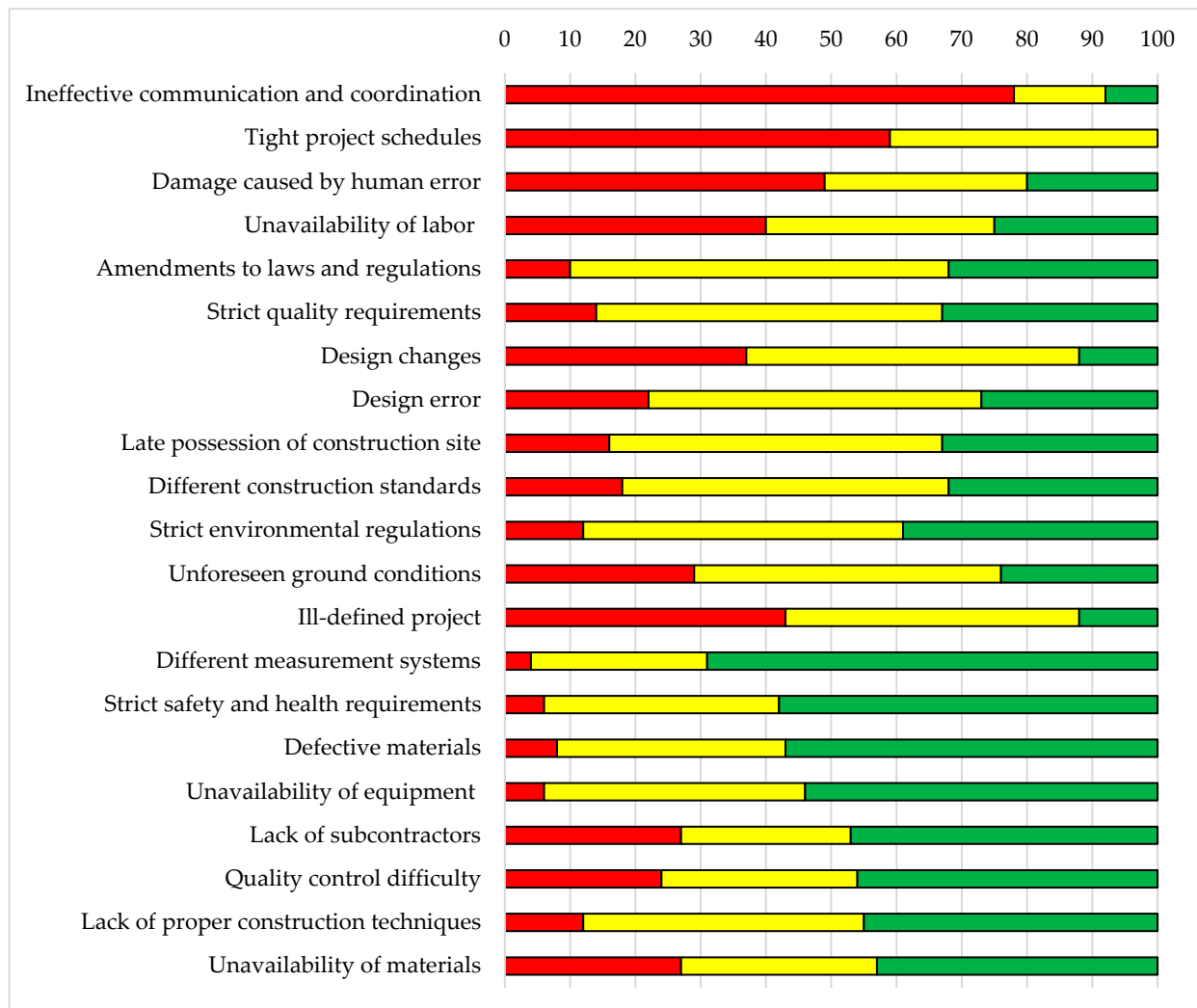


Figure 3. Operational risk criticality scales.

Figure 4 shows the criticality distributions of two operational risk factors. Each bar represents a criticality value. In addition, each color represents a level of criticality. Green represents low criticality, yellow represents moderate criticality and red represents high criticality. In this case, for “ineffective communication and coordination”, the criticality value 15 had the highest frequency (>10,000). “Tight project schedules” had the second highest frequency of high criticality, and it did not have a frequency of low criticality. It had a criticality value of 12 most frequently (>10,000).

