Needs Assessment of Key Influencers of Mass Timber Construction

Knowledge Gaps in the Insurance, Finance and Commercial Real Estate Sectors in British Columbia

May 2020

SCIUS Advisory™

Prepared for Forestry Innovation Investment

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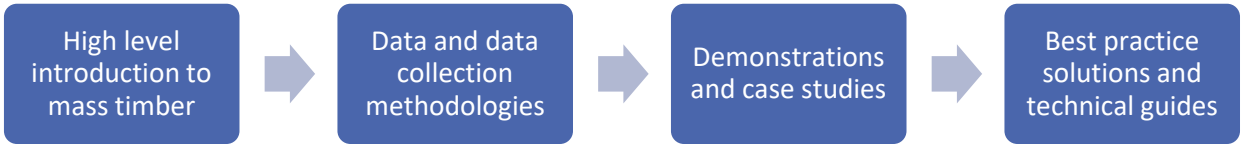
Executive Summary

Recent developments in mass timber construction have opened up new possibilities to use wood in large, complex buildings, but with this opportunity comes the need to understand the market dynamics of the commercial real estate industry. While architects, engineers, and builders drive the growth in mass timber construction, other professionals have a significant influence on the form, configuration and systems deployed in building design and construction decisions. These five “key influencer” groups can hold significant power over real estate and construction decision-making. This study identifies knowledge gaps and concerns for these groups and makes recommendations for how to address them.

1. **Finance and lending** comprise commercial and private investors, commercial / institutional property owners and developers, asset management, grant agencies, crown corporations, banks and lending institutions, pension funds, mortgage brokers and asset managers. Construction projects require professional financial management. The familiarity of the investor / lender with mass timber and their understanding of, and tolerance for, the risks (real or perceived) may impact funding for construction projects.
2. **Insurance and bonding** for construction projects is provided by insurance and underwriting companies, insurance brokers, sureties and also involves legal services. Similar to financiers and lenders, insurers evaluate the liabilities and risks associated and set rates based upon their assessment. Rates are set with the aid of historical performance data, which may result in higher rates or lack of coverage if a project utilizes innovative or less established products, technologies and/or approaches.
3. **Property management** services are not only performed by dedicated property management companies but also by quantity surveyors and chartered surveyors. Institutional owners may also maintain property management services “in-house”. Property management involvement at an early stage varies, but operational and maintenance budgets over the lifetime of a building may be considered at the design stage, particularly if the project delivery follows a design-build-operate model.
4. **Marketing and leasing** services for commercial and residential properties are provided by commercial leasing agents, real estate marketing companies and realtors, and are frequently brought in early on large projects to provide advice to investors on the configuration of a new project. If marketing agents do not believe a mass timber project will sell or lease, then the investor is likely to choose a different solution.
5. **Property valuation and appraisal** not only involves appraisers, quantity surveyors, chartered surveyors but also insurers, accountants, management consultants, governments, assessment and taxation specialists. Property valuations are performed for insurance, taxation, secured lending and other purposes. How the value of a mass timber building compares with a traditional building for the purpose of setting property taxes and rents, or when it comes to mortgaging, acquisition or dispersal will be an important consideration for an investor.

Based on a review of literature, interviews with professionals within each of the key influencer industries and an online survey, this report presents insights from representatives within each of the key influencer professions in Canada and the U.S. who traditionally build in concrete or steel and/or are focused on residential and mixed- use residential over six storeys, larger non-residential such as office and industrial buildings.

Recognizing that little has been done to target mass timber education to key influencer groups so far, it was encouraging to find that the professionals contacted for this research were intrigued by mass timber and interested to know more. There was clear agreement that professional development programs related to the construction, operations and maintenance of mass timber are needed and over 75% stated that they are interested in participating in mass timber training programs. The information needs uncovered from the research for all of the key influencer groups can be primarily organized as follows:



Mass timber is still very new for most key influencers and as such they need a high-level orientation on the basics related to cost, the construction process, the supply chain and the economic, environmental and social/health features of mass timber. This information needs to be presented using constructs and terminology that are familiar to key influencers and easy to incorporate into their work.

All key influencer groups function within very established codes of practice and make decisions based on historical performance data. Given the novelty of mass timber structures this data is lacking. A sustained data gathering initiative therefore that is conducted, analyzed and presented using industry accepted methodologies needs to begin promptly which is then shared across all key influencer groups.

Demonstration of the features, merits and performance of mass timber structures though case studies, videos and tours is necessary to clearly explain the differences in mass timber and light wood-frame construction (materials and labour costs, impact on scheduling, etc.). Key influencers also expressed an interest in the business case for mass timber as part of the reasoning for choosing it on a given project.

Finally, there is a need for a suite of standards, technical guides and best practices to provide confidence to key influencers that mass timber buildings can be managed properly over the long term. Table 1 provides a summary of the information needs for key influencer groups that was identified from the research.

Table 1 Summary of information needs for key influencer groups

Key Influencers	Information Needs
Applicable to <u>all</u> Audiences	A high-level overview that explains the differences in terms of cost, procedure and performance between mass timber and light wood frame construction. Data that proves long term performance of mass timber projects Demonstration of successful projects, both local and international, for inspiration and an understanding of what is working for others. Information about the embodied environmental impacts (especially carbon) of a mass timber structure, how it compares to similar buildings of other materials, what the full life-cycle implications are, including construction, transportation of materials and prefabrication in off-site facilities. Evidence of proper forest management practices and reforestation.
Finance and Lending	Details of the business case for working with mass timber as compared to other materials, with examples in residential, commercial and industrial applications. Cost variances and certainty in those costs.
Insurance and Bonding	Information about the scope, severity, frequency and timing of risks associated with mass timber projects and options for mitigation. Examples of claim scenarios or destructive testing in controlled simulations. Information about industry-accepted engineering methods used to address fire and water concerns such as reports demonstrating evidence of low combustibility and susceptibility to water damage. Research into durability and historical damages / claims (e.g. scope, frequency, building type, location and other circumstances).
Property Management	Best practice procedures for conducting conditions assessments of mass timber structures which address the type, scope, cause and prevalence of possible deterioration are possible? What are the methods of remediation? Demonstrations of how water damages mass timber. When does it need to be replaced? Standards of quality assurance for construction. Best practice guide for refurbishing, renovating and/or reconfiguring a mass timber building
Marketing and Leasing	Information about the economic, environmental and social/health features and benefits of mass timber which make it attractive to residential, commercial and industrial uses (for example, how using mass timber contributes to programs such as WELL). Evidence of how high-profile mass timber buildings leased space (e.g. Bullitt and MEC buildings). Examples of how the “biophilic” aspects of mass timber have helped property marketing efforts.
Property Valuation and Appraisal	Valuation data, cap rates and historical performance. Examples of how proven advantages of mass timber have resulted in higher property valuation.

Key Influencers	Information Needs
"Other": Designers	Details about maximum height, weight and clear spans.
	Technical incorporation of mechanical, electrical and plumbing systems.
	Behavior of the material seasonally as well as over longer time periods.
	Alignment with LEED and WELL standards.
	Best practices for detailing the building envelope, washrooms and other areas susceptible to water damage.
	Information and education regarding how moisture behaves and what treatment and renewal of surface practices are recommended.
	How detailed planning and pre-design need to be compared to concrete/steel. What details can be worked out at the construction documents phase.
	Design considerations for acoustic levels, especially between suites in a residential building. What additional detailing is required and what are the costs or permitting issues relevant to those features.
	Clarification in the building code about mass timber specifically.
"Other": Suppliers and Contractors	Training for construction crews on proper procedures for installation.
	Training for contractors on digital tools and the value and practicalities of prefabrication.
	Industry capacity so that sourcing does not add to the complexity of mass timber projects.
	Mass timber products, availability, applications and availability.

The extent to which members of the key influencer groups participate in real estate development projects may vary depending on building use, complexity, size, capital requirements, project delivery method, risk, geographic location, climatic conditions, etc. Nevertheless, this research has illustrated that, to accelerate the adoption of mass timber, these professionals (as well as their respective industry associations) are well positioned to exert pressure on the market and have the power to either accelerate or slow the rate of adoption of mass timber construction solutions.

1. Introduction

Increasingly, the building industry, policymakers and regulators are looking at ways of reducing embodied carbon emissions in buildings that result from the manufacturing and transportation of construction materials, as well as from the construction process itself, by promoting the use of wood as a low carbon alternative. BC wood products from sustainably managed forests have a significant opportunity to contribute to a low carbon future.

Recent developments in mass timber construction have opened up new possibilities for the use of wood in large, complex buildings but, with this opportunity comes the need to better understand the market dynamics of the commercial real estate development industry (which includes industrial, commercial and institutional (ICI) and high-rise residential projects). In particular, it is critical to understand how decisions are made in this market and, once understood, how best to intervene with educational programs and resources to accelerate the adoption of mass timber construction.

While architects, engineers, and builders drive the growth in mass timber construction, other professionals have a significant influence on the form, configuration and systems deployed in building design and construction decisions. These “key influencers” can be organized into five groups:

1. Finance/lending
2. Insurance/bonding
3. Property management
4. Marketing/leasing
5. Property valuation and appraisal

The purpose of this study is to provide guidance as follows:

1. An understanding of the role of each influencer group in building construction and real estate and a qualitative characterization of their impact on building design and construction with mass timber in Canada and the U.S.
2. A review of key influencers’ mass timber knowledge gaps and data needs, from building pre-design to post-occupancy, and how to address them so they can be as conversant in mass timber systems as they are with conventional concrete and steel construction.
3. Prioritized activities in addition to addressing these informational needs that present solutions supported by a summary of the critical information and data needed to address identified needs among key influencers.

Based on a review of literature, interviews with professionals within each of the key influencer industries and an online survey, this report presents insights from representatives within each of the key listed influencer groups in Canada and the U.S. who traditionally build in concrete or

steel and/or are focused on residential and mixed- use residential over six storeys and larger non-residential such as office and industrial buildings.

The literature review was intended to identify and evaluate the issues and perceptions held by the key influencers of mass timber construction and formed the basis of in-depth interviews with industry leaders. The on-line survey questionnaire was structured to fill remaining knowledge gaps. The research methodology, scope and limitations are described in Appendix A and the literature review report, interview process, questions and transcripts and survey design and results are all provided in separate supporting documents.

