

# Overcoming psychological barriers to widespread acceptance of Mass Timber Construction in Australia

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## What is Mass Timber Construction (MTC)?

A building process that uses engineered wood products as the primary structural material. Mass timber construction is typically used in applications as a substitute for wet poured steel reinforced concrete, solid section 'tilt-slab' concrete, and steel framing (Kremer & Symmons, 2015).

Kremer, P. D., & Symmons, M. A. (2015). Mass timber construction as an alternative to concrete and steel in the Australia building industry: a PESTEL evaluation of the potential. *International Wood Products Journal*, 6(3), 138-147.

# Overview

A mixed methods Approach.

Two Studies:

1. Consumer Focused
2. Industry Focused

Aim: To determine barriers and hurdles to a widespread adoption of MTC in Australia and explore acceptance of methods specifically designed to overcome them.



# Study One





## Background

MTC has significant potential in the Australian construction market. Nevertheless, there is hesitation amongst stakeholders to adopt it.

The paucity of consumer-based research conducted thus far suggests this reticence is not surprising.

A more targeted assessment is required, particularly for the Australian market.

# Study One

## Consumer Study

The aim of study one was to ascertain if the attitudes of Australian consumers toward environmental issues and the use of timber in construction are related to factors involved in property purchasing behaviours.

What: 20 min online survey

Who: Australian consumers

When: June 2015 to March 2016

# Participants

281 individuals:  
145 males/136 females

Age group split:  
18-38 Younger & 39+ Older Adults

71 (34%) indicated they worked in the  
building industry

An even distribution of participants  
across Australia





## Environment Attitudes Scale

1. Ecocentric - expressing protection over the resource because of its inherent qualities.
2. Anthropocentric - expressing protection over the environment as a resource for maintaining or enhancing the quality of life.
3. Environmental Apathy - indifference to environmental issues.



## Timber in Urban Construction Scale

Measures consumer attitudes toward the use of timber in construction.

In particular, items explore Material Durability, Constructions Cost, Environmental Attributes, Aesthetics and Physical/Mechanical Properties



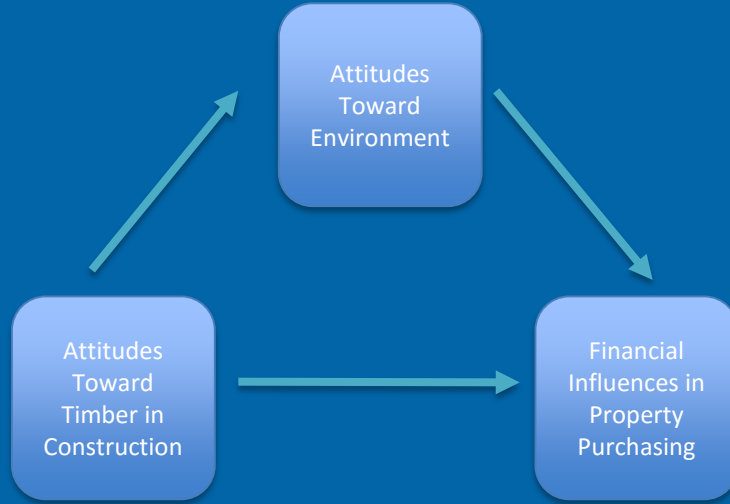
## Buyer Preference in Residential Property

Measures attitudes toward purchasing residential property in Australia.

In particular, items explore Physical Attributes Location, Environment, Financial, Considerations and Psychological Influences.



# Design



The mediator variable serves to clarify the nature of the relationship between the predictor and outcome variables. It explores the underlying mechanism or process.

*H1:* Participants exhibiting greater anthropocentric and apathetic environmental attitudes (but not ecocentric environmental views) will express greater attitudes toward timber in construction.

*H2:* Participants shall indicate strong attitudes relating to the durability of timber use in construction.

*H3:* Apathetic and anthropocentric attitudes toward the environment will significantly predict attitudes toward timber in construction whilst controlling for attitudes toward environmentally sustainable design of products and services.

*H4:* Apathetic and anthropocentric attitudes toward the environment shall mediate the relationship between the use of timber in construction and financial influences in property purchasing decisions. However, ecocentric attitudes shall not.



# Environmental Attitudes

9% ( $n = 24$ ) of participants indicated scores above the mid-point on all three subdomains.