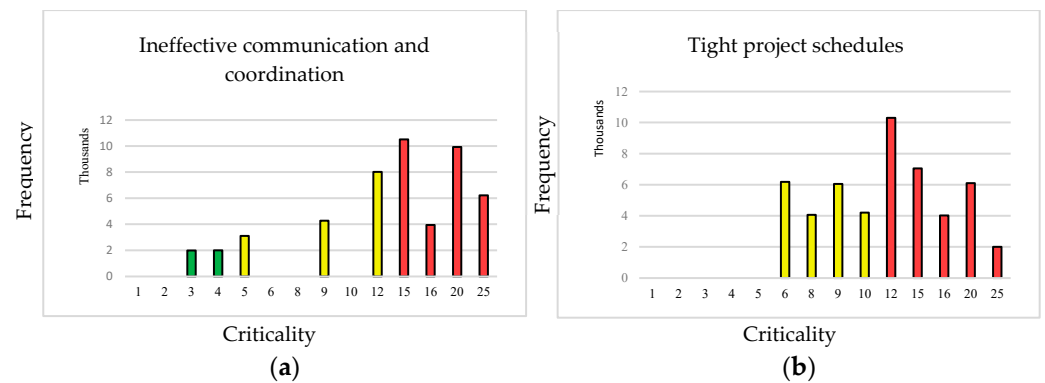


Figure 4. (a) Criticality distributions of the “ineffective communication and coordination” risk and (b) criticality distributions of the “tight project schedules” risk.

4.3.2. Financial Risks

Financial risks had most of their criticality distributions at moderate and high levels. “Price of materials” is the risk factor that obtained the highest frequency, and it is part of the high criticality group. Table 7 shows the financial risks that fall into each criticality level according to their cumulative frequencies. Most risks had a higher frequency of moderate criticality. On the other hand, only two risks had a higher frequency of low criticality.

Table 7. Financial risk criticality levels.

High Criticality	Moderate Criticality	Low Criticality
Material price fluctuation 92%	Insurance risk 65%	
Late payment by the client 57%	Breach of contract 55%	
Lack of capital to finance export 49%	Inflation rate fluctuation 54%	
Imprecision regarding the distribution of risks 49%	Bankruptcy of the project partner 51%	Lower-than-expected project revenue 46%
	Bankruptcy of the client 49%	Excessive costs of transporting goods to a foreign market 39%
	Partner in financial difficulty 47%	
	Rising fuel prices 46%	
	Currency exchange rate fluctuation 45%	
	Interest rate fluctuation 43%	

In addition, Figure 5 presents the criticality scale for each financial risk factor. Each color represents a level of criticality. Green represents low criticality, yellow represents moderate criticality and red represents high criticality. The values from 0 to 100 in Figure 5 are the frequency percentage of each criticality level for each risk. We can visualize all financial risks, along with their critical levels. It is important to highlight that there are risks that do not have a frequency in the three levels of criticality. For example, “material price fluctuation” has its majority frequency in high criticality and only 8% in moderate criticality.

Figure 6 shows the criticality distributions of the two financial risk factors with the highest level of criticality. Each color represents a level of criticality. Green represents low criticality, yellow represents moderate criticality and red represents high criticality. The risk of “material price fluctuation” was most critical. Furthermore, there was no frequency of low criticality levels. It had a criticality value of 12 most frequently (>14,000). On the other hand, “late payment by the client” was critical but had a frequency of all three levels of criticality. It had a criticality value of 20 most frequently (>9000).

