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# Out of the Woods: Perceived versus Experienced Drivers and Barriers to Multistorey Timber Construction in Belgium

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**Abstract.** Multistorey timber construction (MTC) offers a more sustainable architectural alternative to mineral building, but its adoption in Belgium lags. This paper investigates the hypothesis that a limited knowhow on timber construction is a significant barrier to MTC implementation. This study surveys construction professionals with varying experience levels in timber construction to compare perceived challenges between novices and those involved in completed mid-rise timber projects. The research combined literature review, quantitative surveys, and focus groups with timber construction training. Findings reveal that while all participants recognized sustainability benefits, perceived barriers varied significantly by experience level. Technical expertise availability and traditional mineral construction practices were commonly cited challenges. Experienced professionals, except contractors, cited profitability concerns, while novices emphasized building costs and technical limitations, particularly regarding fire performance and durability. The study highlights the need for targeted education, policy changes, and promotion of best practices to address these perceived barriers and facilitate broader adoption of mass timber construction.

## 1. Introduction

The construction industry faces increasing pressure to reduce its carbon footprint and adopt sustainable practices. Multistorey timber construction (MTC) offers substantial environmental benefits and potential for streamlined construction processes, enhancing its value in sustainable architecture and circular construction. Despite these advantages, timber's adoption as a primary material for multistorey buildings remains limited in many regions, including Belgium.

Timber construction, especially in mid-rise buildings from 4 to 10 storeys, offers several advantages: it is renewable, has a lower embodied carbon footprint compared to concrete and steel, reduces construction time through prefabrication, and contributes to occupant well-being. (1) These benefits align well with the growing emphasis on sustainable development and the circular economy in the construction sector. Yet, construction professionals face technical, economic, regulatory, and cultural barriers, with their impact varying based on experience.

The discrepancy between the potential of timber construction and its actual implementation is particularly evident in Belgium's construction landscape. While numerous timber projects are announced with great fanfare in the media, many fail to materialize, succumbing to a myriad of perceived and real barriers (2,3). Belgium ranks high in circular economy implementation (4), yet

IOP Conf. Series: Earth and Environmental Science **1554** (2025) 012068 doi:10.1088/1755-1315/1554/1/012068

the number of new timber houses constructed in Belgium saw a declining trend 2011-2022. Several factors may have played a role, including the impact of the COVID-19 crisis, with shortages, price increases, and rising energy prices. Furthermore, uncertainty due to evolving building regulations and limited resources within small to medium-sized enterprises hinder timber construction. Most companies realize fewer than 10 buildings per year, whereas a smaller percentage of larger companies account for the majority of the residential timber construction market (5). This phenomenon raises important questions about the nature of these obstacles, the factors that impede the widespread adoption of MTC in the country and how to overcome them.

A key barrier to MTC in Europe is the limited knowledge and experience among construction professionals (6–11), leading to uncertainty about structural performance, fire safety, and best-practices for timber design and construction. However, no study up to date has mapped the drivers and barriers to MTC in Belgium. The central hypothesis behind the slow adoption of timber in multistorey buildings in Belgium is that the lack of knowledge imposes additional challenges to mass timber implementation in construction.

### *1.1. Research Focus and Significance*

First, this study quantifies perceived barriers, drivers, and potential improvement strategies, providing insights into the current state of the Belgian multistorey timber construction (MTC) industry. Second, the research investigated whether the perceived barriers of less experienced, yet motivated construction professionals differ from those reported from professionals that took part in realized mid-rise timber projects in Belgium. The scope of this study includes architects, engineer-consultants, clients, and contractors involved in MTC, classified by their self-declared expertise or number of timber projects involved.

