COBDEN STRATEGIES INC.
Strategic Relationships Delivering Results

RESEARCH AND EDUCATION ENVIRONMENTAL SCAN

FOR

MTI
Mass Timber Institute

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Mass Timber Institute

Environmental Scan

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Disclaimer

- Please note that the views expressed herein have been generated *predominantly* through interviews of key participants in the mass timber supply chain and augmented by limited desk top research.
- The ability to fact check, document and more deeply analyze these views was outside of the scope of this study.
- These findings are not meant therefore to be exhaustive but rather indicative of trends and general circumstances when considering the mass timber opportunity in the Ontario marketplace.

Acknowledgement

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1.0 Executive Summary

This environmental scan was conducted to support the exciting potential of the Mass Timber Institute (MTI) to stimulate the mass timber market in Ontario.

The information gathered here is useful in a number of respects. Advice on the form and scope of the Institute will be helpful as it sets up and begins work. An extensive contact list will ensure the Institute is including important stakeholders as it begins to form partnerships and carry out its mandate.

This scan also provides a current snapshot of existing research and educational training, as well as governance structures and rules, while identifying areas for improvement.

The research included detailed interviews conducted between March and May, 2018 with a wide variety of industry participants. They expressed a great deal of enthusiasm for the MTI and its vision.

The interviews uncovered vital priorities and action items if there is to be substantial growth in mass timber markets, including:

- Support research efforts to close knowledge gaps in a wide variety of areas, from performance factors and fire protection and resistance to moisture management, energy performance and climate change.
- Contribute to the coordination and delivery of research efforts in Ontario and throughout Canada.
- Improve access to mass timber research outcomes by key market participants.
- Oversee improved learning opportunities about mass timber at colleges and universities.
- Pursue strong collaborations across academic players and organizations on educational content development.
- Identify and bridge barriers to accelerate the mass timber market and supply chain.

There is a bright future for the Ontario mass timber market if innovative research is encouraged and industry partners, post-secondary educational institutions, and governments continue to work together to increase knowledge and capacity. For its part, the MTI is gearing up to support and will prioritize its efforts to support mass timber research and education in line with its resources and capacity.

2.0 Introduction

In March 2018, the Ontario government announced funding to establish a Mass Timber Institute in the province. The Institute will also be identifying other funding sources. The MTI's founding partners include the University of Toronto (Co-Chair), George Brown College (Co-Chair), Lakehead University, Laurentian University, the University of Ottawa and FPInnovations. The mandate of the MTI is to focus on mass timber research and development, as well as specialized education in the use of advanced wood products. A goal of the MTI is to leverage this effort to support the acceleration of mass timber products and applications in the Ontario market.

As part of its initiation efforts, the MTI commissioned the completion of this initial environmental scan in support of the following outcomes:

- Increase knowledge of key players and stakeholders active in the mass timber area in Canada.
- Improve understanding of existing research and the educational training landscape in mass timber use.
- Identify gaps and priorities in research and education for the MTI to consider going forward.
- Identify key considerations for the MTI related to governance and its startup efforts.

3.0 Preliminary Mass Timber Contact List

Through the course of this project, a list was generated of key contacts in the mass timber field in Ontario, other jurisdictions in Canada (mainly British Columbia and Quebec) and some U.S./international contacts across the supply chain.

A preliminary mass timber contact list has been compiled in the following categories:

- *Academia*
- *Architecture*
- *Associations (forestry, construction, architecture, industries, etc.)*
- *Building code (governmental and technical)*
- *Construction*
- *Engineering*
- *Governments*
- *Indigenous organizations*
- *Insurance*
- *Research organizations (non-academic)*
- *Labour unions*
- *Wood product/mass timber producers*
- *Wood promotion*

While this list is not exhaustive, it aims to provide a starting point for MTI outreach and communications. It is expected that MTI staff will add to this list over time and use it for connecting research outcomes with the mass timber community. It is noted that some categories, such as Indigenous contacts, were insufficiently populated through this work and need further attention.

4.0 Environmental Scan: Methodology and Approach

A combination of desktop research and detailed interviews was used to conduct this environmental scan.

From the end of March 2018 until mid-May 2018, interviews were held with 20 mass timber experts from business organizations representing key aspects of the mass timber supply chain. These interviewees were selected based on their knowledge of the mass timber space, as well as practical experience working with these products in the marketplace. Other interested parties, such as academic researchers and governments, were not interviewed for this study as they are already existing partners of the MTI.

To ensure consistency in approach, a common set of interview questions was prepared and distributed to interviewees in advance. As well, the preliminary list of research themes from the MTI proposal was provided with the interview package for discussion. Interviews ran from 45 to 90 minutes and often involved some follow-up exchange. A broad suite of mass timber applications was considered in the interviews, including low-rise commercial/institutions and residential buildings, bridges, mid-rise (seven- to 12-story) and tall wood (higher than 12-story) buildings.

While a number of those interviewed were active in Ontario, there was also representation from B.C., Quebec and the United States. Several organizations interviewed also had a strong comprehension of the landscape across Canada.