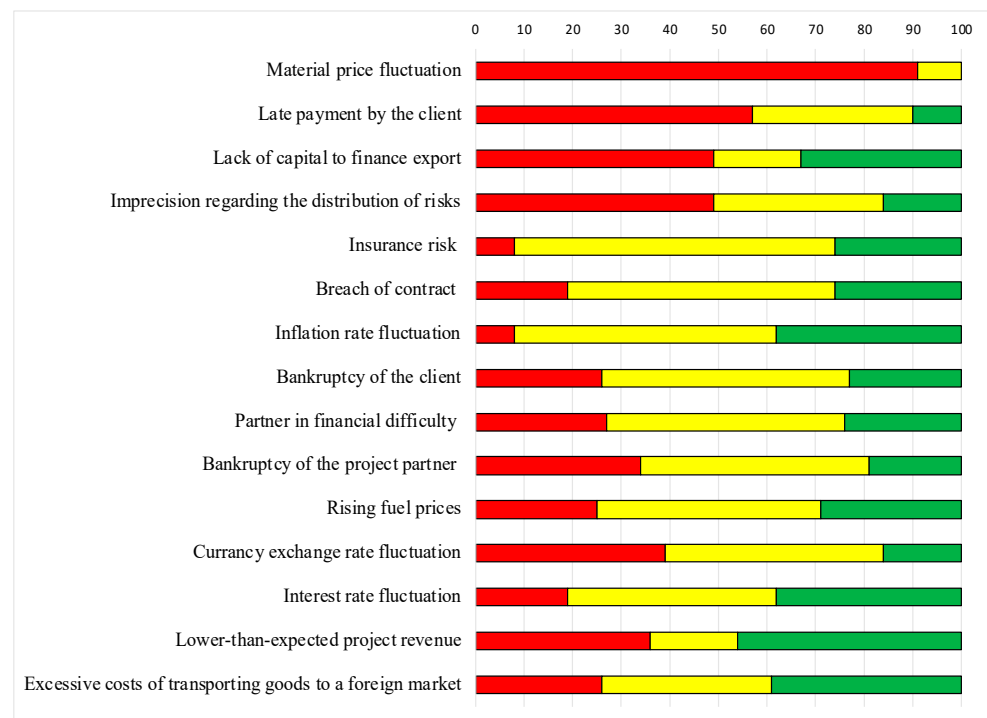


Figure 5. Financial risk criticality scales.

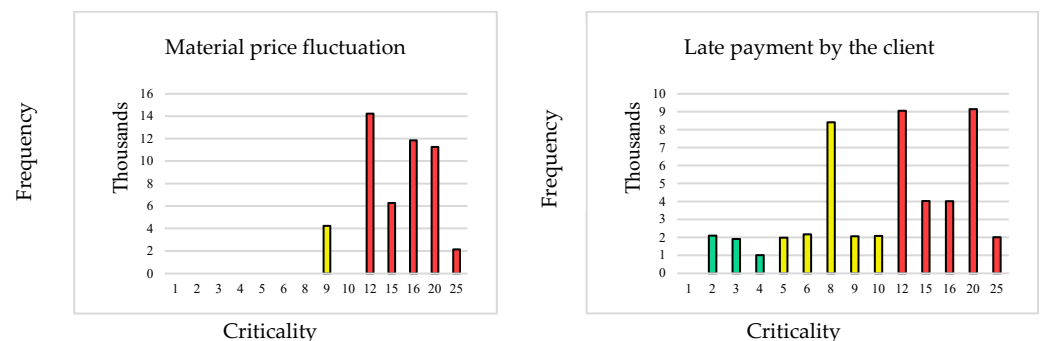


Figure 6. Criticality distributions of the “material price fluctuation” and “late payment by the client” risk factors.

The main operational risk factors were “ineffective communication and coordination”, “tight project schedules”, “damage caused by human error”, and “unavailability of labor”. The first one can be explained by a characteristic of the sector itself since the relationships between companies are generally project-based and not with a view to a long-term partnership. Companies tend to focus more on project partnerships than strategic partnerships. In this way, relationships are discontinuous, which limits the transfer of experience from one project to the next over time [75–77]. This is one of the aspects that limit companies in the construction sector from achieving supply chain gains. Adequate collaborative governance between companies would likely mitigate this risk factor. These results corroborate research by Liu et al. and Bing et al. [44,48].

Although the “tight project schedule” risk factor ranks second in terms of its cumulative frequency of high criticality, it is quite critical if we consider that its criticality distribution does not include any low-level criticality. It is a risk that all companies in the prefabrication sector must manage closely. Furthermore, it is linked to other risk factors such as “unavailability of labor”, “lack of subcontractors”, and “unavailability of materials”. As for the “damage caused by human error” risk factor, although we are dealing with prefabricated construction, the companies in question are not at the point of production

robotization. Regarding the “unavailability of labor” risk factor, there is usually a shortage of labor in Canada, and there is a need for skilled immigrants to occupy vacant positions in companies in this sector [78].

When it comes to financial risk factors, the “material price fluctuation” risk factor was the most important in terms of its criticality distribution. It had 92% of its frequency at the high criticality level and 8% at the moderate criticality level. This can be explained by the fact that wood is more expensive than other materials (concrete, steel, etc.), and its price is also more volatile.

Focus group participants were asked if they agreed with the results of the MCS. They agreed with most of them and indicated some changes were necessary in terms of the criticality levels of some risk factors, such as “rising fuel prices”, since this factor had most of its frequency at the moderate criticality level in the simulations; however, fuel prices have increased considerably since the war in Ukraine ramped up in 2022. The “inflation rate fluctuation”, “lack of subcontractors”, and “unavailability of materials” risk factors were also considered highly critical rather than moderate or low criticality.