By comparing the perceptions of less experienced professionals with the experiences of those who have completed timber projects, the study uncovered discrepancies between anticipated and actual challenges. This mixed-methods research, combining quantitative surveys and qualitative focus groups, highlights misconceptions that may deter professionals from adopting timber construction and areas where education, training, or support are needed. The insights in this study have a dual effect of informing policymakers and industry leaders on how to promote and support timber construction more effectively by (1) clarifying perceived challenges and (2) focusing on addressing real challenges faced by practitioners.

## 2. State of the Art: Stakeholder Perceptions and Barriers to Timber Construction

Literature reveals a segmented market for timber construction, with a concentration of impactful stakeholders in Central and Northern Europe (12). Perceptions of timber construction are stakeholder-dependent, influenced by professional background, geographic location, and project involvement. Studies have focused on clients (6,7,9,10,13–15), architects (6–8,10,14–20), academics (6,21,22), policy makers (7–9,15,21,23,24), residents (25), engineers (6,7,10,14,15,18,20,26) or contractors (6,9,15), but rarely incorporated the four main professional stakeholders for design: architects, engineer-consultants, clients, and contractors.

### *2.1. Barriers and Opportunities for Adoption*

Research indicates several political, cultural, technical, economic, and socio-environmental barriers. Key technical hurdles include concerns about fire performance, structural properties, acoustics, durability and complexities of multi-layer construction (6,8–10,13,14,18,20,22,26). Lack of availability of technical expertise and the need for digitalization are other technical challenges. (6–11). These technical concerns are often coupled with economic considerations, such as perceived higher building costs and a lack of readily available financial information for risk management. Economic considerations encompass the variable frequency of demand for timber projects, conventional bidding practices and the need for partner cooperation (6,8,10,14,22,27). Sustainability-related barriers include concerns about deforestation and timber availability (8,9,20,23,26). Moreover, regulatory hurdles related to building codes and standards (6,7,10,22,23), alongside a prevailing "concrete, brick, and steel building tradition," further impede progress (7–10,22,24,28). Despite these diverse challenges, it is crucial to acknowledge that perceptions of these barriers can differ significantly among experienced and inexperienced professionals (18).

Mass timber construction offers compelling opportunities, including its sustainability, potential for rapid construction, and aesthetic appeal. Timber's renewability and carbon sequestration potential make it an attractive alternative to traditional materials (9–11,13,14,17,18,20,22–24,26). The prefabrication capabilities of MTC allow for faster construction times, reducing on-site labour and minimizing disruption (9–11,18,22,26). Also, MTC can stimulate local economies, promote innovation in the construction industry, and create new business opportunities (8,9,23,24,26). Additionally, architects and engineers value wood for its strength-to-weight ratio, aesthetic appeal, and design flexibility (9–11,13,14,18–20,26).

### *2.2. Overcoming Barriers Through Education and Collaboration*
Recognizing knowledge gaps, studies emphasize the need for technical knowledge, education, and industry collaboration (12,29). Addressing these barriers through improved building codes and technology transfer could promote wider adoption of timber in Multistorey construction (10,15). Collaboration and knowledge sharing are essential (12), along with open-source financial and commercial information for risk management (27).

Several strategies have been formulated in the literature to address these barriers: Association or coordination office for timber construction (6,16,24,30,32) establishing a brand image of timber construction (23,30); Training and supporting forestry to improve local resource and infrastructure availability (23,33,36); Network of partners or bidding community with aligned contractual incentives (6,16,21,22,24,30–33); Implementation of timber and timber construction related knowledge in academic curriculum (16,22,30,34,35) as well as open-source timber information, design examples and post-academic education (6,15,16,24,33–35); Integration of timber expertise in early design stages (30) and supporting new business models suitable for timber construction (16,24,33); Increase products standardisation through specialisation in multistorey buildings (30,34) and increase prefabrication level (16,30),; Promotion of research and development (15,23,30,31,33,34); More supportive regulations and certifications for low impact materials (6,15,16,23,24,33–37) and reduced support for dominant regime technologies (24). A comprehensive approach to overcoming barriers integrates three core elements: education, collaboration, and supportive policies.