Organizations that generously contributed to their knowledge to this environmental scan include:

Binational Softwood Lumber Council

Blackwell Engineering

Carpenter's Union (District Council of Ontario)

Canadian Wood Council

CHM Fire Consultants

EllisDon

Equilibrium Consulting

Fast & Epp

FORM Architecture

FPInnovations

Kirkor Architects and Planners

Louisiana Pacific Corporation

National Research Council

Nordic Structures

Residential Construction Council of Ontario (Rescon)

Seagate Structures

Tall Wood Design Institute

Timber Systems

5.0 General Feedback

There is a high level of support for the MTI and its vision among interviewees, who see a real need for an Institute. There is a positive view that recent announcements in Ontario about mass timber buildings and the Institute, among other initiatives, have created a sense of momentum in the Ontario market, which had been seen to be lagging other jurisdictions.

While the mass timber research landscape is crowded, the MTI is welcomed by interviewees, particularly for the unique role it could play in coordinating, leveraging and transferring knowledge created in Ontario academic institutes to mass timber developments beginning to take shape. Interviewees felt that this coordination is currently lacking.

The mass timber education space is more nascent, with ample opportunity for the MTI to make important contributions to education and training efforts for both graduating students and continuing education. While excellent efforts are underway in some aspects of the education domain, much more remains to be accomplished.

There is also a strong recognition of the importance of the MTI taking a market-oriented approach to its mandate, specifically aimed at supporting the development of the marketplace for mass timber products. To truly see traction in new mass timber markets, several things are needed at the market level:

- A multi-disciplinary approach to the mass timber marketplace (and the Institute) is believed to be a critical success factor.
- Given the unique aspects of each material (e.g. steel, concrete, wood), the potential future role of hybrid solutions, and the need for material choice by designers, a balanced role for mass timber (and its valuable attributes) alongside steel and concrete is deemed very important.
- Supply chains for mass timber products need to grow significantly. If products are made available, it is believed that they will be assessed for design applications.
- Significant code changes are required to lift mass timber products to an equal footing with steel and concrete and help them reach market potential. Changes such as “high building” definitions and striving to eliminate “non-combustible” differentiation in the code would have a profound impact on adoption of the products.

Finally, many interviewees stress that the MTI should create strong partnerships and collaborations with the Canadian Wood Council (CWC), Ontario WoodWorks! and FPInnovations along with many others

(such as Forest Innovation Investments BC, Binational Softwood Lumber Board and Rescon) who play a very important role in the mass timber community. Ontario WoodWorks! is a major voice for the mass timber opportunity in Ontario and is an existing partner for MTI. FPInnovations is also an existing MTI partner and a strong research player in the mass timber arena.

Looking ahead, all interviewees are interested in future engagement with the MTI as it makes important decisions on its areas of focus and support the idea of a workshop later this year.

6.0 Current Research Landscape

As part of the environmental scan, attempts were made through interviews and modest research to determine key academic institutions involved in mass timber research and education, beyond the current MTI partner organizations.

There are significant mass timber research activities underway across Canada. Research efforts have been guided by a National Strategy for Tall Wood established in 2012. It was highlighted through the interview process that work is underway to update this strategy, including research priorities, collaboration and co-ordination. The MTI will want to be sure to participate in this effort going forward.

In addition to ongoing work, the research landscape is now supporting a broader suite of potential applications than those associated only with tall buildings. It is recognized that new applications and processes are driving new research needs. For example, research priorities were identified at a national conference in March 2018 on the low-rise opportunity for mass timber. The Canadian Wood Council has supplied some preliminary information from the workshop to MTI. This information should be consulted for consistency and MTI research planning once available.

Some interviewees identified organizations they are directly working with on research projects. When identified, individual researchers and their affiliations have been added to the MTI contact list.

6.1 Government Support

For some time, federal and provincial governments have played a significant role in supporting research efforts financially, including through FPInnovations and direct research contributions from governmental labs such as those at Natural Resources Canada, Canmet (Canada Centre for Mineral and Energy Technology) and the National Research Council (NRC). The NRC plays a critical role in two areas for mass timber – developing the National Building Code and, secondly, delivering a strong research and development effort on product performance (fire, acoustics, indoor air quality, etc.) to product evaluation within a national evaluation system. More information on NRC's Construction Group can be found here: www.nrc-cnrc.gc.ca/eng/rd/construction/index.html

6.2 FPInnovations

FPInnovations is the major industrial research institute for the forest industry and is funded by the industry, as well as federal and provincial governments. It has more than 525 staff, R&D laboratories located in Montreal, Quebec City and Vancouver, and technology transfer offices across Canada.

It is a participating partner in the MTI with a significant research program in the mass timber area. This research has predominantly been focused on Cross Laminated Timber (CLT). FPI has many research collaborations with Canadian universities and other organizations. A detailed presentation from FPI on their mass timber activities has been provided to the MTI.