Finally, the “excessive transportation costs” risk factor was considered moderately critical, also due to the war in Ukraine. An important aspect that was highlighted by the focus group participants is that some risks generate other risks, which signals a causal path. They generate other impacts in addition to having their own financial or operational consequences. One example that was pointed out during the focus group was that the “unavailability of labor”, “lack of subcontractors”, and “unavailability of materials” risk factors contribute to “tight project schedules”. Furthermore, these risk factors can delay project delivery, and participants stated they have worsened with the COVID-19 pandemic.

The “exchange rate fluctuation” risk factor was said to be moderately to highly critical. It is a risk that is usually considered during project planning, but it must still be monitored during project execution. Financial risks are more critical. This result confirms research by Akintoye and MacLeod and also Naderpour et al. [79,80]. Financial risk influences the cash flows of construction projects. Not surprisingly, this source of risk is very important to companies in the timber construction sector.

4.4. Managerial Insights and Recommendations

There are a few recommendations that could be implemented to limit operational risks. Regarding the risk of “ineffective communication and coordination”, we suggest implementing BIM, digitalization, and better governance of alliances. This suggestion corroborates research by Ganbat et al. [50]. With regard to “tight project schedules”, this is associated with other risks (for example, lack of manpower, unavailability of materials, etc.). It is, therefore, important to address these risks that are the source of it in order to resolve the “tight project schedule”.

With regard to the “human error” risk, investing in automation, BIM, and workforce training has been suggested. With regard to the “unavailability of labor” risk, we suggest investing in automation, labor training, and developing a project to attract immigrant labor. With regard to the “lack of subcontractors” risk, it is suggested to invest in partnerships with subcontractors. For the “unavailability of materials” risk, investing in partnerships with an exclusive supplier has been suggested. With regard to financial risks, it is suggested that hedge contracts are needed for the “exchange rate” and “interest rate” financial risks. This assessment is individualized for each project.

5. Conclusions

This research proposed to analyze the operational and financial risks associated with the internationalization of Canadian small and medium-sized enterprises operating in the prefabricated wood construction sector in the American market. It first presents a review of the literature on operational and financial risks in construction projects completed abroad. As a result of our research, we found 36 risk factors, of which 21 were operational and 15 were financial. We then categorized the risk factors identified into eight categories:

design, standards, coordination, resources, internal, partner, client, and market. Afterward, we asked professionals from different types of prefabrication companies to identify the probability of occurrence and magnitude of the impact of each risk factor identified. We used that information to calculate each risk factor's criticality by Monte Carlo simulation to generate scenarios that work as a decision-making tool in risk assessment. Then, this research identified the risks associated with international construction projects based on different types of prefabrication.

The operational risks with high criticality are concentrated in the "coordination" and "resources" operational risk categories. On the other hand, the financial risks with high criticality are distributed across the four financial risk categories. It is important to note that some risk factors have narrow cumulative criticality distributions, such as the "ill-defined project" risk factor, which had 45% moderate criticality and 43% high criticality, and the "lack of proper construction techniques" risk factor, which had 45% low criticality and 43% moderate criticality. When we compare the criticality of the operational and financial risks identified, we see that the financial ones are more critical.

Risk analysis with the SMC is dynamic and should be used to support export decision-making. It is also an interesting tool for companies wishing to export, as it was carried out for the entire prefabricated timber construction sector. As the risk analysis framework was developed for the entire prefabricated timber construction sector, it can be used by companies wishing to start an alliance. It is worth noting that the companies themselves need to decide on the next steps in risk management, such as which actions to take (accept, prevent, mitigate, transfer, share). These actions will depend on the existing supply chain and the levels of collaboration established.

The limitations of this study are as follows: The study's focus on prefabricated wood construction companies in the province of Quebec may limit the generalizability of its conclusions to other cultural or industrial contexts. In addition, this research has identified a limitation in terms of data. Since the data are based on expert opinion, construction projects do not have risk histories. Therefore, there is a possibility of response bias.

For future research, it would be interesting to increase the number of responses gathered to perform cluster analyses and to perform risk analyses considering all the members in a prefabricated construction supply chain. In addition, we also suggest mapping the risks and analyzing them from the different phases of the construction project and their respective stakeholders. It would also be interesting to carry out comparative studies with other types of prefabricated construction other than wood in order to better understand the particularities of each material in relation to risks.