## 3. Methods

### *3.1. Data Collection*
The study is based on a thorough review of existing literature on timber construction stakeholders, barriers, and drivers within the European and Belgian context. This review served two key purposes: (a) to establish a baseline understanding of the current state of knowledge, and (b) to inform the development of our survey and focus group protocols. Databases such as Scopus and Web of Science were used to identify relevant scientific journals and publications.

IOP Conf. Series: Earth and Environmental Science **1554** (2025) 012068 doi:10.1088/1755-1315/1554/1/012068

A quantitative survey was sent to 75 construction professionals in Belgium, selected for their involvement in timber construction. The survey, conducted between June 2023 and June 2024, aimed to quantify the perceived importance of various drivers and barriers. Participants were asked to rate these factors using a five-point Likert scale, ranging from major barrier (-2) to major driver (+2). The survey also collected data on the number of timber projects the respondents were involved in, to allow for comparative analysis based on experience level. Seventeen out of 46 respondents had been involved 5 or less timber projects and qualified as novices, 9 respondents between 5 and 10 projects, whereas 20 have been involved more than 10 timber projects.

To gain a deeper understanding of the nuances behind the survey responses, the authors conducted focus groups with architects and building professionals participating in a masterclass about mid-rise timber construction. Participants were recruited via e-mails and newsletters. Two parallel session of semi-structured focus groups were held. Each session comprised of 4 groups with a maximum of eight participants and lasted for 45 minutes. Each group was guided by a pre-defined set of open-ended questions designed to explore one key thematic field emerging from the survey data, namely technical, social & environmental, political & cultural and economic. (38) The questions elicited detailed discussions regarding the drivers and barriers to timber construction, as well as their perceptions of circularity in timber buildings in Belgium. The focus groups were audio-recorded and transcribed verbatim.

| | **Survey** | | **Focus Groups** | |
|---|---|---|---|---|
| | **Participants** | **Av. number of timber projects** | **Participants** | **Mostly mentioned** |
| **engineer-consultant** | 16 | 11 | 10 | no experience |
| **contractor** | 9 | 12 | 1 | basic knowledge |
| **client** | 7 | 6 | 1 | no experience |
| **architect** | 14 | 9 | 10 | basic knowledge |
| | **46** | | **22** | |

**Figure 1.** Stakeholder distribution

*3.2. Data Analysis*

The data analysis followed a data-driven analytical process without predefined theoretical frameworks. Quantitative data from the online survey were analysed with inferential statistics (ANOVA) to compare perceptions between the novice and experienced groups and professional role. Statistical significance was set at $p < 0.05$. Qualitative data from the focus groups transcripts were analysed using thematic analysis. Thematic analysis involved identifying recurring themes and patterns within the data, coding the transcripts, and grouping codes into overarching themes related to barriers, drivers, and improvement strategies for MTC. (39). A concept's importance to an actor group can be gauged by how often it is brought up within that group. By targeting different participant groups (data triangulation), using different data collection methods (methodological triangulation) and conducting the data-analysis independently by at least two researchers, methodological quality was optimized (40).

To visualize the complex interplay of actors, factors, and their relationships influencing MTC adoption, an Actor-Network Cognitive Map (ANCM) was constructed. This map integrated insights from the survey data, focus group transcripts, and literature review, identifying key actors (e.g., architects, engineers, clients, policymakers), relevant factors and artefacts (e.g., building codes, timber properties, processes), and the cognitive links (positive or negative) between them.

IOP Conf. Series: Earth and Environmental Science **1554** (2025) 012068 doi:10.1088/1755-1315/1554/1/012068

(41) The ANCM helped to reveal the perceived relationships between actors and factors, visualizing how different actors perceive barriers and drivers, and identifying potential leverage points for interventions aimed at promoting MTC adoption.