2. Key influencer roles and impacts

The extent to which members of the key influencer groups participate in real estate development projects varies in accordance to building use, complexity, size, capital requirements, project delivery method, risk, geographic location, climatic conditions, etc. Nevertheless, to accelerate the adoption of mass timber, these professionals (as well as their respective industry associations) are well positioned to exert pressure on the market and have the power to either accelerate or slow the rate of adoption of mass timber construction solutions.

The five key influencer groups are described below in terms of their role in real estate and construction, and their impact on building design and construction with mass timber in the North American context. Of these, the finance/lending and insurance groups are the key decision makers – they can have a direct impact on whether a mass timber project goes ahead or not. The property managers, marketing / leasing and appraisers and property valuation and appraisers are important advisors to these decision-makers. In particular, some marketing companies can have a very strong influence on the development of residential projects.

1. Finance and lending

According to the Urban Development Institute (UDI), real estate development contributes about 7% of BC's GDP, making real estate and construction combined worth over 15% of the provincial economy[1]. Financing the development and construction of buildings takes a wide range of forms but the key players are generally commercial and private investors, commercial / institutional property owners and developers, asset management, grant agencies, crown corporations, banks and lending institutions and pension funds. There are also intermediaries such as mortgage brokers, asset managers, investment syndicates and so on.

Some lenders are more engaged in (and more knowledgeable about) the building design and construction process than others. For example, Vancity, and its affiliate Citizens Bank, are experienced "impact investors" using their involvement in real estate developments to advance

[1] Jeff Fisher, Vice President & Senior Policy Advisor. Urban Development Institute, interview 2019

Vancity's sustainability and social justice agendas.[2] Some institutional building owners (such as universities) that self-fund their projects and pension funds are also experienced and sophisticated investors who take a long term "total cost of ownership" view of their projects, looking beyond the capital cost of a construction project. Others, such as most of the "Big 5" banks and (as a consequence) the highly leveraged residential development companies are simply looking for a reliable short-term gain which means they are more interested in a proven building typology. Either way, the investor's familiarity with mass timber and tolerance for new ideas will be key to the realization of a mass timber project – if the investor is not on board, it will not go ahead. It is worth noting that the financial industry as a whole is dominated by global companies whose centres for decision making are outside BC.

2. **Insurance and bonding**

Managing the risks associated with BC's $20bn construction industry involves a large number of insurance and underwriting companies, insurance brokers, health and safety, sureties and, of course, lawyers. How risk is apportioned in a construction project is dictated by the contract and agreed form of project delivery. There are specialized insurance policies available depending on whether the project is a design-build, construction management, and so on. The types of insurance commonly used in construction projects includes:

1. **Commercial General Liability** (CGL) insurance provides contractors with protection against a range of potential common claims, including bodily injury, property damage or personal injury. A standard CGL also provides coverage in the completed operations phase for damage to work performed on the insured's behalf by subcontractors.
2. **Builders' risk** (sometimes referred to as course of construction) covers a building or insured area when it is under construction. The policy will pay for damages up to the coverage limit, which must accurately reflect the total completed value of the structure. This policy will be in the range of one to four percent of the construction cost.
3. **Professional liability** policies cover liability that arises from an insured's performance of their professional services, which subsequently leads to a loss. This insurance, which is also known as errors and omissions (E&O) insurance, provides coverage to architects, engineers and increasingly, "design-build contractors" for claims for damages alleged to be the result of the negligent performance of professional services (which must include a mental or intellectual component) as defined in the policy.
4. **Wrap-up liability** is a liability policy that serves as all-encompassing insurance, which protects all contractors and subcontractors working on a large project. Wrap-up

[2] For more details about Vancity's impact investment strategy, visit www.vancity.com/AboutVancity/InvestingInCommunities/ImpactLending

insurance is intended for larger construction projects and offers uniform coverage as the owner and all contractors are insured on one policy by one insurer.

Bonding is required of contractors for commercial projects and a surety bond (also known as a contractor bond) is a legal guarantee issued by an insurance company (surety) that provides financial protection to the project owner in the event that a contractor defaults on a job, does not complete the project in the time allowed, or fails to deliver up to adequate standard that was agreed before the construction contract started.

Underwriters of E&O policies become interested in particular construction projects when local governments require architects and engineers to sign letters of assurance that the building will perform in accordance with prevailing building codes. If they do not understand the proposed innovation, they can withhold coverage. Some insurance companies are working hard to get up to speed with mass timber construction and to understand potential risks (such as fire) but others may be more circumspect. Most of the large insurance companies are based outside of Canada and draw on standard policies and instruments that are not necessarily oriented towards BC. Certainly, if designers and builders cannot get adequate coverage to allow them to design and build mass timber buildings, then they will not do so.

5. **Property management**

The property managers, quantity surveyors and chartered surveyors involved with operating and maintaining a property so that it continues to generate “best value” returns over its functional life are important voices in the formation of a new construction project. Most property management services are performed by stand-alone companies although some commercial and institutional owners may retain property management services “in-house”.

The degree to which they are actually involved in the decision-making varies from having a say to having no say at all. Frequently, capital budgets and operating budgets are often managed separately, and the maintainability of a building is often not as fully considered at the design stage as it should be. Conversely, projects that are delivered using a design-build-operate arrangement (e.g. a public-private partnership (P3)) will take the views of the property manager extremely seriously.

6. **Marketing/leasing**

The commercial leasing agents, real estate marketing companies and realtors are frequently the face of new developments – it is their job to brand, sell and/or lease a property and, as such, are primarily locally based and extremely atune with the regional market conditions and the predilections of buyers and tenants.

The major marketing companies are frequently brought in early on large projects to provide advice to investors on the configuration of a new project. Indeed, the marketing agent may sometimes be consulted before the architect in high profile large residential / mixed use projects.

If marketing agents do not believe a mass timber project will sell or lease, then the investor is likely to choose a different solution.

7. **Property valuation and appraisal**

Appraisers, quantity surveyors, chartered surveyors, insurers, accountants, management consultants, governments, assessment and taxation specialists are all involved (to a greater or lesser degree) in the business of ensuring that the value of a real estate asset is established and maintained properly so that government dues and assessments can be levied and properties can be bought and sold.

Appraisers and valuers undertake property valuations for insurance, taxation, secured lending and other purposes and each comes with its own set of rules and requirements: the pension fund regulators have their own regulations, the banking system has its own standards for secured lending, and so on.

How the value of a mass timber building compares with a traditional building for the purpose of setting property taxes and rents, or when it comes to mortgaging, acquisition or dispersal will be an important consideration for an investor.

3. Key influencers' mass timber knowledge and data needs

From the literature review, 54 issues emerged to be of interest to key influencers sorted from highest to lowest importance (Table 2). Based on this information and further insights from the in-depth interviews and survey, a series of technical topics were identified that key influencers need to understand when contemplating a mass timber project. For each topic, the relevant issues are summarized, and a list of the key data needs and/or knowledge gaps is provided highlighting targeted requirements for key influencers where applicable. The findings from the literature review were compared against and augmented by insights from the in-depth interviews and the survey.

Table 2 Issues identified during the literature review organized from highest to lowest importance.[3]

Issue		Audience				
		Finance / lending	Insurance / bonding	Property management	Marketing / leasing	Property valuation & appraisal
1.	In mass timber construction there are concerns about the performance of the resins that hold the wood together. These relate to durability; fire resistance; delamination and moisture resistance.	X		X		
2.	Some owners have limited confidence in mass timber due to lack of understanding of operations and maintenance.	X		X		
3.	In mass timber and stick-frame construction building repairs become replacement for severe fires.		X	X		
4.	Property valuation on mass timber buildings is lower than comparable non-timber buildings by ~20% due to the perception that mass timber is less durable and carries a higher risk of fire.	X		X		
5.	Mass timber projects require additional fire safety measures during construction which increase cost.	X				
6.	In mass timber construction it is critical to design and maintain a good envelope as even small amounts of moisture can cause deterioration.	X		X		
7.	Regulatory and often restrictive building code requirements for mass timber projects are not well defined.	X	X			
8.	Risk engineers and underwriters should be provided with professional development programs to educate them in technical programs such as mass timber construction.	X	X	X	X	X
9.	Reduced schedules offered by CLT can enable time-critical projects to be realized (e.g. schools).	X				

[3] Importance ranking is based on the combined judgement of the Scius and FII project team.

Issue	Audience				
	Finance / lending	Insurance / bonding	Property management	Marketing / leasing	Property valuation & appraisal
10. Insurance industry does not identify mass timber as a unique approach and thus working with an insurance broker that understands the unique characteristics of mass timber is vital to securing adequately priced policies that provide the right level of coverage.		X			
11. Mass timber projects have an increased risk of water damage during construction and throughout building operations, however If sufficiently protected and well detailed there is no reason the material should deteriorate over time.		X	X		X
12. There is confusion between wood frame and mass timber construction in project documentation.	X			X	
13. In mass timber projects full modeling upfront, requires designers, architects and owners to think through all details at the outset and to resolve any issues or concerns with backup evidence provided by engineers and manufacturers.	X				
14. Performance-based workarounds are often needed to prove to the local authority having jurisdiction, typically through third-party testing, that the mass timber products can perform as well as currently allowed materials such as steel and concrete.	X				
15. There is uncertainty in lifetime durability and value associated with mass timber projects.	X		X		
16. Drywall encapsulation of stairwells and fire exits provides a level of safety equivalent to that of concrete/steel.	X	X			X
17. Fire risk can be reduced during construction through hot work permits, fire watch personnel and encapsulation of the mass timber structure keeping pace with erection to within a few storeys.	X	X			
18. In mass timber structures the contribution of encapsulated timber to a compartment fire is either non-existing or insignificant, however, failure of the encapsulation can lead to the involvement of timber in the fire.	X	X			