6.3 Academic Research

There is a strong and active community of academic researchers involved in various fields of study in the mass timber arena. From a historical perspective, it is worth highlighting the important role that the Natural Sciences and Engineering Research Council (NSERC) strategic network, NEWBuildS (Network for Engineered Wood-based Building Systems), played in advancing academic research in innovative wood products and buildings systems. Established in 2010, the network worked on developing design methods and construction technologies for traditional light-weight wood frame in mid-rise construction, as well as investigating new applications for heavier systems built with timber products, such as Cross Laminated Timber (CLT) panels. NEWBuildS was funded by NSERC from 2010 until 2015 and brought together 40 researchers from 13 universities, FPInnovations, the Canadian Wood Council (CWC) and the NRC. Over the five years of the project, NEWBuildS supported mass timber education with more than 70 highly qualified people (HQP) generated, and more than 60 PhD and MSc theses contributed significantly to the state of knowledge on mass timber systems. Some researchers from this network remain active in this area today.

As outlined in the MTI proposal to the Ontario government, the five founding MTI academic partners (University of Toronto, George Brown College, Lakehead University, Laurentian University and the University of Ottawa) all have research capabilities to support mass timber development.

Through the course of interviews for this environmental scan, additional researchers were highlighted from multiple universities across the country. Research at other colleges was not identified. When prompted, interviewees raised colleges as critical partners in skills and education, but not in the context of research. This may be an area to consider for additional effort.

The following university research and educational efforts were highlighted (beyond the current MTI academic partners):

The *University of British Columbia's* Faculty of Forestry's Timber Engineering and Applied Mechanics conducts significant CLT research with an emphasis on product manufacturing and structural applications such as connections. (http://team.forestry.ubc.ca/research/)

The *University of Northern British Columbia* has a Wood Innovation and Design Centre which is home to the Master of Engineering in Integrated Wood Design program. A Wood Innovation Research lab is also under construction to build and test large-scale integrated wood structures using engineered wood products such as Cross-Laminated Timber, Glued Laminated Timber and Laminated Veneer Lumber. UNBC recently initiated some CLT–Steel hybrid research. (https://www.unbc.ca/graduate-engineering)

The *University of Alberta* has an NSERC Research Chair in the Industrialization of Building Construction which covers many aspects of Tall Wood buildings and other mass timber applications. (https://www.ualberta.ca/engineering/research/groups/modular-construction/research/building-science)

Carleton University has an NSERC-Forintek Industrial Research Chair in Fire Safety Engineering that has been heavily engaged in fire research for CLT along with NRC. Note that NRC's fire lab is no longer operational. (https://carleton.ca/fse/)

Laval University has an Industrial Research Chair on Sustainable Eco-Responsible Wood Construction, a multi-disciplinary effort developing "eco-responsible solutions that use wood to reduce the ecological footprint of buildings". (https://circerb.chaire.ulaval.ca/)

Université du Québec à Chicoutimi undertakes research in the mass timber area and offers a graduate program in the use of wood in construction. (http://cesam.uqac.ca/formations_org/#s_22 and http://programmes.uqac.ca/0723/officiel)

Please note that this initial listing should be subject to further validation and should be complemented with a listing of the research efforts underway at MTI's academic partners.

6.4 MTI Role: Research, Coordination & Dissemination

Interviewees generally saw three important roles for the MTI in the mass timber research domain.

First, most expressed the view that, while lots of research is going on related to mass timber, particularly on performance factors, there are some definite gaps to be filled. MTI should only support research aimed directly at filling those research gaps. (See Section 7.0 for identified priorities).

Secondly, MTI could play an important role by "facilitating the co-ordination of research efforts in Ontario" across important research universities and jurisdictions. This goes beyond the current academic partners of the MTI to a broader ``inclusion'' of Ontario universities and colleges that can or do contribute to the effort. Interviewees also wondered if perhaps the MTI could "help synthesize and convert important research developments in the EU for the Canadian marketplace." Given the maturity and success of the EU mass timber marketplace, much can be learned from thoroughly understanding how mass timber is supported there and what research outcomes might be applicable in Ontario and Canada.

Finally, interviewees were hopeful that the MTI could assist in ensuring that research outcomes (both from MTI activities and those of others) are easily accessible to the design and development community. Interviewees expressed that there is a "great start with existing guidelines and handbooks currently available," but engineers, architects, contractors and developers say that "much more needs to be done in terms of providing guidance." They hope that the MTI will fulfill a critical role in knowledge dissemination.

One example highlighted by several engineers and contractors is that lots of research is conducted on the fly through developing each individual mass timber project to meet code requirements. With the possibility of several more important projects in Ontario and perhaps twelve to fifteen more coming along across Canada, they saw a potential role for the MTI in pulling together and synthesizing research outcomes generated through these projects for improved dissemination to the marketplace.

With its limited resources, MTI will need to carefully consider its priorities moving forward to determine where it can best contribute to progress in mass timber utilization.

7.0 Highlighted Research Priorities

When describing their experiences with mass timber construction, interviewees note that mass timber is still at an early stage of development in North America and shows a lot of promise. However, these products face headwinds related to cost structure, Canadian supply chains, a lagging regulatory environment and lack of repeatable solutions applicable to Canadian requirements. They are often considered “high risk” in the marketplace.

To address these challenges, interviewees presented a wide range of research gaps. The following list outlines key areas where there is strong alignment among interviewees on research needs. Note that this list also tries to capture areas where interviewees feel research was sufficiently advanced and did not need MTI support.