The quantitative survey data and qualitative focus group data were integrated to provide a more comprehensive understanding of the research questions. Specifically, the qualitative data were used to: 1) validate and contextualize the survey findings; 2) provide deeper insights into the reasons behind the observed differences in perceptions between the actor groups; and 3) generate new hypotheses for future research.

## 4. Results and discussion

The survey and focus group results reveal a complex landscape of drivers and barriers in mid-rise timber construction, with notable differences between experienced and novice actors. This disparity underscores the critical role of education and experience in closing that gap and shaping perceptions and decision-making processes more in line with the industry.

### *4.1. Belgian Timber Projects and Experience*

The survey encompassed a diverse range of timber projects, with completion or termination years spanning from 2010 to 2027. The majority (63.6%) were due after 2022, indicating a recent surge in timber construction. Project scales varied, with building costs predominantly falling between two to five million euros (28.2%) or ten to fifty million euros (35.9%). Most projects featured 4 floors above ground (26.1%), with 45.6% reaching up 5 to 11 floors. Notably, 70.5% of projects initially considered structural timber, though only 47.7% ultimately used it as the final structural material. This confirms the experience level of the survey participants being higher than the focus group participants, although experienced mostly in low-rise timber projects.

### *4.2. Drivers: A Common Ground*

Figure 2 shows several key drivers across all experience levels that emerge as universally recognized benefits of timber construction. Circularity and carbon reduction stand out as primary motivators, both in the focus groups and the survey reflecting the growing emphasis on sustainability in the construction sector. The bio-build trend, increased construction speed, enhanced branding opportunities, and the potential for innovation also serve as significant incentives for adopting timber in mid-rise projects.

### *4.3. Barriers: A Tale of Two Perspectives*

While drivers show consistency across experience levels, barriers present a more nuanced picture. The diversion between experienced actors and novices highlight the impact of practical knowledge on risk assessment and problem-solving approaches.

Both experienced and novice actors identify the availability of technical expertise and the entrenched mineral building tradition as significant obstacles. This focus group and survey consensus suggests that these factors represent systemic challenges within the Belgium building industry, requiring broad-based solutions that address both skill development and cultural shifts.

Financial perceptions on the other hand vary based on experience. Experienced actors, particularly architects and engineers, cite profitability as service providers as a major concern. In contrast, novice actors broadly discussed the overall building costs as the primary financial barrier in the focus groups. This discrepancy may reflect a more nuanced understanding of project economics among experienced professionals, who recognize that research and development study costs are underestimated, while their experience gives them confidence in keeping the construction costs feasible. Also, novices mention conventional bidding as an obstacle and architects mention partner trust issues.

