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SUSTAINABILITY IN THE BRAZILIAN TIMBER HOUSING VIRTUAL MARKET

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SUSTENTABILIDAD EN EL MERCADO VIRTUAL BRASILEÑO DE LAS VIVIENDAS DE MADERA PROCESADA

SUSTENTABILIDADE NO MERCADO VIRTUAL BRASILEIRO DE CASAS DE MADEIRA

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RESUMEN

Las viviendas de madera procesada son sustentables y basadas en biorecursos, siendo una alternativa a la construcción tradicional de albañilería y acero y estudios recuentes han demostrado que este sector, en Brasil, cuenta con cientos de pequeñas y medianas empresas dedicadas a este tipo de vivienda. Este estudio exploratorio, a la vez que analizó esta población, evaluó los perfiles disponibles en Instagram®, observando sus estrategias de negocio y lo que revelan a sus clientes sobre los beneficios en cuando a sustentabilidad y asuntos relacionados a esta. Todos los perfiles corporativos disponibles fueron estudiados y se compiló una muestra significativa de alrededor del 80% de un sector, desde un mercado actualmente compuesto por más de 400 empresas. Sin embargo, alrededor del 70% de estas empresas brasileñas aún no exploran adecuadamente los temas de sustentabilidad de sus productos y servicios de viviendas de madera, lo que evidencia un escenario incipiente. Además, existe una clara oportunidad para aprovecharse de los argumentos publicados en sus perfiles de Instagram® como una estrategia de concientización afirmativa. Aunque se sugirieron algunas justificaciones para convencer a los clientes nacionales para considerar las viviendas de madera, este mercado virtual puede mejorar sustantivamente.

Palabras clave
industria de la construcción, estructuras de madera, estudios de mercado, sustentabilidad

ABSTRACT

Timber housing is a sustainable bioresource-based alternative to traditional construction with masonry and steel, and recent studies have shown that this sector in Brazil has hundreds of timber housing SMEs. This exploratory study, while analyzing this population, evaluated the profiles available on Instagram®, observing their business strategies and what they have disclosed to clients on sustainability benefits and issues. All the available corporate profiles were surveyed, and a significant sample of about 80% of a sector was compiled, from a market currently formed by over 400 companies. However, about 70% of these Brazilian companies still do not adequately explore sustainability issues in their timber housing products and service, evidencing an incipient scenario. Moreover, there is a clear opportunity to leverage the arguments posted on their Instagram® profiles as an affirmative awareness strategy. Although some justifications were suggested to convince domestic customers to consider timber housing, this virtual market has a lot of room for improvement.

Keywords
construction industry, wood structures, market studies, sustainability

RESUMO

As casas de madeira são uma alternativa sustentável e baseada em biorrecursos à construção tradicional com alvenaria e aço. Estudos recentes mostram que esse setor no Brasil é representado por centenas de PMEs focadas em casas de madeira. Este estudo exploratório analisou essa população por meio de uma avaliação dos perfis disponíveis na rede social Instagram®, observando suas estratégias de negócios e o que divulgavam aos clientes sobre benefícios e questões relativas à sustentabilidade. Todos os perfis corporativos disponíveis foram pesquisados e uma amostra significativa de cerca de 80% do setor foi compilada, em um mercado atualmente formado por mais de 400 empresas. No entanto, cerca de 70% dessas empresas brasileiras ainda não exploram adequadamente as questões da sustentabilidade em seus produtos e serviços de habitação de madeira, evidenciando um cenário incipiente. Além disso, existe uma clara oportunidade para aproveitar os argumentos publicados em seus perfis do Instagram® como uma estratégia afirmativa de conscientização. Embora algumas justificativas tenham sido sugeridas para convencer os clientes domésticos a considerarem a habitação de madeira, ainda resta muito espaço para melhorias nesse mercado virtual.

Palavras-chave
setor da construção, estruturas de madeira, estudos de mercado, sustentabilidade

INTRODUCTION

As many around the world wonder about the few rationalized solutions there are in the market and search for new sustainable responses, a wholesome way has favored the development of contributions to promote environmentally friendly alternatives.