A) Performance Factors (General)

Research in all areas of performance (seismic, fire, etc.) is well underway for CLT in some applications. However, interviewees identify a gap and potential next big step for this product related to vertical and lateral applications (e.g. to replace shear walls, building cores) in tall structures. Much more guidance is needed to incorporate these additional uses into design. (It was noted that Brock Commons had to have a concrete lateral system).

Producers, engineers, construction companies, and FPI raised the point that while CLT has lots of work underway, very little has been done on performance factors for mass timber products that are not CLT (e.g. NLT, DLT, etc). For example, acoustic membranes for CLT products are available, but there is no information on whether these membranes would work on other mass timber products.

Furthermore, while there is a lot of research being done on code aspects, there is a lack of synthesis of this work to produce guidance and best practices in key areas like acoustics and vibrations. This was cited repeatedly as an important opportunity for the MTI to consider as part of its mandate in developing the mass timber market. Engineers and designers highlighted that much of the current research is not accessible until it is ``codified in the standard.''

Experience to date has been that regulators need to see testing and validating here in Canada to a certain level to get approvals. It is not a simple matter of accepting the word of other areas like New Zealand where codes are very progressive.

B) Fire Protection and Resistance

Issues related to fire came up many times. Construction companies are reporting that this topic, along with acoustics (see below), are the most common technical questions asked by building developers. This is also a major issue for regulators, and while there are “code changes that are planned, these won’t be sufficient to address new buildings being planned in Ontario.” Hence more work is needed going forward.

There is a general feeling that a lot of good work is being done in the area of fire protection related to the use of CLT in structures, but that more work should be done on fire resistance of mass timber products. Beyond CLT, there is little work on fire properties of NLT, DLT, SCL, etc. and on other elements like fire stopping, fire doors, etc. The four new Ontario builds represent an opportunity to undertake more fire testing and continue to increase available fire data. One suggestion is a common shared library to act as a home for new fire information.

In addition, the issue of fire safety during construction of mass timber buildings remains "one of the primary concerns of the regulators." This continues to be a needed area of focus for researchers.

C) Acoustics & Vibration

Acoustics and vibration assessments are two areas of performance where interviewees feel there is still much work to be done across every product type. Some data exists for CLT but it was viewed as insufficient. Beyond CLT, interviewees say there's very little data and information available about acoustics or vibration for all other products and in all applications.

On the acoustic side, there is a difference between technical acceptability and livability for building occupants. Noise transmission between units and through the building envelope (from outside to indoors) needs to be further evaluated.

On the vibration side, engineers say more reliable data and better tools are needed to understand issues related to mass timber applications. Even in the case of flooring, which is the more predominant application, improved vibration tools are required.

D) Wind Dynamics

Some engineers feel that wind dynamics will more likely govern design in Toronto and Ontario markets (like seismic does in B.C.) in applications greater than 10 storeys. Currently there is insufficient information available on wind dynamics for all products.

E) Connection Design and Ductility

Connection design is a significant challenge in mass timber construction. A lot of work needs to be done to make connection design easier for architects and engineers. Connections between walls, floors and columns all need improvement, as do connections between material types (e.g. wood to steel, wood to concrete, wood to other wood products).

The design community reports that connector design, availability and application drive many aspects of a building's design. A broader range of connector configurations is needed to improve the current experience, described as time consuming with a lot of "one-off efforts with no opportunity for replicability." Interviewees compared the situation to the steel sector, which supplies product and design detail, including connectors, making things a lot smoother for the build. Some specific stories cite a complete disconnect between the design, the connector and the mass timber product. "The mass timber supply chain must be adapted to align with full solution approach or true market potential will not be achieved."

To underscore the importance of this area, “it must be recognized that if there is a mistake in the design/supply of connectors, the entire construction stops.” This significantly harms the long-term reputation of mass timber.

F) Hybrid Applications

Hybrid applications are described as the use of timber and steel, timber and concrete or even all three in building design.

The general impression among building designers is that “this will be the most efficient approach moving forward.” There are strong views that the design community needs flexibility to choose materials and the combination of materials according to their performance under different building requirements. In developing hybrid systems, there is a lot to learn about how these different materials function together and how the building system overall will actually perform. This uncertainty is a problem in the longer term for creating a mass timber market.

Some place emphasis on the need to create an equal footing for mass timber products with steel and concrete. There are “dimensional and physical realities with timber that architects don’t experience with slurries that can mold to our vision.’’ That said, “mass timber products provide aesthetic, comfort and performance” that are appealing on their own or in hybrid systems.

While the need for Building Information Modeling (BIM) platforms is mentioned frequently for all mass timber applications, it is highlighted even more for hybrid systems. Without BIM acceptance and utilization, there would remain significant barriers to constructing with mass timber.

New methods of hybrid construction should be researched, including tilt up systems for warehouses and some recent construction projects such as those undertaken by Rona Inc.

G) Moisture Management During Construction & Operations

How to handle different mass timber products in the exposed environment during construction is a major challenge, according to general contractors and engineers. Construction companies say there is very little guidance available on how to protect these unique products from rain. Understanding the exact constraints to exposure would help with water management during construction.