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References

1. Renuka, S.M.; Umarani, C.; Kamal, S. A review on critical risk factors in the life cycle of construction projects. *J. Civ. Eng. Res.* **2014**, *4*, 31–36.
2. Taroun, A. Towards a better modelling and assessment of construction risk: Insights from a literature review. *Int. J. Proj. Manag.* **2014**, *32*, 101–115. [\[CrossRef\]](#)
3. Latham, S.M. Constructing the Team. HMSO. 1994. Available online: <https://constructingexcellence.org.uk/wp-content/uploads/2014/10/Constructing-the-team-The-Latham-Report.pdf> (accessed on 7 July 2022).
4. Zhi, H. Risk management for overseas construction projects. *Int. J. Proj. Manag.* **1995**, *13*, 231–237. [\[CrossRef\]](#)
5. Bu-Qammaz, A.S.; Dikmen, I.; Birgonul, M.T. Risk assessment of international construction projects using the analytic network process. *Can. J. Civ. Eng.* **2009**, *36*, 1170–1181. [\[CrossRef\]](#)
6. Viswanathan, S.K.; Jha, K.N. Critical risk factors in international construction projects: An Indian perspective. *Eng. Constr. Archit. Manag.* **2020**, *27*, 1169–1190. [\[CrossRef\]](#)
7. Tamošaitienė, J.; Zavadskas, E.K.; Turskis, Z. Multi-criteria risk assessment of a construction project. *Procedia Comput. Sci.* **2013**, *17*, 129–133. [\[CrossRef\]](#)
8. Hwang, B.G.; Zhao, X.; Toh, L.P. Risk management in small construction projects in Singapore: Status, barriers and impact. *Int. J. Proj. Manag.* **2014**, *32*, 116–124. [\[CrossRef\]](#)
9. Qazi, A.; Dikmen, I. From risk matrices to risk networks in construction projects. *IEEE Trans. Eng. Manag.* **2019**, *68*, 1449–1460. [\[CrossRef\]](#)
10. Li, M.; Li, G.; Huang, Y.; Deng, L. Research on investment risk management of Chinese prefabricated construction projects based on a system dynamics model. *Buildings* **2017**, *7*, 83. [\[CrossRef\]](#)
11. Pan, W.; Goodier, C. House-building business models and off-site construction take-up. *Int. J. Proj. Manag.* **2012**, *18*, 84–93. [\[CrossRef\]](#)
12. Goulding, J.; Arif, M. *Offsite Production and Manufacturing—Research Roadmap Report*; Bakens, W., Ed.; International Council for Research and Innovation in Building and Construction (CIB): Rotterdam, The Netherlands, 2013.
13. Brege, S.; Stehn, L.; Nord, T. Business models in industrialized building of multi-storey houses. *Constr. Manag. Econ.* **2014**, *32*, 208–226. [\[CrossRef\]](#)
14. Goulding, J.S.; Pour Rahimian, F.; Arif, M.; Sharp, M.D. New offsite production and business models in construction: Priorities for the future research agenda. *Archit. Eng. Des. Manag.* **2015**, *11*, 163–184. [\[CrossRef\]](#)
15. Goverse, T.; Hekkert, M.P.; Groenewegen, P.; Worrell, E.; Smits, R.E. Wood innovation in the residential construction sector; opportunities and constraints. *Resour. Conserv. Recycl.* **2001**, *34*, 53–74. [\[CrossRef\]](#)