Issue	Audience				
	Finance / lending	Insurance / bonding	Property management	Marketing / leasing	Property valuation & appraisal
19. Charring protection during fire and the conclusiveness of fire testing in mass timber are still under discussion.	X	X	X		
20. Fire and course of construction insurance is more expensive in mass timber projects than in concrete/steel construction.		X			
21. In mass timber projects there's still some uncertainty about liability around prefabricated components (i.e. who is responsible in case of failure or compromised performance).	X				
22. Front-loaded design of mass timber projects due to pre-fabrication and detailed assembly planning reduces on-site issues and change orders.	X				
23. CLT has been proven through rigorous testing to externally char and maintain its structural integrity in a fire situation.		X			
24. Mass timber needs to be sealed properly to avoid insect infestation and mould growth.	X	X	X		
25. Even for buildings six stories or less, building codes haven't specifically recognized mass timber systems in many US jurisdictions.	X	X			
26. Some Canadian provinces will permit as of 2020 the construction of mass timber buildings of up to 12 storeys without requiring an application for equivalent measures.	X	X			X
27. There's a general perception that mass timber is like light wood-frame construction.	X	X	X		
28. Data collection of new wood construction performance should be shared between insurance carriers.		X			
29. Selecting contractors and subcontractors with mass timber experience is difficult. Using less experienced trades can lead to poor practices, unknown risks.	X		X		
30. Developers can lease offices in mass timber buildings sooner than in conventional projects.	X			X	

Issue	Audience				
	Finance / lending	Insurance / bonding	Property management	Marketing / leasing	Property valuation & appraisal
31. Shorter construction schedule of mass timber projects reduces cost for the developer and reflects in lower lease rates for tenants.	X			X	
32. Lower anticipated operating expenses results in a higher NPV and lower financing requirements.	X			X	X
33. Health and wellness benefits of mass timber are not perceived as beneficial from a leasing/marketing perspective.				X	X
34. Mass timber construction needs an evaluation and rehabilitation guide for fire events.		X	X		
35. Mass timber strength is equivalent to reinforced concrete and its wind and seismic performance is like steel.	X	X	X	X	X
36. In mass timber construction many building codes require that structural elements be protected by encapsulation.	X	X			
37. Some form of independent accreditation may be required for mass timber and wood frame projects to confirm that they are “mortgageable”.	X			X	X
38. There's a lack of experience and training for trades and design professionals on proper methods to use, install and design CLT.	X		X		
39. There are no changes in financing requirements between conventional construction and mass timber.	X			X	X
40. Incentives provide an advantage in obtaining funding for mass timber projects.	X				
41. There is a premium value of leasing rates due to the perceived environmental and health benefits of mass timber construction.					IV
42. Wood frame structures are less durable than concrete and have a tendency for higher operating and maintenance costs, however, concrete and steel are also demolished < 50 years if poorly maintained.	X		X		

Issue	Audience				
	Finance / lending	Insurance / bonding	Property management	Marketing / leasing	Property valuation & appraisal
43. Many mass timber projects report no increase in premiums but additional safety measures during construction.	X	X			
44. In mass timber construction there's not enough experience with third-party liability insurance and contractors' all risk insurance.		X			
45. In CLT structures timber provides part of the fire resistance so there is a degree of structural redundancy which for minor fires, where charring has occurred, it is likely that the load-bearing section of the element is still intact.		X	X		
46. Mass timber projects are more susceptible to damage and potential ongoing maintenance associated with insect infestation.	X		X		
47. There is a perceived resistance from lenders and insurers to back CLT which can result in clients' reluctance to adopt the material.	X	X			
48. The use of BIM modelling can help code reviewers and permit authorities identify pre-certified building components and assemblies.	X				
49. Many fire departments do not have equipment necessary to fight mass timber fires at great heights.		X	X		
50. A certification process is required for trades working on mass timber projects as well as an audit system to monitor the certification program itself.	X		X		
51. Lenders and insurers would be better prepared for mass timber projects if builders had the opportunity to access certification and quality assurance programs.	X	X			
52. There's uncertainty and unfamiliarity with mass timber supply chain and design possibilities.	X	X	X		
53. Prefabricated mass timber components can help stabilize construction prices as the supply chain and code adoption develops.	X				

Issue	Audience				
	Finance / lending	Insurance / bonding	Property management	Marketing / leasing	Property valuation & appraisal
54. Public awareness of climate issues has increased demand for wood construction in general and mass timber buildings specifically.	X	X	X	X	X

Analysis of the issues identified in the literature review revealed that 54% hinder the adoption of mass timber construction, while 46% were supportive (Table 2). Further, half of the issues (50%) pertain to risk management and finance, which reinforces the significance of investors, lenders and insurers in realizing mass timber buildings (Table 3Table 3). Technical considerations (i.e. design), expertise of industry practitioners and regulatory issues together make up 44.6% of other important issues. By comparison, industry supply chain issues and environmental considerations are not perceived as being as important (see Appendix A for details on how these issues were analyzed).

Table 3 Issues identified from the literature review ranked in order of frequency mentioned

Type of Issue	Number of Issues	% of Total
Risk Management	14	26.0%
Financial	13	24.0%
Technical	9	16.7%
Knowledge and Expertise	8	14.8%
Regulatory	7	13.0%
Supply Chain	2	3.7%
Environmental	1	1.8%
TOTAL	**54**	**100%**

These findings informed the structure and focus of twelve in-depth interviews with leading experts from within the five key influencer audiences and an online survey comprising nine questions that was completed by 20 respondents.

Table 4 presents a summary of the distribution of the survey respondents across the key influencer groups, 65% of whom were key influencers, the remainder from related professions (see Appendix A for details on the data collection process). The small number of respondents and lack of those in some categories limits the significance of the survey results. However, the results are consistent with interview responses and are included to help inform the recommendations.

Table 4 Distribution of survey respondents

Key influencer category	Number of respondents
Property owner / investor	7
Project finance / lending	3
Project insurance	2
Surety and bonding	0
Marketing and leasing	1
Appraisal and valuation	0
Property management	1
Other (architect, engineering consultant, energy manager, contractor, building material supplier, structural engineer)	6
TOTAL	**20**

Table 5 presents a snapshot of the top-line survey findings in terms of the general results (all respondents) and those that identified as a key influencer (65% of the total respondents).

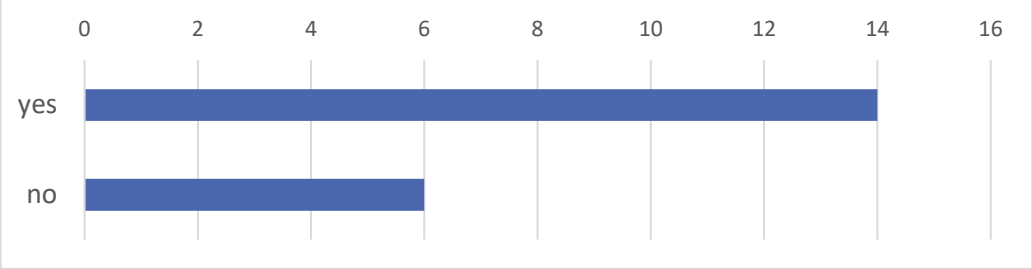
Table 5 Summary of the survey findings

Questions	Responses	General Results	Key Influencer Results
Type of Audience	Key Influencers	65%	
	"Other"	35%	
Mass timber knowledge	Yes	68%	77%
	No	32%	23%
As durable as concrete/steel	Agree	79%	92%
	Neither agree nor disagree	16%	8%
	Disagree	5%	0%
Most important issue	No. 1	Fire/life safety, durability	Strength and stability
	No. 2	Strength and stability	Environmental performance
	No. 3	Environmental performance	Fire/life safety, durability
Need for training and education	Agree	87%	79%
	Neither agree nor disagree	13%	21%
	Disagree	0%	0%

Questions	Responses	General Results	Key Influencer Results
Lower property valuation	Agree	0%	0%
	Neither agree nor disagree	42%	46%
	Disagree	58%	53%
Codes support mass timber	Agree	42%	46%
	Neither agree nor disagree	21%	15%
	Disagree	37%	38%
Confusion between mass timber and light wood frame	Agree	68%	61%
	Neither agree nor disagree	16%	23%
	Disagree	16%	15%
Costs more to build	Agree	53%	58%
	Neither agree nor disagree	42%	33%
	Disagree	5%	8%

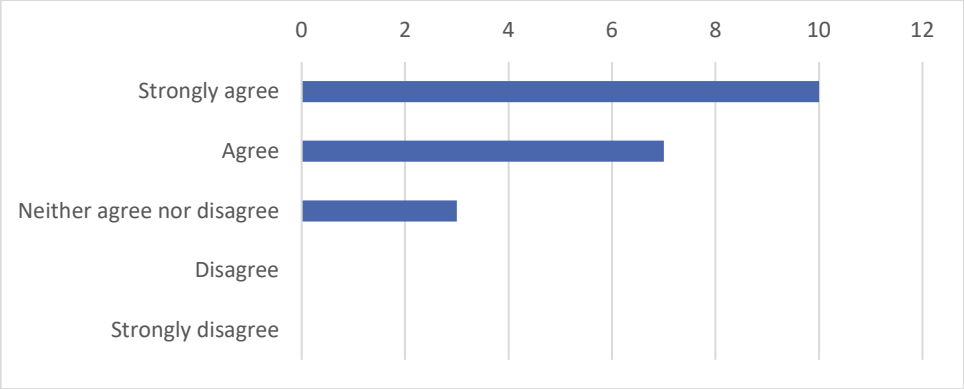
While the interviews were oriented towards leading experts, the survey was intended to gather insights from mainstream practitioners who may be less familiar with mass timber construction. That said, the survey respondents had an appreciation of the topic (Figure 1).

Figure 1 Do you feel that you understand the properties and performance of mass timber buildings sufficiently well that you could consider using mass timber in a project today?



While the majority of the respondents felt they understood features of mass timber construction, there was clear agreement among survey and interview respondents that professional development programs related to it are needed. 85% of survey participants saw a need for professional development programs to better understand construction, operations and maintenance of mass timber building and 75% of interviewees responded that they were interested in participating in mass timber training programs (Figure 2).

Figure 2 Do you agree that there is a need for professional development programs in your industry to better understand construction, operations and maintenance of mass timber?