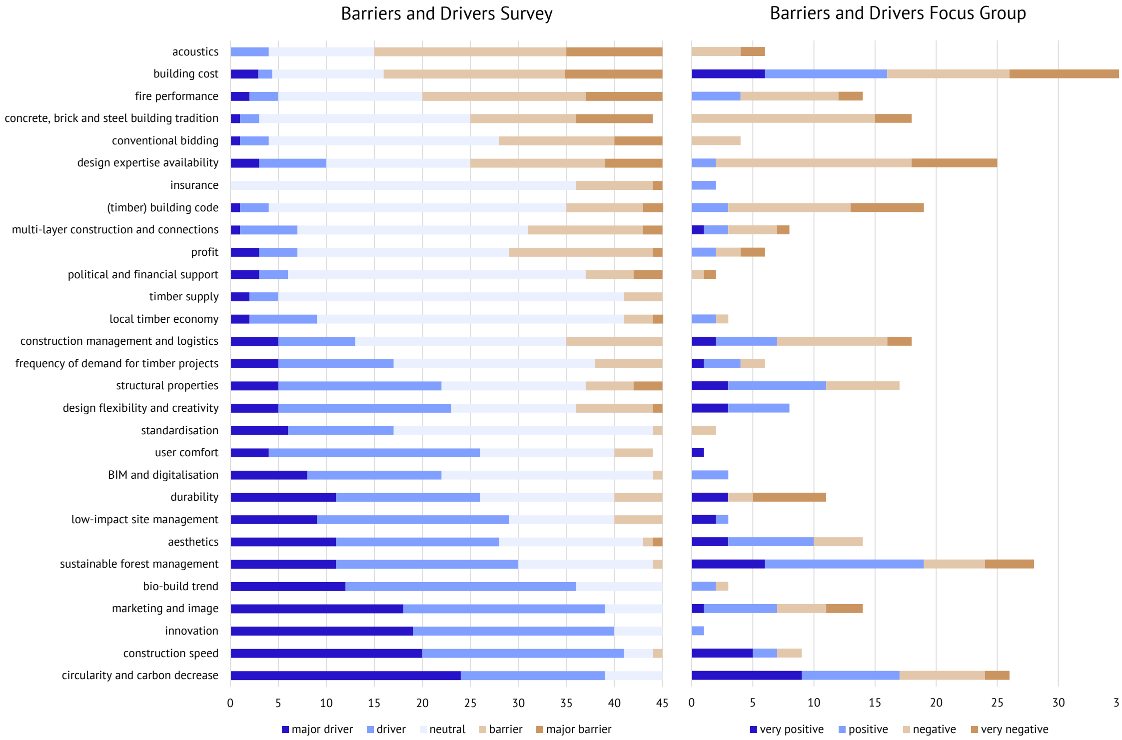


**Figure 2.** Timber construction actor's drivers and barriers ordered by average survey scoring, increasing. Focus group's comments are labelled with sentiment.

The perception of technical challenges shows a stark contrast between experience levels. Experienced architects and engineers generally view most technical factors positively, with acoustics being the notable exception, also recognised across the globe (6). Conversely, novice actors express concerns about a broader range of technical limitations, including fire performance, durability, and structural properties. This divergence suggests that hands-on experience often mitigates perceived technical barriers, transforming them from obstacles into manageable challenges.

The data also reveals that experienced actors place higher value on external timber expertise in early design stages, while novices prioritize increased prefabrication to decrease risks. Similarly, low impact site management and construction speed become a more significant driver with increasing experience. Novices focus on the environmental aspects and rank forestry support to improve local infrastructure and reduced support for dominant technologies and building materials higher than experienced actors.

The findings in this study strongly support the hypothesis that lack of knowledge imposes additional challenges to mass timber implementation, attested by the differing perceptions of technical barriers between experienced and novice actors.

### *4.4. Actor's roles and Actor-Network Cognitive Map*

The Actor-network cognitive map (Figure 3) reveals diverse motivations and concerns across stakeholders based upon the survey. Blue lines connect actors with their perceived barriers, while drivers are shown in brown. Thicker lines and bigger dots indicate more frequent and significant records. The colour of the factor dots reflects their overall positive or negative influence.