In this context, wood could be used in greener products to provide a sustainable lifestyle. For example, Maldonado et al. (2020) suggested that wood could boost job and wealth development for micro and small-sized businesses. The advantages of timber used in construction have also been widely shown in research, for example, lower energy consumption for production and lower carbon emissions of timber buildings compared to masonry ones, as verified by Gustavsson and Sathre (2006) and Oliver et al. (2014), more efficient use of resources in the sustainability context for wood against masonry as studied by Svajlenka and Kozlovská (2018), the heating efficiency of timber houses as measured by Svajlenka and Kozlovská (2020a), wood solutions as lower carbon options in the life cycle as stated by Hart and Pomponi (2020), multiple uses of forestry species and wood products and efficient carbon fixation in different wood-based construction techniques as identified by De Araujo et al. (2020b), and other contributions. However, Heräjärvi (2019) suggests that marketing on timber construction can be fallacious when, specifically, it is described as an effective tool to mitigate climate change since the effects of replacing traditional resources multiply the outcomes for physical carbon stocks. Heilmayr et al. (2020) warn that the misuse of forestry subsidies undermines increased carbon storage and biodiversity objectives. Thus, policies should address the protection of natural forests aligned with plantations, which are weakened when popular solutions are still based on non-renewable sources such as minerals.

Hence, wood is the only widely used building material that can be regarded as a genuinely sustainable solution (Ramage et al., 2017) for timber products (De Araujo et al., 2022b). As experts have confirmed, this vision coincides with evidence that this bioresource offers superior credentials to other construction materials (Wang et al., 2014), where timber buildings could ensure a brighter future with lower liabilities (Heräjärvi, 2019).

Except for some Northern Hemisphere nations, the timber housing model is at an incipient stage. However, this solution is still latent in the rest of the world, specifically if compared to masonry. Even so, numerous countries are looking to add timber housing as a modern construction solution. In these territories, which are more closely connected to a spontaneous movement towards a consumption transition, the timber industry could become a real protagonist due to its processing with higher levels of prefabrication, utilization of renewable resources, and rationality of production inputs as well as lower environmental pollution. The advantages of low carbon emissions from the wood sector identified by Fujii and Managi (2013) and from sustainable timber construction made in industrial plants analyzed by Svajlenka and Kozlovská (2020b) add to this perspective. Fujii and Managi (2013) confirmed that the wood industry, especially for products and construction, is greener than the food, tobacco, petrochemical, mining, metallurgical, and transport sectors.

Even without a government plan to effectively promote timber housing and its industry, Brazil is ahead of many nations. For example, Brazil currently has multiple forest resources available (IBÁ, 2020; Rabelo et al., 2020), uses numerous native and exotic species in wood construction (De Araujo et al., 2021a), has dozens of large industrial parks for a domestic sector formed by hundreds of compact-sized timber house developers located in different states (De Araujo et al., 2021b), has both domestic and foreign markets for timber houses (De Araujo et al., 2020a) and among these, markets that are receptive to certified goods from sustainable practices (Lima, 2017; Meijueiro et al., 2020; Ribeiro, 2020). Despite the positive factors, illegal deforestation remains a domestic problem, as confirmed by Leite-Filho et al. (2021). There is also an apparent lack of incentives to use sustainably certified wood, as cited by Romero et al. (2015) and De Araujo et al. (2021a). However, there are few standard studies on the timber housing market and only from the last two decades, for example, Wahl (2008), Morgado and Pedro (2011), Wherry and Buehlmann (2014), Hurmekoski et al. (2015), Moore (2015), Egan Consulting (2017), Koppelhuber et al. (2017), Shigue (2018), De Araujo et al. (2020a), Ahmed (2021), MBIE (2021), and Garay-Moena et al. (2022). Unfortunately, these contributions fail to address contemporary topics such as virtual spaces and platforms, used to disseminate socioeconomic and environmental aspects. Though, in one recent study by De Araujo et al. (2022a) which addressed the electronic timber house market, the companies surveyed shared basic graphic and textual information. However, e-commerce could not be confirmed due to a lack of product pricing.

The purpose of this sectorial study prioritized research into the business strategy and disclosure to customers regarding sustainability approaches in the context of timber houses produced and/or marketed by companies specialized in timber construction in Brazil. Using the Instagram® profiles of each domestic developer, a sectorial scenario was analyzed to verify flaws through a lack of limitations of the sustainable contents on timber housing in the corporate profile of the companies sampled. Affirmative suggestions were proposed to include, improve, and reinforce content using arguments based on literature and authors' opinions to

endorse and complement the possible strategies for the Brazilian timber housing sector.