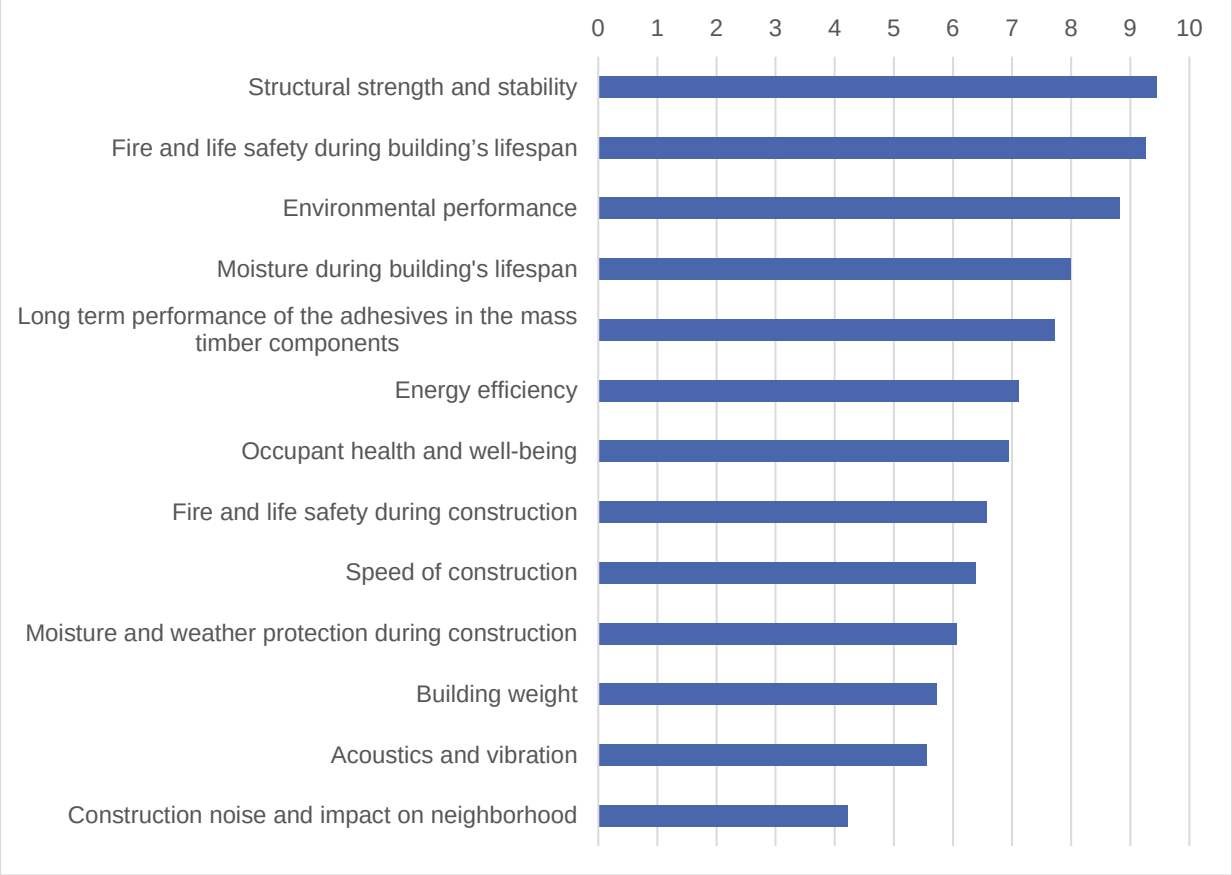


When asked what they thought were particularly hot topics related to mass timber for their industry, survey respondents suggested the following:

- It would resurrect our provincial economy. It's an amazing renewable resource. Can act as both a conserving material as well as a carbon sink. We need to liaise with the forestry sector to make this work.
- Cost, durability, performance.
- Outside of construction, maintenance, operations - helpful to increase knowledge to influencing roles that could impact decision to go with mass timber (policy makers, sustainability professionals).
- Safety factors, constructability and coordinating trades (plumbers who cut through joists, etc.).
- Regulatory processes/building code changes. Broader knowledge among consultants and broader construction knowledge.
- Advantage of gaining expertise and experience now as the product begins to increase its market share.
- Construction methods to prevent moisture impacts and fire during construction. Lifecycle monitoring and maintenance of wood structures.
- Understanding mass timber as a material and how to design for acoustics and fire. Choosing appropriate assemblies.

To provide further context and to prioritize key influencers' mass timber knowledge and data needs, survey respondents were asked to identify what they thought to be the most important considerations when building with mass timber (Figure 3).

Figure 3 What do you think are the most important considerations when building with mass timber? Please rank the most significant considerations.



From the literature review, interviews and survey, key influencers need to understand the following topics when contemplating a mass timber project.

1. Structural strength and long-term durability
2. Performance in a fire
3. Environmental and health performance
4. Economic considerations
5. Codes, regulations and standards
6. Understanding the difference between mass timber and other structural systems
7. Operational and maintenance requirements
8. Project sequencing and prefabrication issues

The research findings for each topic are discussed below. In each case, the relevant issues are summarized, and a list of the key data needs and/or knowledge gaps is provided highlighting targeted requirements for key influencers where applicable.

There were many comments that pointed to higher premiums and perceived risks arising from a sense of unease that could not be explained specifically and which can only be put down to lack of willingness or interest in trying something new. At the same time, there were also numerous ideas or suggestions on how to accelerate the adoption of mass timber projects and these are also included in this section.

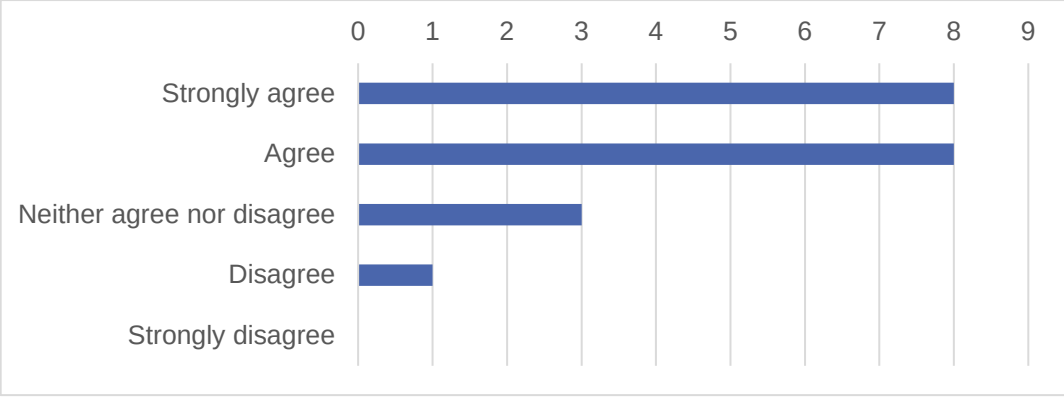
There were also many instances where the lack of knowledge within other industry stakeholder groups are highlighted by key influencers as barrier to mass timber construction and these are also noted. All of the findings must be read in the context of an industry grappling with the newness of mass timber. In particular, it was indicated several times that there are no industry-accepted guidelines regarding mass timber currently available for lenders, insurers, appraisers all of whom function primarily within very clear regulations, technical parameters and investment pro formas and who primarily base their decisions on historical performance data.

> "I fully support mass timber and would recommend it for new buildings, but I don't know much about its performance to form strong arguments."
>
> Survey respondent

3.1. Structural strength and long-term durability

The survey respondents mostly agreed that mass timber buildings can be as strong and durable as concrete and steel buildings (Figure 4).

Figure 4 Based on your current level of understanding, do you think that mass timber buildings can be as durable and long-lasting as concrete and steel buildings?



There were no major concerns from the interviewees about the performance of adhesives given that they primarily relied on professionals, manufacturer specifications and testing/certification. Certainly, interviewees felt that moisture issues were something to be aware of and designed for, but it was not "a deal breaker" – i.e. it was not a primary issue if proper processes are in

place and quality assurance principles are followed. Interviewees also noted that it was important to allow time in schedule to deliver and install during better weather.

When asked what they were most concerned about regarding the durability of mass timber buildings, survey respondents offered the following comments:

- My perception is mass timber can be at least sufficiently durable, but I don't know if it is as durable or more durable compared to concrete and steel.
- Insects.
- Breakdown of glues and adhesive over time and in UV.
- Unproven long-term performance.
- Historical data.
- Unproven technology.
- Moisture ingress during construction and over the life of the building causing rot in the wood structure.
- It all depends on the application and exposure. They definitely require protection from trapped moisture.

Interestingly, the seismic performance of mass timber only came up in the literature review and was not raised by interviewees or the survey. This suggests more can be done to promote the scientifically proven seismic resilience of mass timber. When probed on the topic of wood decay and insect infestation, interviewees were not aware of any issues in Canada, and assume mass timber is like other wood buildings.

> "Tallwood House is performing very well today; but we do not have evidence of how a building like this will perform over the life of such a building."
>
> Survey respondent

> I think it would be really important to dig deeply into code and mitigation in design and find out what are architects and engineers involved with mass timber doing differently because of some of the concerns [about durability]. So, for example, floor drains aren't required by code but if you're doing a twelve storey CLT rental building, I would like to think somebody would say, 'You know what, floor drains might really make sense here'."
>
> Interviewee – insurer

Data needs and knowledge gaps

- **Insurers**:
    - Information that helps them identify risks and the solutions necessary to accommodate or mitigate them upfront.
    - Research is needed to gather data on historical damages / value of claims
- **Insurers and property managers:**
    - information about and demonstrations of how water damages mass timber. When does it need to be replaced?
- **All key influencers:**
    - Sharing of best practices and experiences.
    - Case studies and/or impartial evidence of successful projects.
    - Evidence that clarifies the differences in durability performance with stick-frame construction.
- **Other industry stakeholders:**
    - Education on mass timber is needed for the engineers and consultants on which owners rely.
    - Industry accepted quality assurance processes for mass timber need to be developed for application during construction.
    - Research and best practices manual regarding detailing mass timber where it has the potential to come into contact with water both externally and internally, e.g. near washrooms.
    - Education of construction crews is necessary so that they adhere to proper procedures.

3.2. Performance in a fire

The performance of a building in a fire is considered 1) during construction and 2) during its operational service life. Insurance costs can be a major consideration for both if the building is built of wood. However, the difference in premiums between mass timber and light wood frame can be significant with construction insurance up to 10 times more per month for light wood frame.

Recent code changes have made the discussion about fire with insurers much easier but there is the persistent view that wood buildings pose a higher fire risk than concrete and steel. Changing that perception will be required to lower perceived risk. However, interviewees generally felt that a good deal of work has been done related to fire testing for mass timber and the facts are available - there just needs to be more effort to get it in the hands of key decision-

makers. It is worth stating that some interviewees felt that the current requirement for encapsulation of structural elements is unnecessary based on the proven fire resistance of mass timber and that this has been done “to appease those who don’t understand the material”.