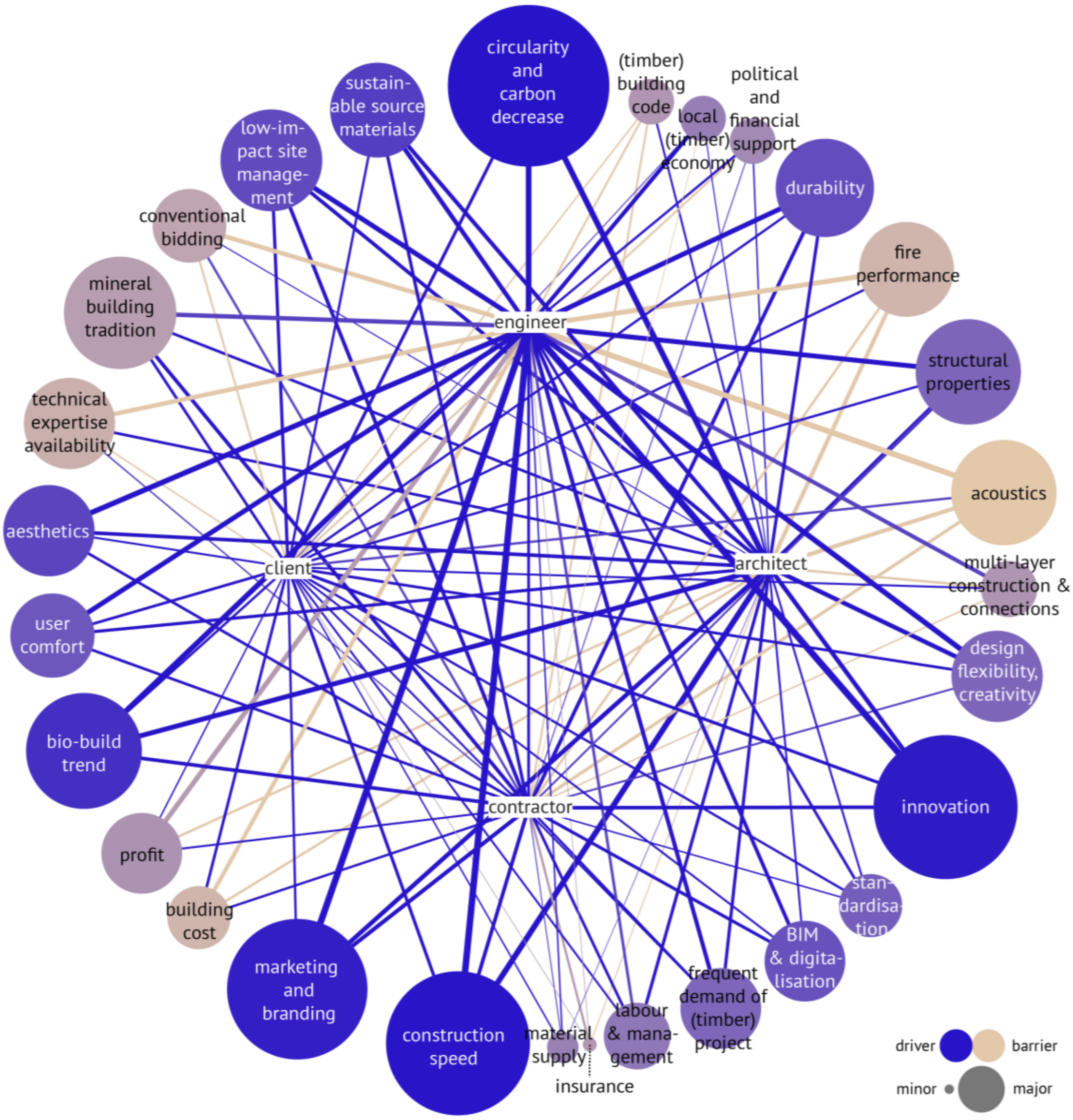


**Figure 3.** Belgian Timber construction Actor-Network's Cognitive Map. The bigger the dot, the stronger the factor, and the bluer the dot, the more unanimously positive as a driver.

Actor roles significantly influenced perceptions of drivers and barriers. Contractors and clients viewed company profit as a driver, while architects and engineers considered it a barrier. Conventional bidding was seen as neutral by architects but as a barrier by clients, contractors, and engineers. Circularity and carbon decrease were major drivers for clients and architects but less significant for engineers and contractors. Building cost perceptions also varied, with contractors viewing it more positively than engineers.

Perceived as the most influential actors for material choice in the construction industry (17), architects, structural engineers and developers can be considered true enablers for a shift towards a larger timber construction industry. Focusing on external expertise and alternative collaboration forms, the pitfalls of financial risks can be avoided through active partnership.