31% ( $n = 86$ ) of participants indicated scores over the mid-point on the Ecocentric and Anthropocentric subdomains.

13% ( $n = 37$ ) of participants indicated scores over the mid-point on the Ecocentric and Apathetic subdomains.

22% ( $n = 63$ ) of participants indicated scores over the mid-point on the Anthropocentric and Apathetic subdomains.



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# Knowledge of Mass Timber Construction

Participants were asked about their knowledge of MTC with 224 (80%) responding 'no knowledge' and 57 (20%) responding 'I had prior knowledge'.

Participant knowledge was gained from television shows such as Grand Designs (United Kingdom), within the workplace (within the construction industry), working on CLT projects, via various media channels (including social media), through university research studies, and via industry conferences/exhibitions.



# Environmental Sustainable Design and Attitudes toward Purchasing

Participants were asked to rate their level of knowledge about the Australian Green Building Council Green Star Program. The average rating ( $M = 1.9$ ,  $SD = 1.27$ ) indicates poor knowledge of the program.

Participants indicated the extent of influence an Environment or Sustainability Rating System would have on their decisions to purchase an apartment/home/ investment property. The average rating ( $M = 2.88$ ,  $SD = 1.22$ ) indicates a neutral acceptance of such programs.

Finally, participants indicated how important Environmental Sustainable Design Building practices are in decisions to purchase products and services the average rating ( $M = 3.29$ ,  $SD = 1.28$ ) indicates that sustainable building practices are somewhat important.

# Construction Materials and Attitudes toward Purchasing

Participants indicated how important the 'structural soundness of the building' ( $M = 1.51$ ,  $SD = .70$ ) and the 'construction type e.g. brick, timber, concrete' ( $M = 2.20$ ,  $SD = .70$ ) are in the purchasing decision of a property.

Participants were also asked 'if they would direct their builder to use structural timber (for supporting the overall building) in the construction of my next home' ( $M = 2.80$ ,  $SD = .86$ ). 13% ( $n = 36$ ) of participants indicated it was important or very important, 60% ( $n = 167$ ) indicated a neutral response, and 28% ( $n = 78$ ) indicated it was unimportant or very unimportant to them to have the builder use structural timber in the construction of their next home.

Results indicate a neutral association between the use of timber as a structural material in housing, yet, the majority of homes are still built using timber framing and engineered structural timber.

In terms of durability, participants were asked to rate their level of agreement with the following statement 'I am concerned about the durability of timber' ( $M = 2.61$ ,  $SD = .95$ ). 53% ( $n = 148$ ) of participants indicated they agreed or strongly agreed, 27% ( $n = 77$ ) indicated a neutral response, and 20% ( $n = 58$ ) indicated they disagreed or strongly disagreed that they are concerned about the durability of timber.

Participants were also asked their level of agreement with the following statement 'using timber increases the risk of fire' ( $M = 3.49$ ,  $SD = .93$ ). 54% ( $n = 154$ ) of participants indicated agree or strongly agree, 31% ( $n = 88$ ) indicated a neutral response and 13% ( $n = 38$ ) indicated they disagree or strongly disagree that using timber increases the risk of fire.

Results correlate with previous research that timber durability is a primary concern.

# Environmental and Attitudes toward Purchasing

Participants were asked if 'CO2 emissions are lower when processing and constructing with timber when compared to alternative materials, such as construction of concrete and steel' ( $M = 2.53$ ,  $SD = .76$ ). 6% ( $n = 17$ ) indicated they agreed or strongly agreed, 40% ( $n = 111$ ) indicated a neutral response and 29% ( $n = 82$ ) of participants disagreed or strongly disagreed that CO2 emissions are lower when processing and constructing with timber when compared to alternative materials, such as construction of concrete and steel.

In order to make a comparison between the sustainability of timber and commonly purchased environmental products, participants were asked 'how important are the use of solar panels' in their decision to purchase a property ( $M = 2.42$ ,  $SD = .95$ ). 11% ( $n = 32$ ) indicated they are important or very important, 36% ( $n = 101$ ) indicated a neutral response and 53% ( $n = 150$ ) responded unimportant or very unimportant.

Results indicate timber may not be considered as an 'environmentally friendly' as other products – such as solar panels – and this may be due to the very different 'visibility' timber has compared to retail products, including solar panels.