Longer-term exposure to rain and sunshine is also a problem for mass timber buildings. Lots of commercial coatings and sealers are available in the marketplace. However, there are many examples of failure and/or heavy maintenance costs for building owners. More work needs to be done on coatings and sealer formulations and on accessibility of data and information. More guidance and best practices are needed.

H) Carbon & Climate Change

Architects and producers hold the view that the carbon, environmental and social benefits of wood are not sufficiently studied or articulated, yet they represent major drivers in a potential developer’s decision to use mass timber products. Architects also cite an opportunity for mass timber in the global Architecture 2030 climate challenge which states that “all new buildings, developments and major renovations shall be carbon-neutral by 2030.”

Architects describe wood as a material with unique performance features for comfort, health and livability. It is critically important to ensure there is research into the social and environmental benefits of building with wood, beyond performance and code requirements, to generate a strong body of evidence. Social and health factors are emerging in EU research on mass timber.

On the climate adaptation front, there is a lack of information about how mass timber products fare under heavier rain, wind and snow conditions associated with a changing climate. The NRC recently launched a $40-million study to better understand this issue and address gaps for new code requirements that will emerge. The MTI could potentially collaborate in this area to further advance knowledge.

I) Energy Performance

The overall energy performance of mass timber buildings needs to be better characterized to reflect actual performance versus the current regulatory context. It would be useful to study energy performance of mass timber buildings. This research could help ensure more appropriate R-factor ratings, better knowledge about performance and better financials for mass timber buildings.

J) Overall Financial Performance of Mass Timber

There is a lack of knowledge in the marketplace of cost savings related to mass timber construction. While the material is more expensive than alternatives, there are a variety of ways that mass timber can reduce costs - from construction savings and long-term energy performance to inherent carbon aspects. Work should be done to better demonstrate the overall financial performance of these products, potentially using the proposed new Ontario buildings as case studies.

K) Building of the Future

How do we solve the future building challenges for use of mass timber in areas such as hybridization, panelization, industrialization, technology and retrofits? For mass timber to truly reach its potential, it is necessary to consider the full *building system*, not just individual components.

L) New Product Formulations

Manufacturers and others say a lot is happening with respect to wood product development and that the MTI does not need to work in new product formulation.

M) Product Evaluations

The MTI should not pursue specific product evaluations to national standards since there is already a strong national evaluation system where products are tested and evaluated to a wide range of these standards.

8.0 Mass Timber Education & Skills Development

There is a clear consensus among interviewees that there is insufficient learning opportunities for mass timber in current course offerings in many fields, including engineering, architecture and construction-oriented programs. WoodWORKS!/CWC have been offering class presentations, along with participation in educator conferences etc., to address this gap and have now supported developing an Education Roadmap. The roadmap is focused on four key areas - on-the-job learning experiences, new tools and resources for students and educators, strengthening and expanding the network of champions, and additional work in communication and awareness of mass timber. A draft Education Roadmap has been prepared by CWC with its partners and shared with MTI.

Many points raised by those interviewed for this study are considered in the draft roadmap. However, interviewees stress the importance of deepening the technical content of the existing effort. Efforts to date are viewed as important introductions into the field, but it is time to move beyond promotion. As highlighted in the list below, engineers, architects and others hope to see much more technical content incorporated into the educational and professional development curriculums like those in steel and concrete moving forward. The MTI could play a role in facilitating development of new curriculum content that is more technical. At the same time, it is noted that mass timber promotion and public awareness campaigns are well handled by CWC, Woodworks! and others, and the MTI would not need to undertake promotional activities.

8.1 Critical Education Gaps

One special note is the absence of fire skills and testing facilities in Canada. It is hoped that Carleton University and Lakehead University will be able to improve on fire risk assessment skills in this critically important area. It is a serious challenge given the recent closure of the NRC fire lab. The NRC is unable to identify when its lab will be back in operation.

An urgent gap exists in educating code officials and regulators at the provincial and municipal levels. A common view is that there are only a few officials in Canada who have ``embraced mass timber'' and that much work needs to be done to educate code officials on many aspects of mass timber. The Alliance of Canadian Building Officials Association (ACBOA) is an important prospective partner for the MTI because it drives the education effort for more than 7,000 regulators in Canada. It is responsible for developing training modules for code officials that do not address mass timber in any capacity. The association should be approached to explore how the MTI could help address this gap.

As noted in the roadmap, a concerted effort must be made to increase mass timber awareness with architects and engineers. Professional associations offer opportunities to enhance mass timber educational activities. For example, members of the Ontario Architecture Association (OAA) are required to take continuing education programs annually. The MTI could work with OAA and other professional associations to advance course material in many aspects of mass timber construction.

8.2 Educational Efforts by Labour

The Carpenters' Union and others are calling for advanced training in mass timber, in part from concern about workers' safety.

The College of Carpenters and Allied Trades is providing leadership with unions. While the standard curriculum for carpentry does not yet address mass timber, this college is developing a specific certificate for mass timber carpentry. It is envisioned that it will be four to five weeks supplemental and available to both apprentices and journeymen. The Carpenters' Union believes this is the only certificate program currently designed specifically for mass timber in North America.