METHODOLOGY

Due to restrictive impositions caused by the Covid-19 pandemic ravaging the world, traditional scientific studies and commercial activities are suffering repeated setbacks imposed by the global crises. As a result, virtual activities have intensified, becoming an excellent resource to research innovation. In the context of timber houses, virtual methods have been efficiently used by De Araujo et al. (2019), De Araujo et al. (2021a), and De Araujo et al. (2021b). Given this scenario, sustainability in corporate profiles of Brazilian timber housing producers and dealers virtually available on Instagram® was investigated. As Instagram® is used for trading goods, the goal was to evaluate active profiles.

This exploratory study started by identifying companies using the search terms shown in Table 1 (with plural versions). The search was made using Brazilian Portuguese terms in the Instagram® platform's search engine. The lead researcher's knowledge of the Brazilian timber construction sector, from previous scientific studies on this topic, was vital for this process. The search concluded when no unprecedented profile was found in the search engine results for individualized inquiries. In this process, every repeated profile was disregarded. In addition, after a detailed investigation of the content and posts in each profile, those companies outside the studied topic were discarded as having goals that fell outside the scope of this study. These included the rental of timber houses for vacations, timber-built hotels, as well as wood product enthusiasts and fans, and construction specialists who used other non-wood-based materials.

The method was based on a similar replication and update of the e-commerce and virtual sales research of De Araujo et al. (2022a). The lead researcher confirmed the absence of some companies in the new profile listing. These missing profiles were individually prospected by their corporate names, as a previous list led by De Araujo et al. (2021b) did not disclose information or identify the Instagram® profiles. Some profiles not previously prospected were found based on new searches using their names, which allowed listing their new profiles. Several companies on the previous list were not found on Instagram®, which suggested that they did not have a profile on this network.

In practice, the term-based searches returned random results. After three months, the list of profiles was rechecked using signs of activities and posted content to confirm all the companies were operational. After this validation, profiles, and information were noted in a database built using Microsoft Excel 2010.

Table 1: Search terms used in the company identification and respective English term. Source: Prepared and translated by the Authors.

Search term in Brazilian Portuguese	Search term translated into English
Habitação em madeira	Timber housing
Casa de madeira	Timber house
Construção em madeira	Timber construction
Casa pré-fabricada em madeira	Prefabricated timber house
Construção sustentável em madeira	Sustainable timber building
Construção verde em madeira	Green timber building
Madeira pré-fabricada	Prefabricated timber
Kit pré-fabricado	Prefabricated kit
Construção seca em madeira	Dry timber construction
Construção modular	Modular construction
Casa modular	Modular house
Madeira lamelada colada cruzada	Cross-laminated timber
Casa de toras	Log-home
Enxaimel	Half-timbered frame
Tábua e mata-junta	Clapboard and wainscot
Casa náutica	Nautical house
Chalé	Chalet (A-frame)

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Table 2: Issues and aspects under evaluation in this exploratory sectoral survey. Source: Prepared by the authors

Issue	Justification	Alternative
Issue 1: investigate the existence of posts on sustainability	Understand whether companies are using sustainability topics for products and services	Yes; No
Issue 2: investigate types of subjects contained in the posts with direct relation to sustainability and their main arguments	Understand all arguments used in the contents posted about sustainability related to their goods and services	Sustainable product; Certifications and seals; Environmental awareness; Greater cleaning and lower waste generation; Greater carbon fixation in wooden materials; Lower carbon emissions from production; Greater production and time efficiency; Ecological and renewable materials

Table 3: Sector and sampling populations obtained in this exploratory sectoral survey. Source: De Araujo et al. (2022a).

Company Population	Unitary Volume (Companies)	Sector Percentage (%)	Margin of Error (%)
Overall sector	402	100	–
Without profiles	87	22	–
With profiles	315	78	–
Sampling	315	78	2.57%

The second stage involved the compilation of profiles to form the regular listing, enabling effective sampling. All the profiles were evaluated to obtain a significant sampling. Then, the margin of error was calculated considering the sector's total population, which included companies with corporate profiles on Instagram® and without any profile on this social network. Statistical software developed by Raosoft (2004) was used, as well as its prescriptions of 50% response distribution and 95% confidence level. Alongside this method, both the total population and sampled population were input to verify the margin of error for this study.