Participants were asked if 'the total cost of building is higher when using timber compared to alternative products' ( $M = 2.08$ ,  $SD = .78$ ). 26% ( $n = 71$ ) indicated they agreed or strongly agreed, 57% ( $n = 160$ ) indicated a neutral response and 18% ( $n = 50$ ) of participants disagreed or strongly disagreed the total cost of building is higher when using timber compared to alternative products.

Participants were also asked 'if when using timber energy costs (in the construction of the building and in running the building - heating and cooling) were higher compared to alternative materials, such as concrete and steel' ( $M = 2.01$ ,  $SD = .81$ ). 23% ( $n = 63$ ) indicated they agreed or strongly agreed, 55% ( $n = 157$ ) indicated a neutral response and 22% ( $n = 61$ ) of participants disagreed or strongly disagreed that using timber energy costs (in the construction of and in running the building - heating and cooling) were considered higher compared to alternative materials.

Results indicate the perceived costs associated with the use of timber in construction, energy consumption and running costs are higher.

# Older and Younger Adult Attitudinal Comparison

An analysis of differences in attitudes between older (38+) and younger adults (18-38) revealed that older adults ( $M = 3.53$ ,  $SD = 1.31$ ) had statistically significant (Levene's test was violated, unequal variance assumed  $t(92.95) = -3.36$ ,  $p = .001$ , Cohen's  $d = .47$  a medium effect) lower scores on attitudes toward the importance of structural soundness and construction components in property purchasing decisions than younger adults ( $M = 4.19$ ,  $SD = 1.49$ ).

Participants responses about the use of structural timber (for supporting the overall building) in the construction of their next home, results indicate older adults ( $M = 3.72$ ,  $SD = 1.10$ ) had statistically significant ( $t(279) = 2.38$ ,  $p = .018$ , Cohen's  $d = .31$  a medium effect) higher scores than younger adults ( $M = 3.38$ ,  $SD = 1.06$ ). However, an analysis of differences in attitudes toward the influence of environmental sustainable design in property purchasing decisions revealed that older adults ( $M = 26.20$ ,  $SD = 4.97$ ) had near statistically significant ( $t(279) = -1.92$ ,  $p = .056$ , Cohen's  $d = .23$  a small effect) lower scores than younger adults ( $M = 27.5$ ,  $SD = 4.86$ ).

Whilst this difference was not strictly statistically significant it is an interesting finding.

# Attitudes Toward Timber, Knowledge of MTC

In order to find the strength, or not, of the relationship between environmental attitudes and participants knowledge of MTC was undertaken.

A correlation analysis revealed a significantly moderate relationship for participants without prior knowledge of MTC and the relationship between Anthropocentric views and attitudes toward the use of Timber in Construction ( $r = .33$ ,  $p < .001$ ,  $r^2 = .11$ ).

Similarly, a significantly weaker relationship exists for participants without prior knowledge of MTC and the relationship between Ecocentric environmental attitudes and attitudes toward the use of Timber in Construction ( $r = .22$ ,  $p < .001$ ,  $r^2 = .05$ ).

Combined, participants without prior knowledge of MTC holding Ecocentric and Anthropocentric views about the environment explained 16% of the data.

Whereas, for participants without prior knowledge of MTC, the relationship between Apathetic environmental attitudes and the use of timber in construction was not significant.

Further analyses revealed a significantly moderate relationship for participants with prior knowledge of MTC and the relationship between Anthropocentric environmental views and attitudes toward using timber in construction ( $r = .29$ ,  $p = .013$ ,  $r^2 = .08$ ) which explained 8% of the data.

However, for participants with prior knowledge of MTC and the relationship between Ecocentric or Apathetic environmental attitudes and the use of Timber in Construction was not significant.



# Mediation Analysis

Anthropocentric attitudes toward the environment **mediates** the relationship between participant's attitudes toward the use of Timber in Construction and Financial Influences in property purchasing decisions.

Holding anthropocentric attitudes (expressing protection over the environment as a resource for maintaining or enhancing the quality of life) mediates the relationship between the use of timber in construction (favourable attitudes toward sustainability, durability, structural properties, economics) and financial factors involved in making a property purchasing decision (such as monthly repayments, interest rates, return on investment and cost of insurance).