8.3 The Unique Role for Colleges

There was strong consensus that college-level education programs are not addressed sufficiently and are considered to be an important gap to be filled. As noted below, a few colleges are moving forward on some offerings and labour unions also appear to be playing an important role in developing mass timber training programs in North America through existing training facilities. But overall, college educational programs are in the very early stages of offering exposure to mass timber.

Practitioners describe very real differences in skills when faced with mass timber construction. Increased comfort associated with handling heavier materials, demands for flying forms and logistics, staging of construction and melding of different materials together, as well as increasing forming skills, are all highlighted examples. Further use of tools such as BIM are needed to support project management and supervision of mass timber construction projects. In the mass timber domain, trades often have to contend with unique wood attributes requiring new tools and hardware. The trades need exposure to these things in their training programs, similar to what exists for steel, concrete and light timber framing construction techniques. This is deemed critical to supporting the market.

Some specific colleges and organizations are playing important roles in mass timber skills development:

The *British Columbia Institute of Technology's* School of Construction and the Environment offers two courses that directly cover mass timber and the use of wood in larger building construction systems. One course is offered in the Architectural and Building Technology Diploma program and the other one is offered in the Architectural Science Bachelor program.

Southern Alberta Institute of Technology's School of Construction offers two courses in the area of wood construction, but it is not clear if they cover mass timber in either larger or residential building construction systems. One course is offered in the Civil Engineering Technology Diploma program and the other one is offered in the Engineering Design and Drafting Technology Diploma program.

Seneca College offers courses in wood for construction in its Civil Engineering Technician & Technology programs. However, it appears that these courses do not specifically target mass timber. Seneca also has Fire Protection programs focused mainly on fire prevention and suppression (design and installation of fire protection systems, governing codes and standards and, as an option, training in fire investigation, insurance and wild land fire suppression). An introduction to building construction fundamentals to identify the parts, terms and methods of construction relative to fire protection is provided in the *Plan Review and Building Construction* course.

Algonguin College offers several fire programs with some relevance. For example, it offers an Occupational Safety & Health – Fire Code Administration program which provides knowledge and skills on conducting fire inspections in buildings, including those under construction, renovation and

demolition. It also covers how to review and make recommendations for changes to fire safety plans and protocols.

Humber College – Centre for Skilled Trades and Technology provide an excellent opportunity to add modules on mass timber construction.

8.4 Tall Wood Design Institute, Oregon

The Tall Wood Design Institute is working on several important educational initiatives and offers interesting insight for the MTI. In 2018, they are offering for the first time a one-week summer academy for architects and engineers on mass timber. This program provides educational content instructing the design community on key aspects of mass timber design and performance (program can be found here: http://tallwoodinstitute.org/event/mass-timber-intensive-summer-design-build-workshop)

The program includes forestry, manufacturing and tall wood building tours, as well as guest speaker seminars and hands-on experience with some mass timber products in a CLT design challenge.

The Institute is developing the first-ever mass timber manufacturing certificate program, where students will learn about manufacturing and construction techniques.

It is also developing modules in post-education for general contractors, project managers, site crews and carpenters which it hopes to launch this fall.

Finally, it offers mass timber courses in the colleges of Forestry, Engineering and Architecture Design and the Department of Architecture at the University of Oregon.

8.5 Timber OnLine Education (TOE)

Ontario's Mass Timber Program has provided funding to support a free online global education/teaching program in wood construction called Timber OnLine Education (TOE) that will deliver courses in a wide range of disciplines (sustainable wood design, construction, fabrication, development, policy and environmental education). Courses will be taught by experts in their native tongue and translated into as many as 30 different languages to broaden global understanding of the issues. The teaching platform will deliver high-level broad-based education to the wider public, as well as provide very detailed technical information for professionals and trades in the private and public sector.

While TOE will offer a global education, it will also direct users of the online platform to local resources within their country or region. In Canada for example, TOE will complement Canadian Wood Council (CWC) programs that specifically educate architects and engineers and encourage owners and developers to consider building in wood.

The program is run by Design Build Research (DBR), a Vancouver not-for-profit institute focused on global design and construction education. Michael Green, a well-known architect active in promoting mass timber, is a principal in DBR and the Executive Director is Iain Macdonald. The TOE program is in its introductory phase. The MTI will want to establish contact with the TOE to explore the potential for collaboration.

8.6 Potential MTI Role: Education and Training Content and Dissemination

Overall, it was felt that the MTI could drive the development of educational material with much deeper technical content than currently available. It could work with professional associations, unions, TOE tools, etc. to disseminate advanced course material in many aspects of mass timber construction. The MTI could work with others (CWC, OWW, etc.) to hold technical workshops and facilitate research presentations at key industry conferences. The MTI should explore collaborations with other organizations to support improved educational delivery in this field.