16. Piccardo, C.; Hughes, M. Design strategies to increase the reuse of wood materials in buildings: Lessons from architectural practice. *J. Clean. Prod.* **2022**, *368*, 133083. [\[CrossRef\]](#)
17. Behera, P.; Mohanty, R.P.; Prakash, A. Understanding construction supply chain management. *Prod. Plan. Control* **2015**, *26*, 1332–1350. [\[CrossRef\]](#)
18. Dainty, A.R.; Briscoe, G.H.; Millett, S.J. Subcontractor perspectives on supply chain alliances. *Constr. Manag. Econ.* **2001**, *19*, 841–848. [\[CrossRef\]](#)
19. Rezgui, Y.; Miles, J. Exploring the potential of SME alliances in the construction sector. *J. Constr. Eng. Manag.* **2010**, *136*, 558–567. [\[CrossRef\]](#)
20. Michna, A.; Kmiecik, R.; Czerwińska-Lubszczyk, A. Dimensions of intercompany cooperation in the construction industry and their relations to performance of SMEs. *Eng. Econ.* **2020**, *31*, 221–232. [\[CrossRef\]](#)
21. Commission de la Construction du Québec. *Annual Construction Industry Statistics 2020*; Commission de la Construction du Québec: Montreal, QC, Canada, 2021.
22. Ritchie, B.; Brindley, C. Supply chain risk management and performance: A guiding framework for future development. *Int. J. Oper. Prod. Manag.* **2007**, *27*, 303–322. [\[CrossRef\]](#)
23. Rao, S.; Goldsby, T.J. Supply chain risks: A review and typology. *Int. J. Logist. Manag.* **2009**, *20*, 97–123. [\[CrossRef\]](#)
24. Lehoux, N.; D’Amours, S.; Langevin, A. Inter-firm collaborations and supply chain coordination: Review of key elements and case study. *Prod. Plan. Control* **2014**, *25*, 858–872. [\[CrossRef\]](#)
25. Gentry, J.J.; Vellenga, D.B. Using logistics alliances to gain a strategic advantage in the marketplace. *J. Mark. Theory Pract.* **1996**, *4*, 37–44. [\[CrossRef\]](#)
26. Bleeke, J.; Ernst, D. Is your strategic alliance really a sale? *Harv. Bus. Rev.* **1995**, *73*, 97–105.
27. Kauser, S.; Shaw, V. International Strategic Alliances: Objectives, motives and success. *J. Glob. Mark.* **2004**, *17*, 7–43. [\[CrossRef\]](#)
28. Sampson, R.C. R&D alliances and firm performance: The impact of technological diversity and alliance organization on innovation. *Acad. Manag. J.* **2007**, *50*, 364–386.
29. Lai, W.H.; Chang, P.L. Corporate motivation and performance in R&D alliances. *J. Bus. Res.* **2010**, *63*, 490–496.
30. Nielsen, B.B. Strategic fit, contractual, and procedural governance in alliances. *J. Bus. Res.* **2010**, *63*, 682–689. [\[CrossRef\]](#)
31. Li, L.; Qian, G.; Qian, Z. Do partners in international strategic alliances share resources, costs, and risks? *J. Bus. Res.* **2013**, *66*, 489–498. [\[CrossRef\]](#)
32. Chopra, S.; Sodhi, M.S. Supply-chain breakdown. *MIT Sloan Manag. Rev.* **2004**, *46*, 53–61.
33. Gulati, R. Alliances and networks. *Strateg. Manag. J.* **1998**, *19*, 293–317. [\[CrossRef\]](#)