Moreover, although the architects report a limited developer interest, contractors and developers often claim a lack of experienced designers, showing misalignment between those two groups. Most stakeholders see this limited awareness of new timber technologies as the main drawback for multistorey timber construction. Therefore, education along with a professional environment openly supporting interdisciplinary exchange, could increase the use of structural timber.

Since both the architect and the manufacturer are driven by innovation, their collaboration may be much more fruitful. If the policy maker could stimulate a more active contribution of the designers to engineered wood products and open interdisciplinary communication, the aligned interests in innovation, sustainability and local economic development of these three actors may form new opportunities. This tool identified opportunities for innovation and network building, emphasizing the potential for collaboration.

*4.5. Bridging the Gap: Strategies for Overcoming Barriers*

To address the perceived barriers and leverage the recognized drivers, several strategies emerge from the survey and focus groups:

- Education: Implementing comprehensive education programs (both university level and vocational training) and facilitating knowledge transfer between experienced and novice actors can help expose environmental uncertainties and perceived technical challenges.
- Policy Support: Developing rules and certificates for low-impact materials can provide a regulatory framework that encourages the adoption of timber in mid-rise construction.
- Research and Development: Promoting timber-focused R&D can address persistent technical challenges, such as acoustics, and drive innovation in the sector.
- Open-Access Information: Creating platforms for sharing timber construction best practices, building lifecycle cost and technical data can democratize knowledge and support informed decision-making across experience levels.
- Collaboration: Encouraging transdisciplinary cooperation, particularly between architects, manufacturers, and policy makers, can foster innovation.

A clear and grounded message on sustainable forest management, lifecycle assessment and timber circularity could help the novices to convince their peers to choose for structural timber, but ambivalent sentiments exist. Uninformed focus groups participants vowed for an association for timber construction which lobbies, informs and connects likeminded professionals. The dispersed education and dissemination efforts of industry representatives and wood organisations in Belgium, such as Confédération Belge du Bois, hout info bois, Ligne Bois and Fedustria, might contribute to a more limited reach. This difference in strategy preference further underscores the impact of education on timber construction.

The survey results demonstrate that while perceived barriers can indeed be mitigated through education and experience, some challenges, such as acoustics, persist even among experienced actors. The findings underscore the importance of targeted educational initiatives, policy support, and industry collaboration in overcoming both perceived and real barriers to mid-rise timber construction.

## 5. Conclusion

This study revealed critical insights into the perceived and experienced barriers to multistorey timber construction (MTC) in Belgium. While a universal recognition of sustainability benefits exists among construction professionals, the study confirms that the nature and perceived severity of these barriers vary significantly based on experience levels. Novices, often deterred by concerns regarding costs, fire safety, and a perceived lack of technical expertise, contrasted with experienced professionals, especially those beyond contractors, who prioritized profitability and regulatory clarity.

These findings underscore the need for targeted strategies to promote MTC adoption. This study recommends: 1) Developing and disseminating educational programs specifically tailored to address the knowledge gaps identified among novice professionals, focusing on cost-effective design solutions, fire safety performance, and available technical support. 2) Implementing policy changes that streamline building codes and provide clear guidance on timber construction regulations, thereby reducing uncertainty for developers and investors. 3) Fostering collaboration and knowledge sharing between experienced and less-experienced professionals through industry workshops, mentorship programs, and open-source platforms. 4) Investigating financial incentives and risk mitigation strategies to improve perceived profitability among experienced professionals, particularly non-contractors.

Ultimately, realizing the potential of MTC in Belgium requires a multi-faceted approach that addresses both the practical challenges and the underlying perceptions that impede its adoption. By acting on these recommendations, policymakers, industry leaders, and educators can collectively create a more supportive and enabling environment for timber construction, fostering innovation, reducing carbon emissions, and building a more environmentally responsible future. Future research should focus on comparative analyses across different regions and in-depth investigations into the effectiveness of various intervention strategies.

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