> “I don't think that loss due to fire is an issue. That's not part of our consideration in terms of what we're thinking about for building because building code allows for mass timber to be used. There's height limitations and we’d like the height limitations to go higher. But all the other fire and life safety has been addressed so far by the building code.”
>
> Interviewee – marketing and leasing

Insurers base their assessments on historical data and there is a lack of sufficient comparable projects to help the insurance industry develop a statistically reliable track record for mass timber buildings. As a result, premiums for mass timber projects remain higher than for concrete and steel. Interviewees generally understood the charring process and how it maintains the structural integrity of mass timber in a fire but the degree to which materials need to be replaced, how much it would cost and how it gets done after a fire was unclear.

> “I can’t personally see an occupied mass timber building having a fire that would equate to a total loss. It just doesn’t make sense to me.”
>
> Interviewee – insurer

In terms of the fire risk impact on property valuation, the properties of mass timber are not sufficiently well-understood and perceptions will only change based on proof of performance of buildings over time. The appraisers interviewed noted that their profession was largely unaware of the proven abilities and performance of mass timber so they tend to trust designers and engineers.

> “If you ask your standard industrial occupier what building he wants, he wants to build out of concrete because he believes that you can flood it, you can set fire to it, you can have rain all year round, and it won’t matter.”
>
> Interviewee – valuation

Data needs and knowledge gaps

- **Insurers:**
    - A major effort is required to educate insurers about when mass timber can be exposed and when encapsulation is necessary, depending on building occupancy and design.
    - More readily available examples of claim scenarios or destructive testing in a controlled simulation would help ease concerns of risk.
    - Education about the differences in performance and issues of risk (e.g. proximity to hot works) between light wood frame and mass timber during construction.
    - Information is needed about remediation costs to a mass timber structure as a result of a fire (or water damage) and how it gets done.
    - Industry engagement (insurers and underwriters) to understand the specifics of why rates are higher for mass timber and what performance criteria would reduce them.

- **Property valuation and appraisal**:
    - Long-range performance testing of mass timber buildings to show how they hold up over time.
    - If the insurance is higher because of the risk, the value will be affected
    - Funding or political incentives could help improve perceived value.
- **All key influencers:**
    - Data is needed to demonstrate that although insurance costs for mass timber projects may be higher than for concrete and steel buildings, the time frame the policy is in effect is shorter due to the accelerated construction schedule.
    - Statistical data analysis is needed to demonstrate that the risk profile for mass timber construction is different from light wood frame.
- **Other industry stakeholders:**
    - Project teams on tall buildings need to know how to install sprinkler / fire suppression systems as construction proceeds higher. This can be an issue during freezing temperatures.
    - Fire safety best practices are well described and accepted for light wood frame construction and can also be applied to mass timber. Project teams need to know that they can apply these approaches on a mass timber project as well.

3.3. Environmental and health performance

A key motivation for selecting mass timber is the low embodied energy and carbon benefits that arise from the wood itself. Interviewees felt that while some investors and end users will be drawn to this benefit, strong impartial science-based evidence is needed with respect to how much carbon is being saved over the full lifecycle.

When asked if they thought building in mass timber was worth the effort in the context of fighting climate change, they pointed to the need for real data as key to the decision-making process. There was little understanding of the scale of the environmental impact building wood has versus other initiatives to combat climate change. Similarly, the renewable aspect of wood products needs to be demonstrated and sustainable reforestation promoted to key influencer audiences.

> "The impact of spaces on our lives will force an increased awareness of our environment because everyone has been forced to work from home. People will start to pay more attention to it."
>
> Interviewee - architect

Although climate change has become a more important policy issue, other concerns still take priority for many investors and commercial tenants. While interviewees did not believe there was any evidence of purchasing choices being made because of climate change – more research is needed on this. Interviewees also noted that the emphasis on drywall encapsulation is limiting the carbon sequestration benefits of using wood. It was also mentioned that transportation of mass timber products over long distances does not help wood's low carbon image.

However, the operational energy efficiency and environmental performance of a mass timber building are also important, and this includes considerations related to envelope design, indoor air quality and acoustics. Interviewees generally agreed that mass timber equates really well with high performance buildings. In particular, key influencers need to know that mass timber is well suited to designs for the high end of the BC Step Code and Passive House standards.

Interviewees did not specifically raise envelope design for mass timber buildings as a specific area of concern. Different envelope and cladding materials require different construction details, but they are not dissimilar to concrete and steel construction. Certainly, the ability to prefabricate envelope elements in a factory setting aids in quality control and air tightness. In general, mass timber envelope requirements are well aligned with the improved performance outlined in the BC Step Code.

It is well known in the marketing and leasing world that health and wellness is important to building occupants and buildings that promote health and well-being can get a premium on lease rates and a higher valuation due to reduced vacancies and tenant turn-over. However, interviewees noted that while the biophilic aspects of a wood structure were marketable, empirical evidence is needed that demonstrates the benefits (e.g. worker productivity,

construction worker safety, etc.). They also noted that while “tenants like the natural feel, they like high ceilings even more.”

> “We do a lot of market sounding. In our major markets, we're looking at [former industrial] districts that are being reimagined - ones that are primarily millennial marketplaces where millennials are going to be representing more than 50% of the future employees or talent pool. For them sustainability is really, really important. We also know that it’s important to them to be able to understand where and how the building that they're in has been delivered to the site in a sustainable way.”
>
> Interviewee – marketing and leasing

In terms of indoor air quality, mass timber buildings require no different design approaches to conventional buildings although interviewees noted that “some people think the glues detract from the wellness aspect”. Additionally, key influencers may need to access to information about the off-gassing of adhesives and resins, much of which exists already.

It was also pointed out that wood systems are lighter than traditional site-built alternatives and can also result in sound transmission issues if not carefully addressed during the design stage.

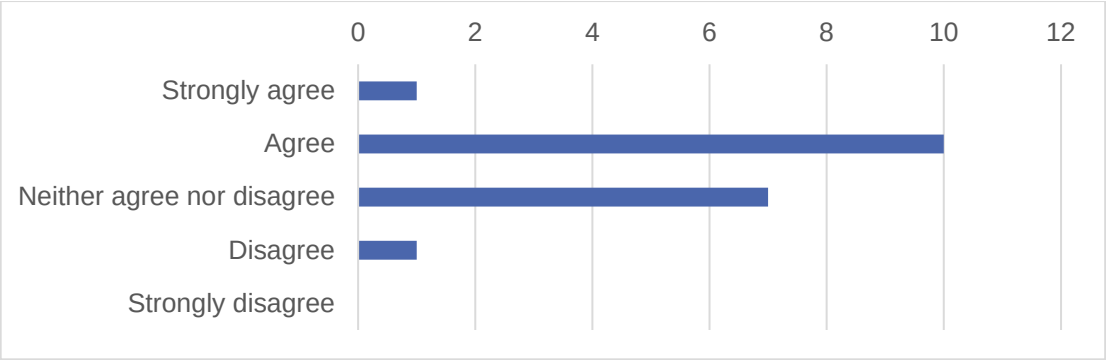
Data needs and knowledge gaps

- **All key influencers:**
    - Sound transmission between floors and demising walls is seen to be a shortcoming in all types of wood buildings. More thorough detailing, work and money is required to mitigate the footfall noise, and inspectors are now scrutinizing this, which results in increases to permitting risk.
    - Are all processes (from forest management to transportation to prefabricated components to construction) managed sustainably and cost effectively?
    - Understanding the embodied carbon aspect: how is it calculated?
    - How does mass timber contribute to LEED or WELL standards?
    - Off-gassing information about the adhesives and resins used in mass timber components may need to be packaged differently for non-technical professionals (i.e. not EPDs and MSDS sheets).
    - Understanding cladding differences and water protection requirements.

3.4. Economic considerations

Interviewees were asked a range of questions about their perceptions of the economic costs and performance of mass timber projects to better understand the market dynamics and motivations of investors, purchasers and tenants which, in turn, would influence marketing and leasing agents and property valuers. Overall, the findings suggest that more data related to development costs, ROI/ROE, leasing times / time on market, operating expenses, financing costs/requirements is needed based on proven examples to better inform decision-making. For example, just over half of the survey respondents thought that mass timber buildings cost more to build than a conventional alternative (Figure 5).

Figure 5 Do you agree that some development costs may be more expensive for a mass timber project, such as insurance premiums, cost of borrowing, or marketing / leasing?



When asked what they thought was the most significant cost difference for a mass timber project, survey respondents suggested the following:

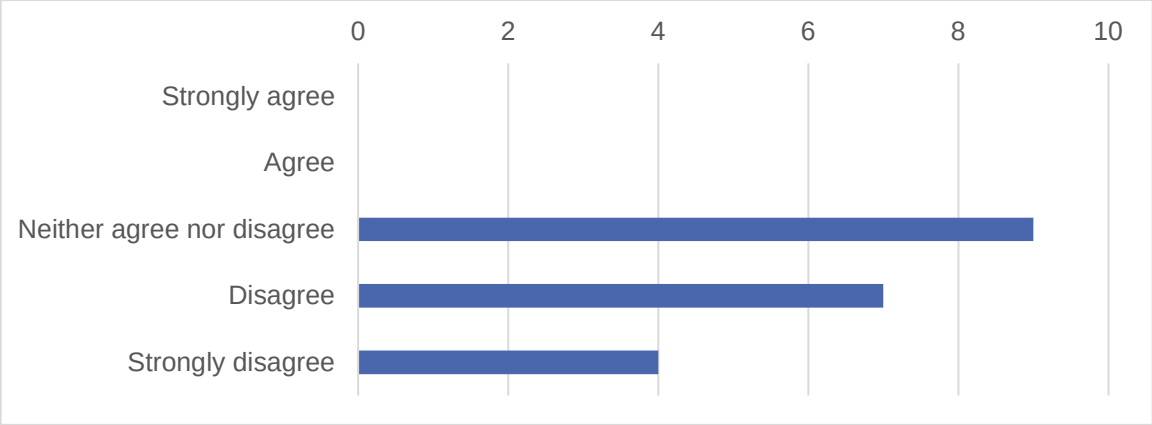
- Pre-development cannot be done as typical design build. Mass timber projects need to follow an integrated design process starting early.
- Lack of experienced contractors, charging a premium regardless if the process is any easier/faster/slower or harder.
- Cost of mass timber.
- Availability of mass timber.
- Design and regulatory process, insurance.
- Cost and time required to coordinate use of mass timber.
- The most significant cost difference is for measures required by most permitting authorities to address fire safety (e.g. drywall encapsulation of wood structure).