34. Hallikas, J.; Karvonen, I.; Pulkkinen, U.; Virolainen, V.M.; Tuominen, M. Risk management processes in supplier networks. *Int. J. Prod. Econ.* **2004**, *90*, 47–58. [\[CrossRef\]](#)
35. Deleris, L.A.; Erhun, F. Risk management in supply networks using Monte-Carlo simulation. In Proceedings of the Winter Simulation Conference, Orlando, FL, USA, 4 December 2005.
36. Antonio, J.M.A.; Gema, S.R.; Angel, R.L. Financial risks in construction projects. *Afr. J. Bus. Manag.* **2011**, *5*, 12325–12328. [\[CrossRef\]](#)
37. Khan, R.A.; Gul, W. Empirical study of critical risk factors causing delays in construction projects. In Proceedings of the 2017 9th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS), Bucharest, Romania, 21–23 September 2017; Volume 2, pp. 900–906.
38. Kolhatkar, M.J.; Dutta, A.B. Financial risks and construction projects. *Int. J. Appl. Innov. Eng. Manag. (IJAIEM)* **2013**, *2*, 235–239.
39. Mustafa, M.A.; Al-Bahar, J.F. Project risk assessment using the analytic hierarchy process. *IEEE Trans. Eng. Manag.* **1991**, *38*, 46–52. [\[CrossRef\]](#)
40. Hastak, M.; Shaked, A. ICRAM-1: Model for international construction risk assessment. *J. Manag. Eng.* **2000**, *16*, 59–69. [\[CrossRef\]](#)
41. Dikmen, I.; Birgonul, M.T.; Han, S. Using fuzzy risk assessment to rate cost overrun risk in international construction projects. *Int. J. Proj. Manag.* **2007**, *25*, 494–505. [\[CrossRef\]](#)
42. Abd Karim, N.A.; Rahman, I.A.; Memmon, A.H.; Jamil, N.; Azis, A.A.A. Significant risk factors in construction projects: Contractor's perception. In Proceedings of the 2012 IEEE Colloquium on Humanities, Science and Engineering (CHUSER), Kota Kinabalu, Malaysia, 3–4 December 2012; pp. 347–350.
43. Rezakhani, P. Classifying key risk factors in construction projects. *Bul. Inst. Politeh. Din Lasi* **2012**, *58*, 27–38.
44. Liu, J.; Zhao, X.; Yan, P. Risk paths in international construction projects: Case study from Chinese contractors. *J. Constr. Eng. Manag.* **2016**, *142*, 05016002. [\[CrossRef\]](#)
45. Abd El-Karim, M.S.B.A.; Mosa El Nawawy, O.A.; Abdel-Alim, A.M. Identification and assessment of risk factors affecting construction projects. *HBRC J.* **2017**, *13*, 202–216. [\[CrossRef\]](#)
46. Abdelghany, Y.; Ezeldin, A.S. Classification of risks for international construction joint ventures (ICJV) projects. In Proceedings of the Construction Research Congress 2010: Innovation for Reshaping Construction Practice, Banff, AB, Canada, 8–10 May 2010; pp. 1254–1263.
47. Bing, L.; Tiong, R.L. Risk management model for international construction joint ventures. *J. Constr. Eng. Manag.* **1999**, *125*, 377–384. [\[CrossRef\]](#)
48. Bing, L.; Tiong, R.L.K.; Fan, W.W.; Chew, D.A.S. Risk management in international construction joint ventures. *J. Constr. Eng. Manag.* **1999**, *125*, 277–284. [\[CrossRef\]](#)
49. Shen, L.Y.; Wu, G.W.; Ng, C.S. Risk assessment for construction joint ventures in China. *J. Constr. Eng. Manag.* **2001**, *127*, 76–81. [\[CrossRef\]](#)
50. Ganbat, T.; Chong, H.Y.; Liao, P.C. Mapping BIM uses for risk mitigation in international construction projects. *Adv. Civ. Eng.* **2020**, *2020*, 5143879. [\[CrossRef\]](#)
51. Kassem, M.A.; Khoiry, M.A.; Hamzah, N. Theoretical review on critical risk factors in oil and gas construction projects in Yemen. *Eng. Constr. Archit. Manag.* **2020**, *28*, 934–968. [\[CrossRef\]](#)
52. Qazi, A.; Simsekler, M.C.E. Risk assessment of construction projects using Monte Carlo simulation. *Int. J. Manag. Proj. Bus.* **2021**, *14*, 1202–1218. [\[CrossRef\]](#)
53. Kubičková, L.; Toullová, M. Risk factors in the internationalization process of SMEs. *Acta Univ. Agric. Silv. Mendel. Brun.* **2013**, *61*, 2385–2392. [\[CrossRef\]](#)
54. Calvelli, A.; Cannavale, C. Key Risks of Internationalization. In *Internationalizing Firms*; Palgrave Macmillan: Cham, Switzerland, 2019; pp. 129–164. [\[CrossRef\]](#)
55. Ozorhon, B.; Arditi, D.; Dikmen, I.; Birgonul, M.T. Performance of international joint ventures in construction. *J. Manag. Eng.* **2010**, *26*, 209–222. [\[CrossRef\]](#)
56. Safaeian, M.; Fathollahi-Fard, A.M.; Kabirifar, K.; Yazdani, M.; Shapouri, M. Selecting appropriate risk response strategies considering utility function and budget constraints: A case study of a construction company in Iran. *Buildings* **2022**, *12*, 98. [\[CrossRef\]](#)
57. Yousri, E.; Sayed, A.E.B.; Farag, M.A.; Abdelalim, A.M. Risk identification of building construction projects in Egypt. *Buildings* **2023**, *13*, 1084. [\[CrossRef\]](#)
58. Zsidisin, G.A.; Ellram, L.M.; Carter, J.R.; Cavinato, J.L. An analysis of supply risk assessment techniques. *Int. J. Phys. Distrib. Logist. Manag.* **2004**, *34*, 397–413. [\[CrossRef\]](#)
59. Ouabouch, L.; Amri, M. Analysing supply chain risk factors: A probability-impact matrix applied to pharmaceutical industry. *J. Logist. Manag.* **2013**, *2*, 35–40.
60. McCormack, K.; Wilkerson, T.; Marrow, D.; Davey, M.; Shah, M.; Yee, D. Managing risk in your organization with the SCOR methodology. *Supply Chain. Counc. Risk Res. Team* **2008**, *1*, 1–32.
61. Huang, J.W.; Wang, X.X. Risk analysis of construction schedule based on PERT and MC simulation. In Proceedings of the 2009 International Conference on Information Management, Innovation Management and Industrial Engineering, Xi'an, China, 26–27 December 2009; Volume 2, pp. 150–153.