8.7 Interview Highlights on Education & Skills

Interviewees offer the following views on the new skills that are needed for mass timber applications:

- Introducing more timber engineering aspects at a very technical level (even how to spec them) is crucial and currently missing on design side. Emphasize integrated design approaches that look at fire, acoustics and vibration of mass timber systems.
- While existing promotional efforts are good, there is an urgent need to develop deeper technical information for the engineering and design community. This could improve understanding of product applications for best use and performance (e.g. vibration, acoustics, etc.)
- Modern connection design is a research theme, but also as an educational element, with more emphasis needed in existing and future engineering programs on connections, their importance and keeping pace with significant changes in this space.
- The BIM platform is viewed by interviewees as crucial for mass timber applications by interviewees. However, there is very little real use in the marketplace (reportedly less than 10 per cent of contractors are using BIM). While there could be a need to assess the quality of BIM knowledge dispensed in education programs, the issue may lie more with companies. Failure to adopt BIM practices will have big implications for mass timber, but also for the construction sector if there is a disconnect between graduates and typical practice.
- It is recognized that very different skills are needed on the business management side than conventional experiences (project management, supervision, project staging). Specific examples include CAD skills to map sequencing ahead of build, deep knowledge of BIM and site management.
- Improved material management, storage and handling skills, including moisture, weight and forming is needed, particularly with contractors (less analogous to light frame than to steel and cement). There is a need for qualified rigging expertise, and exposure to new equipment and tools associated with timber construction.
- Improved understanding of mould and moisture issues in mass timber production is needed at all points along the supply chain – manufacturers, architects, designers and contractors.
- Improved skills, knowledge and practices related to all aspects of wood coatings are required.
- Fire risk assessment skills in the mass timber field in Canada are extremely limited and must be increased as an educational priority. As few as three or four individuals are in this space. Efforts to improve this may be compounded by the loss of the NRC fire lab.

- Better linkages are needed across the supply chain, from manufacturing and design to construction. Elements of each could be incorporated in mass timber educational material to help smooth expectations and improve effectiveness of the supply chain.

9.0 Market Barriers to Acceleration

Given the importance of taking a marketplace approach to the MTI, interviewees offer a number of perspectives on existing barriers to advance acceleration of the mass timber market and the supply chain.

On the supply side, current manufacturers would need 20 to 30 new types of skill sets to move more deeply into cut and assembly for mass timber construction. It is viewed as a new business model from many of the current wood supply sector incumbents (e.g. sawmills and EWP facilities). However, some now have the scale and interest to make the investment in fabrication and other equipment needs to bring a fuller solution to market. These suppliers have reviewed building solutions offered by the steel sector and are advancing aspects for mass timber construction.

Beyond CLT, it is early in the development of new market applications and it is uncertain how things will unfold for mass timber products in the future. There are proven technical challenges with existing applications and the logistical issues are significant in mass timber construction – for example, the need to ship the right products in the right sequence at the right time. Product staging is another key challenge because increased space is required close to a job site to realize the time-saving benefits of mass timber use.

Operational performance of existing wood manufacturing is based on large production runs of product. Mass timber applications mean shorter runs with more products. There are other constraints related to sizing and expectations of the design community, which is not well-versed on production.

While the United States has been lagging in the space for years, its growth rate is now well outpacing Canada's.

10.0 MTI Governance & Considerations

Given that the MTI is initiating its activities, the interviewees were offered the opportunity to provide feedback and suggestions on key governance or operating aspects.

Overall feedback is that the MTI needs to take a market-oriented approach to ensure market acceleration. A critical success factor is the structure of the MTI's governance to ensure multi-disciplinary representation (academic, industry, design and engineers, etc.). Some interviewees feel it is important to have regulators (municipal code officials) and more general interest people (such as standards organizations, insurers, etc,) as part of the MTI's governance structure.

During interviews, key members of the mass timber community were asked for recommendations about MTI's advisory structure. Names were provided across the mass timber supply chain's business

community, particularly for the executive. Additional organizations – OAA, IBC and ACBOA - were identified to approach for representation on the MTI advisory structures.

Care should be taken in the board selection process to avoid challenges down the road. To ensure good governance, it is recommended that each member of the executive should have a vote.

A transparent process and qualified review of proposals were considered to be essential for the MTI's success. It was suggested that MTI take care to establish review panels with expertise in given areas.

Repeatedly, interviewees say resources are too limited for the MTI to duplicate efforts of any other existing organization such as CWC, OWW, etc. To ensure this does not happen, interviewees feel that the MTI's working model should involve establishing collaborations and partnerships with other organizations who have activity in the space. This will help ensure the MTI is not reinventing the wheel and should help with overall effectiveness. Interviewees raise the issue of information accessibility, dissemination and relevancy as top priorities to be considered when setting up the MTI.