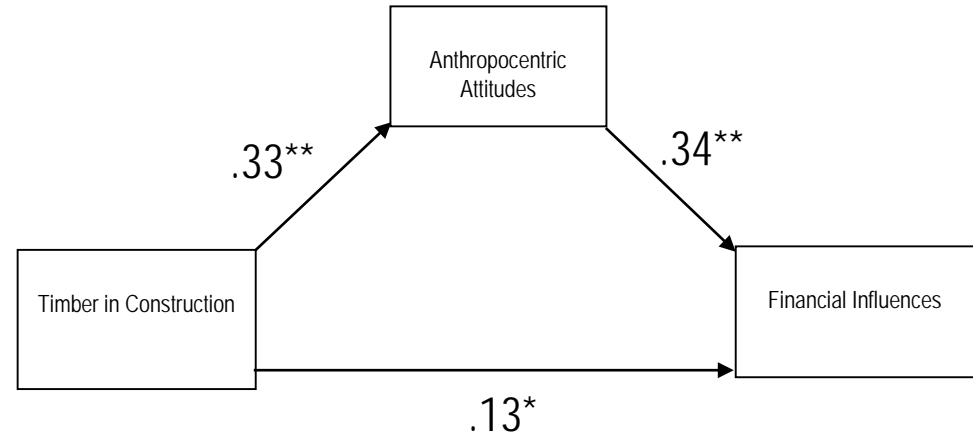


Diagram of mediation analysis coefficients between the variables, \*  $p = .032$ , \*\*  $p = <.001$ .

Recall that the mediator variable serves to clarify the nature of the relationship between the predictor and outcome variables.

## Recommendations

1. The present study supports the development of a composite of 'green' information about the environmental attributes and sustainable design practices inherent within MTC buildings. Consumers want to understand and be educated about the qualities of the property they intend to purchase and how this contributes to environmental efforts.
2. Associated with recommendation one, the present study suggests that overcoming prejudices about the durability of timber in construction through clearly articulated marketing communication messages is vitally important. For example how the buildings are clad internally and externally.
3. Differences in attitudes between older and younger adults results in more targeted marketing messages by age segmentation (as well as along environmental attitudinal lines) could be used to great effect in marketing MTC to Australian consumers.

## Recommendations

4. Property developers should be able to attract sale price premiums for MTC properties based on researching and educating those interested in purchasing (with infographics, videos, education walk-throughs, advertising etc.) about the benefits of the timber and how it will benefit their lives - comfort, running cost reductions etc.
5. To mention timber or not to mention timber, that is the question.
6. Communications about MTC and 'green messages' about the technology should focus on anthropocentric approaches to environmental resource use. It is conceivable that consumers who are educated about MTC, and timber more generally, may resolve/rationalise differences in environmental attitudes (ecocentrism and/or apathy) in order to achieve a degree of environmental utilitarianism – achieving the maximum benefit possible from an environmental resource.

# Study Two



## Background

A thematic analysis seeks to identify and examine patterns or themes within data. This method was applied to interviews conducted with various industry stakeholders from within the construction and forestry sector.

# Study One

## Industry Study

The purpose was to explore the barriers to more widespread adoption of Mass Timber Construction (MTC) in Australia. Each participant provides a unique insight into how identified barriers might be overcome.

What: 1-2hour in-depth interviews

Who: Industry Stakeholders

When: April 2015 to March 2016

# Participants

9 male industry stakeholders

Average of 21 years' experience ( $SD = 5.6$  years) in the Australian construction, building, or forestry industry sector.

Several participants occupied multiple domains of expertise thus the number of opinions offered exceeds the number of actual participants.

Participants primarily from Melbourne and Sydney



## Semi-structured Questionnaire

1. What impact do you think this alternative construction method might have on the your particular product or service?
1. What do you perceive are some of the more general challenges facing the more widespread use MTC in the construction industry more generally?
2. What impacts might this alternative construction method have on costs of your product/service?







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# Knowledge of Mass Timber Construction

The majority of participants (90%) had some prior knowledge of MTC as a method or group of material technologies (Cross Laminated Timber, Laminated Veneer Lumber, Glue Laminated Beams).