The third stage was marked by the definition, justification, and evaluation of the issues presented in Table 2, both to identify the presence of sustainability and to define issues about this topic in the posts available in each corporate profile. It was possible to analyze the panorama in this context under evaluation. While the first issue was dichotomous and was based on the absence/presence of posts on sustainability, the second considered multiple responses with one or more different contents addressed in these posts (Table 2). As a result of the different contents, for issue 1 the quantification of alternatives was binary with the presence or absence of each alternative studied per issue. Whereas for issue 2, the number of arguments about sustainability posted by each corporate profile was counted to identify the frequency of contents used to emphasize the sustainable vocations of disclosed products and services. Regarding the approaches related to the second issue, analyses were made to reveal affirmative paths to explore each studied alternative. The final part proposed affirmative strategies for electronic commerce through Instagram® and clarified topics to customers on the potential of timber houses in the context of sustainability.

RESULTS AND DISCUSSION

In mid-2020, De Araujo et al. (2021b) reported a Brazilian sector formed by 378 companies dedicated explicitly to timber housing production and its market. At the end of 2020, this sectorial listing needed updating as the severe pandemic had devastated all global economies and many negative scenarios had been confirmed, for example by Bartik et al. (2020), Chen et al. (2021), Egger et al. (2021), Iqbal et al. (2021), Verschuur et al. (2021), and others. Due to the challenging moment, the companies operating had been expected to have fallen by the end of 2021. However, this update confirmed a 6.35% increase in the sectoral volume (Table 3).

Through systematized searches using the Instagram® search engine, 301 profiles of timber housing companies were found using the terms listed in Table 1. These

profiles included 14 new companies apart from the previously listed 378 companies. Ten new companies were potentially retrieved during the analyses, although none of these names and location points was hyperlinked to any active Instagram® profile. Thus, with these 24 additional companies, the sectorial population increased from 378 to 402 in 2022. As only 301 companies were identified among those 378 companies in the previous listing, the names of the other 77 companies not found by term-based searches were also inserted in the Instagram® search engine. Using this alternative search, a further 14 previously absent profiles were identified, expanding the current listing to 315 companies with profiles.

After this was done, all the companies were ranked according to the availability/unavailability of their profiles on Instagram®. The ranking discarded companies without any active official profile, as it is impossible to analyze something that does not exist. The sectorial survey targeted the available profiles; obtaining a margin of error for the national sector – which also included companies of the sector without available profiles (Table 3).

From the sectoral survey (Table 3), the sampling considered a significant fraction of nearly 4/5 of the Brazilian timber housing sector. This represented 100% of the timber housing producers and dealers with corporate profiles on Instagram®.

This sampling showed a high representation of this studied sector (Table 3). Using the standard prescription of ± 2.5% for an ideal level, following Pinheiro et al. (2011), the sample coincides with their statistical recommendation since the margin of error obtained in this study was about ± 1.28% (or 2.57%) as confirmed in Table 3; which provides a highly reliable analysis both for the population with corporate profiles and the entire sector – including those companies without profiles on this virtual platform.

The initial query was asked about the presence of sustainability topics on Instagram® posts on those profiles of the Brazilian timber housing sector (Table 2). From the representative sampling (Table 3), higher results prove the low exploration of sustainability topics in the virtual space by those companies dedicated to timber housing production and market in Brazil (Figure 1).

The presence of posts about the sustainability levels of products and services in the sampled companies reflects a behavior already produced by a group of corporations that are seeking to clarify and makes potential customers aware of the advantages and features of timber housing as a more ecological constructive option. However, a significant number of the profiles still have not made any posts about the sustainable aspects of timber housing products and services (Figure 1). The results highlight potential sustainability topics to be studied. In addition to environmental conservation and protection, Rattner (1999) cited that sustainability requires economic

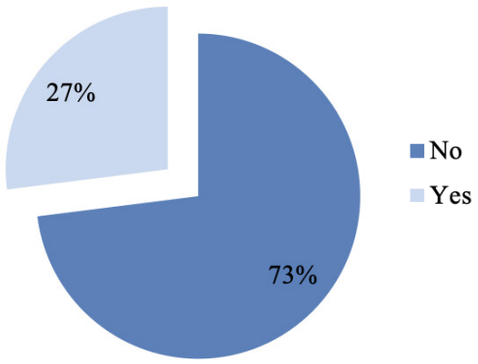

Figure 1: Presence of posts about sustainability on the corporate profiles (n = 315). Source: Preparation by the Authors.