By comparison, interviewees believed that there was currently no evidence that mass timber projects were leasing up sooner or that mass timber office tenants were paying more. That said, they also thought that a mass timber office was attractive and that there were niche groups who are interested in mass timber and more likely to consider it, especially if it fits with the existing market or community: “millennial tech companies like it”.

> “Lower operating expenses would have to be proven. I haven't seen any evidence one way or the other. I think it would probably be marginal, if anything.”
>
> Interviewee - appraiser

In terms of whether mass timber buildings have higher operating expenses, higher ROI/ROE and/or get lower financing rates than non-wood alternatives, most interviewees did not think any of these points were true and have seen no evidence, although one interviewee thought operating expenses should be lower. Similarly, survey respondents did not believe that a mass timber building should receive a lower property valuation than conventional alternatives (Figure 6).

Figure 6 Do you agree that mass timber buildings should receive a lower property valuation than non-mass timber buildings?



Some of the comments offered as to why valuation rates should be on par with conventional buildings include:

- Should be considered as valuable as similar buildings constructed of concrete or steel.
- To my understanding they last just as long as non-mass buildings.
- If the cost is lower, then I suppose you can assess the building cost as lower.
- Why should they [be different]!?

- Should be based on fact, building longevity, and maintenance costs.
- If you are talking about property valuation, there is no reason why they should be lower. In fact, it should maybe higher.

> "If there's a hesitance in the market about buying a timber high rise, then it will be reflected in the absorption rate or duration of sale of the unit – i.e. the time it takes for the unit to sell or lease. That then impacts the cash flow".
>
> Interviewee - valuation

When asked if they thought there should be independent accreditation for "mortgageable" projects most interviewees felt it would not be necessary and that it may turn out to be an additional barrier to entry. However, for some lenders, it would provide a comfort level to have a third-party evaluation or accreditation. Further research on this topic is necessary.

Interviewees were also probed on financing requirements and whether there may be additional costs associated with mass timber projects. Generally, they agreed that there should not be a penalty for a mass timber building although several noted that incentives and grants would be good while the industry is still getting to grips with mass timber.

According to interviewees, some developers believe that lenders may want a contingency because of their low comfort level and concern about the number of risks (known and unknown). Although there was some confusion about the economic efficiency or earning potential of a mass timber building (how much net income it returns), interviewees felt that it is important to understand the "unit" capacity of project (i.e. how many floors, gross floor area, etc.) and whether mass timber allow for more or less unimpeded floor space than a conventional alternative (a typical suburban office is about 85% efficient after cores, columns, corridors, lobbies and other common space are accounted for). That said, assuming that all the engineering and reporting is similar between mass timber and other buildings, then financing requirements would also be similar. Again, more research is required.

Lastly, the topic of government incentives was raised as a way to mitigate potential premiums associated with the adoption of mass timber systems. Interviewees felt strongly that this would provide an advantage in obtaining funding. It reduces the lender's risk and therefore make them more comfortable with the project. Other incentive ideas included:

- Relaxation in density or height restrictions.
- Enhanced customer service at the permitting and inspection level.
- Funding that is particularly directed towards the condo market and affordable housing projects.
- Something to cover cost overruns or ensure building performance.
- Preferred financing, a similar program to ones for affordable housing.

- “No strings attached” programs that do not burden the recipients or tenants unduly into the future.
- An innovation fund for small businesses, where many businesses benefit.

> “I would rather see upfront incentives to help offset current capital cost premiums than lifecycle property tax savings through lower valuations. The latter approach is too indirect and may not give incentive to developers who don't have a long-term ownership stake in the building.”
>
> Survey respondent

Data needs and knowledge gaps

- **Finance / lending:**
  - Research the potential for, and viability of, an independent accreditation for “mortgageable” mass timber projects.
  - Research and data collection are required related to understanding the relative economic efficiency or earning potential of a mass timber building (how much net income it returns) compared to conventional alternatives. This could be wrapped into studies related to life-cycle costing and/or total cost of ownership models.
- **All key influencers:** education on the value of modern methods of construction (i.e. digitization, industrialization) and the use of integrated / lean project delivery methods as a way to capture the advantages of mass timber systems.

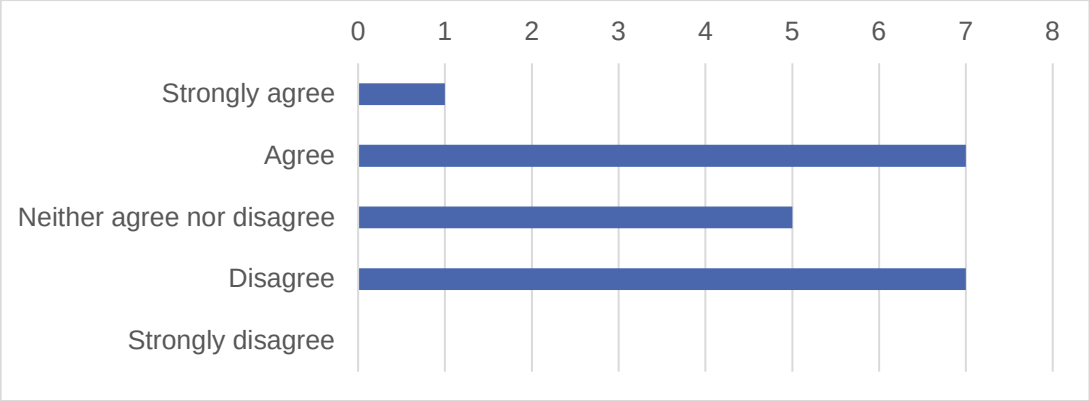
3.5. Codes, regulations and standards

Codes, regulations and standards – and the degree to which they are aligned - can have a significant impact on the real estate industry’s perception of mass timber buildings.

> “If building codes are different in every jurisdiction it makes it more difficult to explain each time you're looking at a new deal. Anything that can make it smoother or easier or less complicated to people that aren't familiar, the easier it is to move deals through the financing process and get approval.”
>
> Interviewee - lender

Survey respondents were divided in their views on whether codes and standards (as they apply to the work that they do) either support or hinder the adoption of mass timber buildings (Figure 7).

Figure 7 Do you agree that the codes, regulations and standards (that apply to the work that you do) support the construction of mass timber buildings?



When asked about the most significant regulatory barrier to the adoption of mass timber, survey respondents offered a wide range of comments:

- Fire safety
- Knowledge - the comfort levels for many inspectors are uninformed.
- Lack policies/regulations to reduce embodied carbon within new buildings. It seems like mass timber is a completely voluntary and considered leading edge, not BAU.
- Fire life safety.
- Geographic. Depending on regions, the performance of the mass timber may differ
- Lack of data.
- Building code update based on performance/fire safety evidence.
- Industry familiarity.
- Building codes are moving in the right direction.
- Need seismic addressed.

While projects like Brock Commons offer powerful technical demonstrations of mass timber, interviewees cautioned that these special projects (i.e. where government is seen to take the financial and regulatory risk) are not part of the general insurance market and therefore not as influential as might be hoped.

When it comes to the regulatory approvals process, interviewees noted that workarounds may be needed to prove the performance of mass timber solutions to local authorities. Testing of standardized components is needed to get certification. There was broad industry support for an expedited pathway for commonly encountered alternative solutions so they do not hold up the approvals process.

Interviewees felt that although pilot projects like Brock Commons demonstrate that projects are technically achievable, the market will still opt for traditional construction methods if local codes and regulations do not easily accommodate mass timber and alternative pathways are challenging to overcome.

Data needs and knowledge gaps

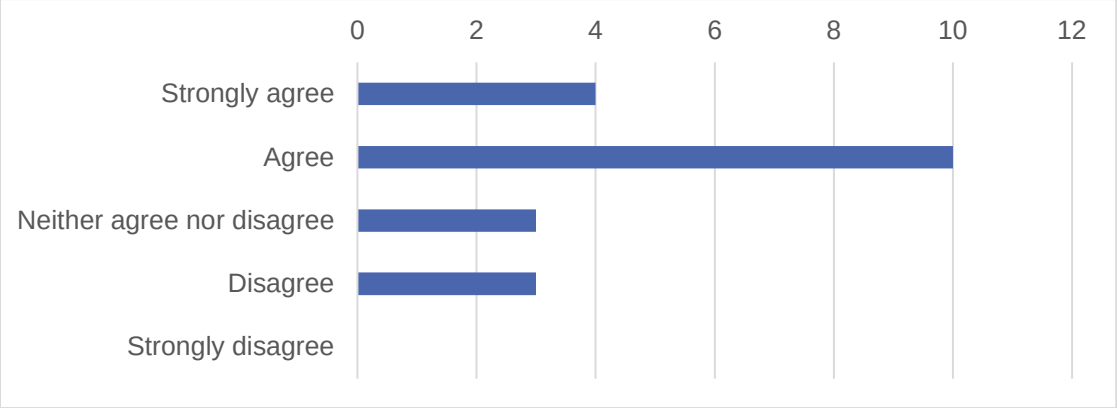
- **Insurers:**
    - Market-oriented case studies in partnership with recognized insurance companies.
    - Collaboration with European insurers that are familiar with Europe's advanced buildings (particularly those that capture prefabrication and industrialization of the construction process) to document and demonstrate the different construction project risk profile afforded by mass timber systems.
    - Government support that covers the insurance premium differential for different types of buildings and uses will accelerate uptake.
    - Insurance policies are usually taken out for 12 months at a time resulting in little incentive for project teams to adopt faster construction processes. Information about mass timber construction processes could encourage insurers to be more flexible about how policies are written and thus serve as an incentive for mass timber.
    - Generally, the insurance industry should be more engaged at the code discussion level and every opportunity should be offered to them to participate.
- **Other industry stakeholders:**
    - Education for municipal engineers and planners is needed so they can develop a comfort level with mass timber.
    - Develop an expedited pathway for commonly encountered alternative solutions to the BC Building Code.
    - A consistent province-wide directive on mass timber that harmonized municipal regulations (similar to how the BC Energy Step Code was structured and rolled out) would streamline projects instead of requiring an understanding of how each city deals with it, increasing time for approvals.