62. Hacura, A.; Jadamus-Hacura, M.; Kocot, A. Risk analysis in investment appraisal based on the Monte Carlo simulation technique. *Eur. Phys. J. B-Condens. Matter Complex Syst.* **2001**, *20*, 551–553. [CrossRef]
63. Kontio, J.; Lehtola, L.; Bragge, J. Using the focus group method in software engineering: Obtaining practitioner and user experiences. In Proceedings of the 2004 International Symposium on Empirical Software Engineering, ISESE'04, Redondo Beach, CA, USA, 20 August 2004; pp. 271–280.
64. Hambach, R.; Mairiaux, P.; François, G.; Braeckman, L.; Balsat, A.; Van Hal, G.; Vandoorne, C.; Van Royen, P.; Van Sprundel, M. Workers' perception of chemical risks: A focus group study. *Risk Anal. Int. J.* **2011**, *31*, 335–342. [CrossRef]
65. Kidd, P.S.; Parshall, M.B. Getting the focus and the group: Enhancing analytical rigor in focus group research. *Qual. Health Res.* **2000**, *10*, 293–308. [CrossRef] [PubMed]
66. Statistique CANADA. Trade Data Online. 2023. Available online: <https://ised-isde.canada.ca/site/trade-data-online/en> (accessed on 10 June 2024).
67. Cid, A. Market Study Report. CIRCERB Report for the Industrialized Construction Initiative (ICI), June 2020. Available online: https://cicerb.chaire.ulaval.ca/wp-content/uploads/2020/07/market-study-report-juin-2020_allan-cid_final.pdf (accessed on 10 June 2024).
68. Blanquet du Chayla, C.; Blanchet, P.; Lehoux, N. A Method to Qualify the Impacts of Certifications for Prefabricated Constructions. *Buildings* **2021**, *11*, 331. [CrossRef]
69. Gouvernement du Québec. 2018. Available online: https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/energie-ressources-naturelles/publications-adm/strategie/STR_industrie_foret_2018-2023_MFFP.pdf (accessed on 16 August 2024).
70. FPIInnovations. *Compétitivité et Opportunités pour l'Industrie Québécoise des Bâtiments Préfabriqués—RTHQ*; FPIInnovations: Pointe Claire, QC, Canada, 2015.
71. Ministère Du Développement Durable. De L'environnement et de la Lutte Contre les Changements Climatiques. Stratégie Gouvernementale de Développement Durable 2015–2020. 2017. Available online: <https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/environnement/publications-adm/developpement-durable/strategie-dd-2015-2020.pdf> (accessed on 15 August 2024).
72. Gosselin, A. Marchés et Modèles d'Affaires: Construction Non-Résidentielle Structurale en Bois. Ph.D. Dissertation, Université Laval, Québec, QC, Canada, 2018.
73. Marketline. *Marketline Industry Profile. Residential Construction in North America*; Marketline: Manchester, UK, 2018.
74. Gouvernement du Canada. Portrait Sectoriel du Québec 2023–2025: Construction. 2024. Available online: <https://www.guichetemplois.gc.ca/analyse-tendances/rapports-marche-travail/quebec/construction> (accessed on 15 August 2024).
75. Bygballe, L.E.; Jahre, M.; Sward, A. Partnering relationships in construction: A literature review. *J. Purch. Supply Manag.* **2010**, *16*, 239–253. [CrossRef]
76. Gadde, L.E.; Dubois, A. Partnering in the construction industry—Problems and opportunities. *J. Purch. Supply Manag.* **2010**, *16*, 254–263. [CrossRef]
77. Annunen, P.; Haapasalo, H. Industrial operation model for the construction industry. *Int. J. Constr. Manag.* **2022**, *23*, 2736–2745. [CrossRef]
78. Construforce. *Immigration Trends in Canada's Construction Sector*; Construforce: Ottawa, ON, Canada, 2020.
79. Akintoye, A.S.; MacLeod, M.J. Risk analysis and management in construction. *Int. J. Proj. Manag.* **1997**, *15*, 31–38. [CrossRef]
80. Naderpour, H.; Kheyroddin, A.; Mortazavi, S. Risk assessment in bridge construction projects in Iran using Monte Carlo simulation technique. *Pract. Period Struct. Des. Constr.* **2019**, *24*, 04019026. [CrossRef]

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