Finally, the MTI should reach out to as many universities and colleges as possible and do so quickly. It will be important for the MTI not to be seen as an ``exclusive academic club of its original founding partners.'' Should this view take hold, it would deeply hinder the MTI going forward. Some specific Ontario academic institutions highlighted for partnership include:

Carleton University – especially on fire

Seneca College

Algonquin College

College of Carpenters and Allied Trades

Timber Online Education Program

11.0 Conclusions & Recommendations

In summary a number of conclusions and recommendations are offered for the MTI's consideration going forward:

- There is strong enthusiasm for the MTI and its proposed role in research and education.
- There were many potential areas identifed via this scan where MTI could play a role. MTI will need to consider where it will be best placed to help given its resources and partnerships. Additional consultation and input should be sought in the weeks ahead. All interviewees expressed interest in maintaining communication with MTI on next steps and ongoing.
- Gaps exist in research today and the MTI can help fill them by focussing on key priority research areas in its calls for research proposals and by working with other organizations on research coordination. Some of these research priorities are driven by the need to address regulatory change in building codes, while others are driven by marketplace needs for more

comprehensive tools and information. Some areas have been identified that interviewees felt the MTI should avoid as they are well covered by others.

- There is a strong and active community of mass timber researchers but also a growing concern that research could be better coordinated. The MTI can play an important role in coordinating research efforts and ensure strong contributions from Ontario academic players. MTI is also encouraged to expand its Ontario support quickly to include several Ontario academic institutions (i.e. College of Carpenters and Allied Trades, Seneca College, Algonquin College, Carleton University (for fire) and Timber online Education program) that already have some role in the mass timber area.
- The MTI is seen as holding tremendous promise to support the accessibility and dissemination of research material to industry and design users.
- There is insufficient learning opportunities in existing educational and continuing educational programs for mass timber use. Furthermore, there is a growing need for additional technical content in those scarce programs that do exist. It was felt that MTI could fulfill an important role in advancing technical information and in the creation of education curriculum.
- An urgent educational gap was identified in ensuring code officials and regulators understand the strategic and technical advantages offered by mass timber. The MTI may wish to connect with ACBOA to explore what might be done to support this education.
- There is additional investigation into college research offerings that may be valuable to explore. This study did not sufficiently cover this topic.
- Further work should be done to augment this report with a compilation of the research and educational efforts with existing MTI partners and further input with federal and provincial governments.
- It was felt that the MTI should establish collaborations and working arrangements with other organizations involved in the mass timber research and education areas. Several organizations interviewed expressed their interest in connecting with MTI to ensure effective approaches.
- It is recommended that the MTI take a multi-disciplinary approach to its Board and advisory structures and that care be taken in selecting these individuals. There was a strong view that there needed to be transparency and sufficient qualifications in selection/decision-making processes of the MTI for long term success.

12.0 Additional Information

Additional information has been provided to MTI but due to confidentiality reasons is not included in this report.

Publically available references and additional information is included in Appendix A.

Appendix A:

REFERENCES AND ADDITIONAL INFORMATION

Building Codes

1. *Guide to the Alternative Solution Method under Ontario's Building Code*, presentation given by Steven Craft, Principal, CHM Fire Consultants, at the Mass Timber & Tall Wood workshops, March 2018 (pdf document)

2. *Ontario's Tall Wood Building Reference*, published by the Ontario Ministry of Natural Resources and Forests, October 2017 (https://files.ontario.ca/ontarios_tall_wood_building_reference.pdf) (pdf document)

3. *Ontario Wood Bridge Reference Guide*, by Moses Structural Engineers and Brown& Co. Engineering Ltd. for the Canadian Wood Council and the Ontario Ministry of Natural Resources and Forestry, 2017, http://cwc.ca/wp-content/uploads/2018/04/Ontario-Wood-Bridge-Reference-Guide.pdf (pdf document)

Carbon Considerations

4. *Climate Change & Carbon Benefits*, presentation given by Adam Robertson, Manager – Codes & Standards, Canadian Wood Council, at the Mass Timber & Tall Wood workshops, March 2018 (pdf document)

Education/Training

5. Wood *Works!* eLearning Centre; https://woodworkselearning.com/ (Internet link)

6. *TOE – DBR Submission to Federal Government (Funding Request)*, document submitted by Michael Green, architect and DBR Founder, on the Timber OnLine Education initiative, http://www.ourcommons.ca/Content/Committee/421/FINA/Brief/BR9073430/br-external/DesignBuildResearch-e.pdf (pdf document)

Ontario's Mass Timber Program

7. *Ontario Update*, presentation given by Steven Street, Technical Manager – Ontario Wood *Works!*, Canadian Wood Council, at the Mass Timber & Tall Wood workshops, March 2018 (pdf document)

Research/Information Resource

8. Think Wood Research Library; https://research.thinkwood.com/resource (Internet link)

9. *Naturally:Wood*, Information resource promoting British Columbia as a global supplier of quality, environmentally-responsible forest products from sustainably-managed forests, https://www.naturallywood.com (Internet link)

10. *Timber Research Project*, Skidmore Owings & Merrill LLP(SOM), https://www.som.com/ideas/research/timber_tower_research_project (Internet link)

Structural Design

11. *Structural Design of Mass Timber Framing Systems*, presentation given by Tanya Luthi, Senior Associate, Fast + Epp, at the Mass Timber & Tall Wood workshops, March 2018 (pdf document)

12. A *Technical Resource for Developing Alternative Solutions Method under OBC*, presentation given by David Moses, Principal, Moses Structural Engineers, at the Mass Timber & Tall Wood workshops, March 2018 (pdf document)