3.6. Understanding the difference between mass timber and other structural systems

Interviewees generally agreed that the difference between mass timber and other structural systems is not well understood, in large part because there are still only a few examples and the industry as a whole has little direct experience. They thought that builders are not sufficiently familiar with the benefits – such as accelerated schedules, cleaner/drier working conditions – to be able to confidently factor them into the project delivery process. The survey respondents also agreed strongly that there was confusion between mass timber and light wood frame.

Both interviewees and survey respondents noted that there is a strong perception in the real estate industry that “wood is wood” (Figure 8). Confusion or lack of understanding of the differences between mass timber and light wood frame is felt to be a key obstacle to the adoption of mass timber. More clarity is needed in regulations defining the differences between mass timber and light wood frame including establishing a clear section of the building code regarding mass timber.

Figure 8 Do you agree that there is confusion between traditional light wood frame construction and mass timber construction in your industry?



When asked what they thought was the most significant source of confusion, survey respondents provided a range of comments, including:

- Lack of information to separate the two for lay people.
- Large percentage of the public thinks wood is wood, doesn't know the difference.
- Distinction between products, variety of mass timber products and where they may be, and are best, used.
- Most people in the construction industry understand the difference. The challenge is perception of the general public.
- Maybe not confusion but lack of understanding. Many people do not know why it is called “mass timber”.

Some interviewees also thought that it is not a priority for end users to know what the building is made of – this is especially true for residential consumers.

> “People don't know what mass timber means or assume it just means a lot of sticks.”
>
> Survey respondent

Data needs and knowledge gaps

- **Insurers:**
    - There is a lack of understanding about different risk profile for mass timber versus light wood frame.
    - It was pointed out that insurance brokers particularly need supporting evidence of risks and features of mass timber, and they don't have it. For most, mass timber is treated the same as wood frame.
- **All key influencers:** The high degree of pre-fabrication warranted by mass timber systems necessitates investment in much more up-front planning (cost and time) and the need for a trained workforce for construction (e.g. specialist mass timber erectors).
- **Other industry stakeholders:**
    - Project teams – and contractors in particular - need to know how to take advantage of the differences.

3.7. Operational and maintenance requirements

Interviewees expressed some uncertainty about what is needed when it came to operations and maintenance requirements for mass timber buildings, although they noted that it may be easier to work with electrical and mechanical services in wood than in steel and concrete. There is little experience with renovations and refurbishment of mass timber buildings and best practices related to activities like changing / upgrading mechanical and electrical systems do not exist.

In terms of dealing with a major disaster, insurers and property managers need to understand how to evaluate and rehabilitate a mass timber building and estimate the related costs.

> "Because it's mass timber, we can relocate things. Not completely turning the building into Swiss cheese, but it's easier to relocate things after the fact with mass timber than it is with concrete."
>
> Interviewee – property manager

Data needs and knowledge gaps

- **Insurers and property managers:**
    - An evaluation and rehabilitation guide and training program that provides information on the costs for and technical approach to remediating a mass timber building after a fire or flood is required. Property managers and insurers need a roadmap to understand the risks upfront and O&M planning.
    - Condition assessment of components regarding what kind of deterioration may occur and methods of remediation.

    - A best practice guide for refurbishing, renovating and/or reconfiguring a mass timber building.
- **All key influencers, but particularly property managers and insurers**: information and education regarding how moisture behaves would be useful. Also, treatment of surfaces, renewal of finishes.

3.8. Project sequencing and prefabrication issues

Mass timber projects may require a different approach to the design and construction sequence. Research by the Lean Construction Institute, the Integrated Project Delivery Alliance and others suggests that time spent up-front on planning and modelling reduces errors and change orders downstream. Systems that rely heavily on prefabrication, such as mass timber, generally require more time at the beginning but then time is saved in the field. They also require experienced contractors with the ability to use digital tools such as BIM. When asked if this was a barrier to adoption, interviewees generally felt that while there is a promise of efficiency and productivity improvements, it is of low to medium significance to key influencer audiences now and will likely be driven by those contractors seeking competitive advantage. Further, it was noted that some designers and contractors do not encourage it because offsite manufacturing takes a component out of their control.

Prefabricated building systems like mass timber can result in faster, quieter construction processes and the greater dimensional accuracy can deliver high quality and energy efficient buildings. It can improve predictability and smooth project execution so long as all of the trades engage with the process. However, interviewees felt that prefabrication is “good if it works” but given the fast, mass-produced nature, can be terrible if it goes wrong. Although transportation risks were not a concern, interviewees were worried that there is still not enough experience of “industrialized construction” in BC and the mainstream industry is still unclear about the advantages. Concerns were also expressed related to inspections and testing as this becomes another risk to the project.

> “We're imagining that mass timber could be built faster than traditional stick build or concrete column and glass construction, but we need the business case to be unequivocal. We just know that the benefits have to be demonstrable in a real and solid way in order for there to be a greater adoption. Not that people don't want to adopt it, they just need more information.”
>
> Interviewee - lender

While data is needed on how mass timber contributes to accelerated construction schedules, it is also important to understand the workflows of the other building trades in order to improve the overall speed of the project. These considerations (particularly improved speed of construction) may be of interest to the finance/lending and insurance communities because there is less chance for issues to arise. Marketers and leasing agents will also like to see greater

predictability of project delivery. However, this has little bearing on property management and property valuation and appraisal.

Data needs and knowledge gaps

- **Finance / lending:** Some investors and lenders will value speed to occupancy / revenue because there is less risk of a changing market. Data is needed not just on the speed of the timber assembly but on the entire project.
- **Finance / lending and insurers:**
    - It is generally known that modular housing companies tend to use design-build contracts but modular building is different from prefabricated solutions which are part of a larger construction contract. These misperceptions may leave investors and insurers confused about who has control of the final product. They need to have confidence that construction contracts are well-defined and explicit as to the roles and responsibilities related to prefabrication. Technical guidance needs to be provided.
    - It would be useful to understand the risks associated with prefabrication / off-site construction as compared to risks of on-site construction, pouring concrete, etc.
- **All key influencers:** education is needed to explain the key features of prefabricated structural systems (e.g. transportation issues, workflows and site-based trade integration) and help dispel the confusion between prefabrication and modular construction.
- **Other industry stakeholders:**
    - Case study examples with quantitative data of how prefabricated construction accelerates project delivery and reduces noise complaints from neighbours are required.
    - Training for builders on the advantages of prefabrication and how to make it profitable.

3.9. Other ideas

When asked what else can be done to increase adoption, interviewees and survey respondents offered numerous ideas including:

- “Bully” a mainstream developer into doing it.
- Install a temporary informational demonstration structure in a plaza in the summer to increase awareness and education, allow people to experience it.
- Opportunities to see and experience projects. Tour, talk to, connect with, people who have built the projects.

- Work with provincial government to educate local building officials to improve approvals process.
- Preferred financing to reduce developer risk.
- Incentives similar to affordable housing.
- Identify the significant ways mass timber is different from concrete.
- Promote the seismic resilience of mass timber.
- Identify facts surrounding embodied carbon.
- Construct a narrative focused on the benefits, similarities to passive house, and strengths of the material.
- More publicity about successful mass timber projects.
- Education for engineers.
- Build the business case in terms of cost comparisons.
- Streamline the permitting process.
- Find private market developers who are willing to take it on, create more examples and be transparent about what works and what doesn't.
- More projects completed to build the data set. If required, get there with government funding or university test projects.
- Support for the supply chain and industry capacity so that sourcing does not add to the complexity.
- Promote the charisma of the material
- Publicize the insurability, security, strength and longevity of the material.
- Education, industry awareness, lobby groups.
- A resource to help designers and developers "join the dots": a staffed resource with lists of suppliers, technical knowledge, industry knowledge, where engineers and architects can access what they need to be more comfortable with the data.
- Sell it as a preferred material, not a substitute material.

Other concerns or comments included:

- Identify issues with the supply chain. Make sure the product is available if you are encouraging people to use it.
- Focus on medium and low-rise structures. Don't think it will catch on for high rise.
- If there is a height limit for mass timber, developers will choose concrete to get more sq.ft.

- Uncertainty around structural capacity, how heavy, how high, length of spans. Questions around what types of buildings is it appropriate for.
- Understanding the client's risks related to regulatory approvals and building codes – how well informed are municipal building officials, regulators and inspectors about mass timber?
- Detailing, materials handling, services coordination, lessons learned
- Project management differences, upfront design resolution.
- Gravity systems, vertical structure impact on design.
- Data that proves the structures perform well.
- Implications to cost and risk. Is the supply chain cost effective? How much benefit is there?
- How far can it span?
- How are mechanical and electrical incorporated?

3.10. Information delivery

In terms of the format and approach to delivering professional education to key influencer groups, establishing contacts with and engagement with industry representatives (associations and large companies) is recommended to best understand the most effective way to deliver education for each key influencer group. That said, many building owners, developers, property managers and appraisers are members of architecture, engineering and chartered surveying professional institutions such as AIBC, EGBC, CIQS and RICS Americas. These relationships are valuable because many of the key influencers rely on knowledgeable third parties for advice. Others – such as owners, investors, lenders, brokers, marketing and leasing agents - attend events organized by BOMA BC, UDI and NAIOP.

> "As a lender, we rely on third party engineers to sign off on the construction to manage the bank's risk. So, we typically rely on the consultants that we use to review the research that's out there and be able to provide a qualified opinion that the bank can then rely upon. I think, for us, it's educating those third parties to be able to provide that to us."
>
> Interviewee - lender

Engaging with key industry associations to further understand opportunities for, and the preferred format for, education on mass timber construction, as well as hosting awareness-raising events in partnership with them, would be a good way to begin the process.

> "I think that it will be necessary to get private market adoption to really help people see it [mass timber construction] as something that is accessible for a broad spectrum of building owners or developers. I think the more case studies, the better. The more times we show off those examples where it's been successful, where we are really transparent about the good, the bad, and the ugly, and demonstrate the overall net good effect, the better."
>
> Interviewee – property manager

Key influencers are busy and like educational experiences to be as practical and readily applicable as possible. Interviewees suggested visits to active sites or completed buildings and providing examples of case study projects that speak to the specifics of their profession (e.g. cap rate, asset value, lease-up time, risk, capex/opex, etc.).