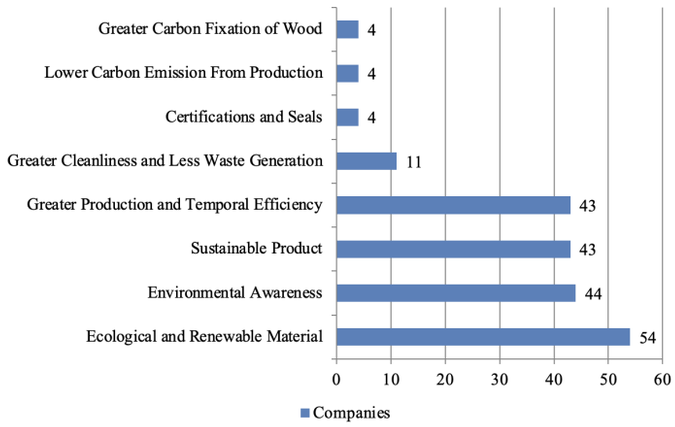

Figure 2: Types of topics approached in the contents posted on sustainability (n = 315). Source: Preparation by the authors.

efficiency, political democracy, social equity, and cultural diversity. This vision forms the precepts of environmental-social-corporate governance. In this sense, Brazilian companies still need to value the potential of their solutions and, if necessary, adapt their activities to ensure more sustainable timber houses.

From the corporate profiles classified positively in the first issue about sustainability (Table 2), the second issue identified all the themes found in the available posts. According to Figure 2, eight sustainability issues were identified in the posts published by the sampled companies, although other correlated issues were not confirmed.

'Ecological and renewable material' was the argument used most by over 17% of the sampled population to emphasize sustainable purposes of products and services related to timber houses (Figure 2). It is expected that this argument will be used more by this sector in the future since silvicultural-based materials are among the most requested resources – both by Brazilian forestry industries, as cited by IBÁ (2020), and by more than three-

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Table 4: Corporate analysis by number of sustainability arguments (n = 315). Source: Preparation by the authors

	Arguments							
Quantity	1	2	3	4	5	6	7	8
Companies	25	24	22	7	4	1	2	0

quarters of the timber housing sector, according to the scenario verified by De Araujo et al. (2021a). In addition, Ramage et al. (2017) suggested that coniferous wood represents an attractive choice for efficiently sustainable buildings. Practically 14% of profiles published posts, looking to develop 'environmental awareness' among their customers (Figure 2). They included clarification on the consumption of wood from a legal origin, of native wood from forest management, of wood from legal silviculture, silviculture far from protected native areas, preservation of biomes and ecosystems, dangers of forest fires, and the production of non-timber forest products from company produced/managed forests.

To emphasize a vital production aspect for clients, 'greater production and temporal efficiency' was confirmed in more than 13% of the samples (Figure 2). The arguments to be explored on this topic are considerable – because rapid production is a positive production attribute of timber construction, as cited by De Araujo et al. (2016) as the conclusion time in civil construction is strictly related to higher costs and delays in conclusion as evaluated by Singh (2010), Larsen et al. (2016), Senouci et al. (2016), Bauer et al. (2017), Chandragiri et al. (2021), and others.

Equal participation was noted for companies that stated that they sold a 'sustainable product' (Figure 2). Despite this, there is still a demand for greater awareness by developers of the environmental benefits of their products. The clarification may consider arguments from De Araujo et al. (2016), Ramage et al. (2017), Heräjärvi (2019), Svajlenka and Kozlovská (2020b), and other studies.

Over 3% of the sampled public already uses 'greater cleanliness and less waste generation' in their products and services as a sustainable justification. This item agrees with the studies of Yazdi et al. (2014), which suggest that material manufacturers are changing their concerns to produce materials from renewable resources considering the increased use of waste streams and, consequently, a lower waste generation. Thus, governments together with industries can develop markets for manufactured goods with fewer wood and lignocellulosic by-products while eliminating incentives for sectors fueled by wood-burning (Pomponi et al., 2020).