*"[My understanding came] through the various demonstration projects that have been constructed around Melbourne. So, from a development point of view, I see it as an interesting and usual addition to the range of products available and it has some specific and definitive uses in its place." Property Developer*

Although knowledge of MTC may be widespread, the impact the technology is having on industry at present appears small,

*"Well there is not enough of it around at the moment to be concerned with it at this stage." Property Underwriter*

# Perceptions of Mass Timber Construction

Participants from the insurance industry considered the technology 'limited' due to the nature of the material it is constructed from – timber

*"From an insurance perspective, one of the things insurance companies look at when determining premiums is the construction materials used. In very simplistic terms, a building with more timber construction generally attracts a higher premium than a building constructed with brick or concrete. So, I guess, initially my thoughts are, any construction, any building with this sort of material in it would most likely incur a higher premium." Insurance Broker*

*"Historically, well, the insurance industry is very conservative. We tend to sit back and wait and see what things do. You would not find insurers going out promoting new products or things like that. Historically, there was a category of products called massive timber construction. It covered very old buildings with large timber beams. We [insurance assessors] would treat this category as non-combustible, but that is only a beam, that's not a whole floor or a wall" Property Underwriter*

However, for some, MTC is not a standalone solution. Rather it forms part of an integrated series of components along with other materials and technologies

*“Looking overseas and looking at the technology, and the small sample we can judge in Australia, I think that the timber industry has kind of put forward cross laminated timber as a solution in its own right for building and construction...” Property Developer*

From a supply point of view,

*“There is a ground swell of interest in MTC, particularly looking at the low and mid-rise to high rise, anything from four to 10-15 storey buildings. I think that people recognise that for single-storey, one-to-two storey family homes that a timber frame building is ultra-competitive and works extremely well.” Supplier*

*“Inevitable for medium to large scale projects” Architect/Builder*

# Perceived benefits of Mass Timber Construction

The consensus amongst participants was that there are many benefits from MTC over traditional forms of construction.

*"It [MTC] would bring far greater sustainability benefits to our service and allow for faster project delivery resulting in higher revenue and margins with a reduced number of site personnel" Architect/Builder*

*"I strongly believe that the environmental features are a key selling point for this product, both in terms of its manufacture and its reusability at the end of building life." Designer*

*"My bottom-line on CLT is that it has innate benefits structurally... it's great as a panel that can be delivered as an exterior facade, with a window already fitted, not that we can do that yet. But if that were the case, then we can compare apples with apples with some of the other systems in the market, and that would be a good use of it" Product Manufacturer*

# Barriers to widespread acceptance

Participants from the insurance industry had this to say about MTC and the impact this new technology has on premiums.

*“The insurance industry rates things based on historical data. Traditionally timber constructed buildings have a higher propensity to have larger losses than a building constructed out of brick or concrete. I understand that this product by the nature of it probably has, umm, is different to a standard piece of timber. However, they [insurers] will probably charge higher premiums purely on the basis that a lot of these systems are new.” Insurance Broker*

It seems important to ensure that the entire supply chain is on-board with the technology,

*“I think the biggest hindrance is the unknown. People do not have enough understanding or knowledge about it [MTC], and even though you get the Developer, Architect and Engineer to support it [MTC]. Sometimes the Developers say, ‘I hear what you say, I see the logic. Nevertheless, I am not sure. Is it actually going to happen that fast? Can it happen as you claim it is going to happen?’ So another hindrance” Supplier*

# Barriers to widespread acceptance

On the subject of durability, specifically relating to fire, participants had this to say,

*"The insurance industry rates things based on historical data. Traditionally timber constructed buildings have a higher propensity to have larger losses than a building constructed out of brick or concrete." Insurance Broker*

*"I think there is a big perception problem, it is true that if you wet timber it isn't constructed or engineered to cope with wet, and it will cause a problem, and it will likewise burn if flame is applied." Forestry Academic*

*"I think that is going to take some years before they attract enough analysis and enough data to be able to make that judgement as to whether the premiums should be loaded. At the outset I just get the feeling that they will probably charge higher premium because it will fall into the timber construction rather than the brick or concrete." Insurance Broker*

# Barriers to widespread acceptance

Other impediments include the savings using an alternate technology,

*"At this point its [cost is] higher, and even on a 'total cost of construction' the margin of saving is so small. I mean what is being quoted in the media at the moment is about 4%. Nobody will make a buying decision on 4% overall. Because builders simply don't quantify their time, um, unless they are a larger organisation with the procedures and the people in place and they have the technology." Property Developer*

Whilst the risk of attempting to use an alternative method might be too great because it's a 'new technology',