> "Tours with developers acquainted with projects. [We] need to talk to them about lessons learned. Also, acoustics need to be addressed. Tours may help with that."
>
> Interviewee

Given that mass timber is still new to many in the key influencer groups, it is also important to focus on early adopters rather than try to appeal to the mainstream who may not see the value in the short term.

Focusing on high level concepts is critical to start with. In particular, it is important to explain the differences between mass timber and light wood frame - how are they the defined; why they are different; the cost differences)certainty/variability of costs with mass timber for budgeting purposes) and the different construction procedures (in terms of labour intensity and skills, speed, etc.). Interviewees strongly agreed that demonstrating a clear and compelling business case for mass timber was essential to engaging key influencers – in particular, how it is better, faster, cheaper, etc. Presenting this information in a manner that promotes the advantages and possibilities of the material, not just as a trade-off to other options, may promote more excitement and interest in adoption.

There was a strong emphasis from the literature review and interviewees on the need for data and a data gathering initiative and sharing between key influencer groups (especially insurers) was suggested.

However, it was noted that the insurance industry would be unlikely to gather and organize data itself - it would have to be from the wood industry – perhaps in the form of a coalition of agencies. That said, it was suggested that perhaps brokers might be more receptive than insurers.

Technical resources, checklists and contact lists were also considered important. It was noted that a barrier to mass timber construction was the lack of experienced consultants and contractors. Certainly, the idea of some type of specialist qualification in mass timber

construction was suggested and may warrant further investigation. However, it is also possible that key influencers may simply not be aware of all of the building professionals with mass timber experience.

3.11. Lessons learned and final thoughts

This study serves as a first in-depth foray into the world of key influencers of mass timber and has reaped a number of lessons learnt for advocates of mass timber construction. The following comments recurred throughout the research and serve as important considerations in the development of educational tools and programs:

- Insurers, sureties and appraisers rely on the professional judgment of registered architects and engineers and on manufacturer specifications and testing certificates.
- There is a general feeling among the audiences interviewed that mass timber facts are generally available but they need better marketing to educate decision-makers.
- There is a real need to change the perception that all wood projects are created equal because key influencers think all wood projects are the same – i.e. “wood is wood” – and that mass timber is as combustible as stick-frame construction. Data that proves the structural performance, durability and longevity of mass timber buildings over time will be necessary to change perceptions.
- There is a perception that mass timber projects can be done, but if local codes and regulations do not easily accommodate them, and they are challenging to overcome, then it is easier for developers to choose a more traditional construction method.
- Mass timber has been seen by several people as having the potential to revitalize BC’s forest industry. Wood is recognized as an amazing renewable resource that can act as both a conserving material as well as a carbon sink.
- Others thought that mass timber construction cannot be delivered through typical design-build because an early integrated design process and well-defined contracts are required.
- Developers and property managers believe that lenders and insurers add “contingency” to the cost of financing and insurance because of their lack of comfort level and fear of unknown risks.
- Millennials are the tenants and homebuyers of the future and their concerns about climate change and their propensity to using digital technology makes them more receptive to innovative construction techniques and work environments such as those represented by mass timber.
- With the shift from analogue to digital project delivery processes, project supply chains are tightening up. Some key influencers appeared to sense this. While not getting into specifics, several noted the need to liaise more closely with the timber suppliers.

Finally, as with the adoption of any new technology, there are examples within each key influencer group of individuals and organizations with very different levels of risk tolerance and enthusiasm for innovation. While mass timber is still very new for most, BC's experiences at the forefront of mass timber innovation has seeded the market with a few institutional owners, insurers and lenders who have become quite knowledgeable about mass timber. Although they are still very much the minority, these innovators and early adopters have become mass timber advocates and may help to shape the development of education programs and services for their industry.

Appendix A: Research methodology, scope and limitations

The research that supports this report comprised a comprehensive literature review that was enriched by in-depth interviews with industry leaders from within the key influencer groups who are early adopters of mass timber and an on-line survey that was fielded to mainstream key influencers. The project started in late-November 2019 and was completed in mid-April 2020. Details of the literature review, interviews and on-line survey are provided in accompanying reports.

1. Literature review

The literature review focused on identifying perceived obstacles to the adoption of mass timber construction in North America. Sources included reports, peer-reviewed academic papers, journal articles and on-line forums and blogs that were recently published and addressed issues that would be of interest to the key influencers. A full list of sources can be found *in Appendix C – Study Sources and Bibliography.*

The findings were grouped and summarized into 79 issues and organized in accordance to criteria that helped us identify whether the issues were financial, related to risk management, technical, regulatory, environmental, associated with knowledge and expertise, or related to industry supply chain. A second set of criteria were also used to determine whether the issues identified supported the adoption of mass timber construction or hinder it.

Based on this process we were able to identify the nature and impact of the issues affecting the adoption of mass timber construction. To determine which issues to prioritize and pursue, we created a rating system for which both the SCIUS team and Client representatives assigned a numeric value to each issue based on a scale of 1 to 5, in which 5 was “most important” and 1 corresponded to “least important”. After discarding issues whose average value was less than 3.25, a total of 54 issues were identified to pursue in the following phases of research.

Once the main issues were identified and ranked, a series of questions addressing these issues were developed and classified as appropriate for either targeted interviews or the longitudinal survey.

2. Interviews

In-depth interviews were conducted to fill information gaps and add richness to the findings distilled from the literature review. The interview process spanned for about six weeks and was conducted in parallel to the longitudinal survey. Individuals from organizations within the five key influencer categories and known to be proactive in the field of mass timber were approached and twelve interviews were completed (Table 7).

Table 6 Key influencer groups from which the in-depth interviewees were drawn

Interviewee	Audience
Interviewee #1	Finance / Lending
Interviewee #2	Finance / Lending
Interviewee #3	Finance / Lending
Interviewee #4	Insurance / bonding
Interviewee #5	Insurance / bonding
Interviewee #6	Insurance / bonding
Interviewee #7	Property management
Interviewee #8	Property management
Interviewee #9	Property management
Interviewee #10	Marketing / leasing
Interviewee #11	Valuation and appraisal
Interviewee #12	Valuation and appraisal
Interviewee #13	“Other”

The average duration of the interviews was 1 hour. The interview process spanned for about six weeks. The interviews were conducted by phone and upon receiving approval from interviewees they were recorded to facilitate information gathering and ensure the accuracy of the transcripts.

The interviews were conducted by phone and upon receiving approval from interviewees they were recorded to facilitate information gathering and ensure the accuracy of the transcripts. Each interviewee was asked a set of questions applicable to the audience they represented. The interviews proved to be extensive and provided very detailed responses. However, they were provided on condition of confidentiality.

3. Survey

The online survey was designed to include a short number of multiple option questions that could be answered by the average individual between 5 and 10 minutes. The survey was longitudinal in the sense that it involved repeated observations of the same variables (i.e. questions people) over a relatively short period of time.

To complement the in-depth interview process, the survey was structured with questions stemming from the prioritized issues obtained from the literature review phase of the study. However, in contrast to the interview questionnaire which had specific questions targeted to each of the key influencer groups, the nine questions of the survey were developed to be

universally applicable and allowed the participant to rank the importance of the issues presented. Survey respondents also had the option to add their own comments and observations. Respondents were required to self-identify themselves with either one of the five key influencer audiences or “other” audience which had to be specified.

Comments and suggestions collected through the survey process were combined with interviewee perceptions and recommendations to develop the list of information needs of key influencers of mass timber construction, as well as the recommended actions, potential tools and lessons learned.

The survey was shared with individuals within key influencer organizations, relevant industry associations and promoted on social media. 20 survey responses were completed. The survey responses do not provide statistically relevant data of the key influencer industries as a whole but does offer useful insights. The results of the survey were also used to confirm the mass timber perceptions expressed by the interviewees as part of the in-person interview process. The team used the survey to calibrate the responses obtained through the comprehensive in-person interviews and to augment the list of perceptions and suggestions obtained through the in-person interviews.

Details of the survey design, promotion, questions and responses are included in a separate document.

4. Analysis and reporting

Mining the extensive transcripts generated during the in-person interviews, as well as the comments provided by survey participants, the team summarized recurring opinions and ideas that upon further analysis provided the basis for the list of information needs of key influencers of mass timber construction, as well as recommended next steps included in Section 4.

The team learned some practical lessons regarding the anticipated scope and timelines of the project as well as the interview and survey process and results. This learning may be useful in future FII research projects and as such it has been included here.

Our search for sources of information for the literature review revealed more sources of information than originally anticipated, resulting in a greater effort at this stage. This in turn necessitated a more comprehensive process to prioritize the large number of issues identified. In the end the team implemented a scoring process so that all the identified issues could be ranked by all team members and the issues that received the highest average score were the ones selected to develop questions for the both the longitudinal survey and the in-person interviews.

Questions for the interviews and survey were derived from the list of prioritized issues obtained during the comprehensive literature review phase of the study. Phrasing of the questions allowed each participant in the interviews to expand upon each topic, resulting in

comprehensive responses. Questions for the survey were designed to be easily answered with an option to provide more information.

Many interviewees needed to be approached several times before they were comfortable participating. The number of interviews was originally expected to be around 20 but, in the end, only 12 interviews were possible during the time allotted to do them. However, the interviews which were initially planned to last about 30 minutes, lasted on average 60 minutes and were significantly more insightful and valuable as originally expected.

Conversely, the survey process was a more complicated process not because of technical complexity but because of the reality that people pay very little attention to on-line surveys because of “on-line fatigue”. The team approached the people on the list who were supposed to distribute the survey among their members, colleagues, staff, etc., three times. This was very time consuming as incommensurate to the number of survey participants that in the end was only 20. Despite the low number of participants the survey was very useful in confirming some of the trends identified during the literature review and the in-person interviews, and because participants were allowed to add comments as needed, the study benefitted from additional thoughts to complement those obtained through in-person interviews.

Insights gathered from individuals in the interviews and survey were listed and compared with other responses to understand the issues of greatest concern and compared to determine consistency both within and amongst disciplines. These insights provided the foundation for both the descriptions of the needs of key influencers and the recommendations on how best to address those needs.

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