Individually, about 1% of the sample highlights 'greater carbon fixation of wood', 'lower carbon emission from production', and 'certifications and seals' for other opportune arguments for greater sustainability of their products and services in Brazil. These arguments may be better explored due to the numerous advantages of wood-based resources. For example, Burnard et al. (2017) mentioned that resources from solid wood with lower processing levels (*e.g.* lumber and machined wood) are more natural than other contemporary solutions with higher manufacturing levels (*e.g.* engineered beams and composite boards); while the use of resins and chemical additives in the production of engineered wood products makes these glued solutions less sustainable compared to products based on solid wood. In the same vein, Yazdi et al. (2014) cited that a healthy building must have zero embodied energy to minimize the environmental impacts of carbon emissions and, therefore, to satisfactorily meet sustainability principles.

Considering the analysis of the types of arguments used by the companies in their posts on corporate profiles (Figure 2), there was a quantification of the number of sampled companies according to the number of arguments shared in their posts. 85 companies declared one or more arguments about the sustainability of their products and services (Figure 1). Many of this population used few arguments to clients (Table 4), for example, 29% with one argument, 28% with two arguments, and 26% with three arguments. Sequentially, 8% of the companies showed four arguments, 5% had five arguments, 1% had six arguments, and 2% had seven arguments.

There is a good opportunity to be explored by this sector by using more arguments to provide clients with clarification regarding the potential and advantage of their products and services (Table 4), both from those topics listed in Figure 2 and other absent arguments. This strategy should be clear and assertive since Wang et al. (2014) verified that end users, usually unfamiliar with wood products, have shown visible preconceptions regarding wood used for construction.

Strategically, Viholainen et al. (2021) suggested the need for a fine approach to the business ecosystem to offer a mindset reversion to develop a sustainability-oriented logic in line with profitable businesses and value creation for clients for construction. Companies may consider the sustainability indicators proposed by Garay et al. (2021) as the right strategy to emphasize timber houses under sustainable descriptions.

The authors of this study suggest further arguments to support an effective promotion and specification of sustainable features of timber houses:

- Lower embodied energy and carbon of timber-based products compared to mineral products, as exemplified by Hammond and Jones (2008) and Oliver et al. (2014);
- Efficient energy consumption from production to wood processing, especially from using low-power machines, as verified by Wargula et al. (2022);
- Multiple wood-based products and diversified wood species suitable as construction inputs, as listed by De Araujo et al. (2020b) and De Araujo et al. (2021a);
- Virtually zero water consumption in timber-based buildings, as cited by De Araujo et al. (2016);
- Lower internal heating to maintain thermal comfort for users, as determined by Svajlenka and Kozlovská (2020a);
- Clean building sites with efficient assembly, as mentioned by De Araujo et al. (2016);
- Easier revitalization, as argued by Ivanov (2005) and Domljan and Jankovic (2022);
- Combination with other materials, achieving good performance and representing a modern action as verified by Harris and Socratous (2013) and Høibø et al. (2015);
- Lower waste generation from periodic maintenance and retrofit procedures, as wood requires periodic maintenance for a long service life as recommended by Highley and Scheffer (1989) and Pearson et al. (2012);
- And as suggestions for more appropriate disposal of construction materials at the end of the service life of timber buildings, the authors also propose the possible reuses of:
  - ¤ Chemically treated timber in sleepers, decks, and fences;
  - ¤ Untreated timber in crafts, furniture, and gardening items.

CONCLUSION

The assessment of timber housing producers and dealers with corporate profiles on Instagram® confirmed their significant participation on this social platform in Brazil. On the other hand, a low margin of error was ensured by comprehensive data collection.

This significant sample revealed an unexpected fact, as there is a well-marked perception that numerous companies still undervalue the sustainability arguments of their products and services. This statement is supported by the limited number of posts about the benefits and characteristics of timber construction, using few arguments in their publications. There is a highly favorable environment and by outlining these arguments fully and intensively, new consumers can be attracted and enlightened about the benefits of timber solutions compared to traditional masonry and steel buildings.

To strengthen the list of justifications identified, further arguments could be raised to convince and attract new clients for timber housing. It is expected that the visibility and commerce of timber construction solutions will be boosted in the Brazilian virtual markets when further clarification and the promotion of sustainable dwellings are implemented.

The replication of this virtual methodology to other territories would allow representative observations through low-cost demands since this survey is suitable to analyze sectors – both nationally and regionally – through a proactive strategy to understand and promote virtual markets for sustainable-oriented products.

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