*"There is a perceived complexity associated with MTC." Architect/Builder*

For developers and builders, assurances are needed that they won't make losses,

*"I agree that is always going to be the challenge. Everyone will be private about the projects and financial aspects." Supplier*



# Suggested strategies for overcoming barriers

Participants were unanimously united that education campaigns about MTC technology are important in addressing many of the obstacles,

*"If anyone has some evidence of the performance of this product from overseas studies, and if it has been in Europe for 10 years, they will have 10 years' worth of data. Therefore, if we can demonstrate the integrity of this product then insurers will certainly take that onboard." Insurance Broker*

*"Australia is in a far better position than Europe. This is because Australians can actually go and visit a huge range of projects - from small to very large - so there is not an unknown anymore." Supplier*

*"I think we need to create a series of product specific applications promoted through specific marketing material." Architect*

*"The ideal solution could be to develop a walk-through model that you could mount on the back of a van or trailer and meet at a University or other institutions and allow people to walk in and see how it would work." Supplier*

# Suggested strategies for overcoming barriers

Promoting the core economic benefits of MTC and appealing to industry stakeholder's sense of 'commercialism' was another popular strategy,

*"It [MTC] will go up in days, not in weeks, and the labour component is reduced compared to concrete, not wet trades etc."*  
Architect

*"They could go to a broker and the insurers would be played-off against each other."* Property Underwriter

*"You could work in with them [MTC manufacturers and distributors] to formulate the ideal and optimal design to make the most of the complex problems found on site."* Architect

*"Because they [second-tier builder] just simply don't have enough resources to do it, so industry has to do that for them, and that is a big task."* Property Developer

## Recommendations

1. *Developing data and information exchange programs/collaborations with European organisations.* Data relating to the considerable amount of work performed using MTC in Europe would certainly benefit Australian construction, particularly the influence of the insurance industry.
2. *Participate in overseas study tours.* Australians can visit a huge range of projects in Europe and Canada. Projects from the very small to very large now provide a sense of what is achievable. Forest and Wood Products Australia, in conjunction with the Timber Development Association (New South Wales) have offered several such trips to industry over the last few years.
3. *Leverage financial service premiums (insurance and investment) by using global organisations.* It is evident from the present study that local financial services organisations load premiums. Finding a global American, Canadian or European company that has had dealings with MTC might result in a completely different view of the product and their premium might be cheaper.

## Recommendations

4. *Use brokerage firms.* Brokers shall communicate with organisations and recommend financial and insurance services that match the clients' expectations. Industry insiders suggest that brokers are able to reverse-auction premiums for services that benefit the client. Pooling projects and clients together provides brokerage firms with leverage. Buyer bargaining power is a useful strategy to secure lower premiums.
5. *Manufacturers could produce a series of product specific applications using MTC.* These applications could be promoted through specific marketing material. For example, a cross laminated timber lift shaft.
6. *Case study scenarios specific to builders at various tiers/levels.* In collaboration with key stakeholders, Australian manufacturers and industry suppliers could develop a series of easy to understand non-commercial in confidence cost saving case studies. These can be developed and disseminated to tier one, two and three builders expressing interest in using MTC, avoiding the requirement of costly quantification comparisons to more traditional forms of construction.

## Recommendations

7. *MTC portable displays.* The development of walk-through showcases or displays that could be mounted on the back of a trailer. Such displays would represent a cross-section of an actual building with internal linings, external cladding, wiring and plumbing etc. Such displays could be parked at common meeting area, such as a University or other institutions, trade shows and conferences allowing people to walk in and see how MTC actually works.
8. *Full-scale testing.* Research conducted by internationally credible sources, such as FM Global, could be commissioned to undertake large-scale testing. Approvals may be granted if product applications are tested and replicated on-site. Approved methods of construction may satisfy the insurance and financial services industries.
9. *Pre-fabricated solutions for complex on-site problems.* MTC manufacturers and distributors could formulate ideal and optimal designs using mass timber components solving some of the more complex problems found on building sites. The specifics for the designer, the shop drawings and the detailers, provide very specific information that makes it very easy to use the product.



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Findings from the studies suggest regardless of the barriers to the widespread acceptance of MTC as a material and method, it has a future in the Australian construction market. In order to forecast a 'future state' or at least to secure lead indicators of MTC's potential, Australian stakeholders need only look at the emerging trends for the material/method in Europe.



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# Thank You

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