Journal of Cleaner Production 294 (2021) 126324

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Timber for future? Attitudes towards timber construction by young millennials in Austria - Marketing implications from a representative study

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ARTICLE INFO

Article history:
Received 10 July 2020
Received in revised form
18 December 2020
Accepted 7 February 2021
Available online 15 February 2021

Handling editor: Dr Sandra Caeiro

Keywords:
Timber construction
Wood building
Attitudes
Perception
Millennials
Generation Y
Bioeconomy
Climate change
Market segmentation
Sustainable building
CLT
Cross-laminated timber
Mass timber
Cluster analysis

ABSTRACT

As the mitigation of climate change becomes critical, the public perception of wood as a sustainable building material that can facilitate the shift towards a bio-based economy is crucial to consider. This study aimed to explore the attitudes towards timber construction among young millennials in Austria, a cohort that in the coming years will increasingly occupy decision-making positions and gain purchasing power. A representative online survey (quota sample, n = 757) was conducted to explore the attitudes of 20 to 29-year-olds towards timber construction and the forest-based sector. In general, timber construction was described positively in comparison to other construction methods, in particular, it was considered aesthetically appealing and ecologically advantageous. Indecisiveness prevailed regarding the role of wood in climate change mitigation. The industry's current approach to advertising does not attract much attention. Doubts were expressed about the sustainability of sourcing wood as a building material and certain physical characteristics for building were perceived as a disadvantage. Four distinct market segments were then identified by means of exploratory factor analysis and a cluster analysis using *Timber Construction Affinity* and *Opinion Leadership Wood* as categorization factors. Two segments are essential for future marketing measures: *Passive Preservers* showed the most negative view of the industry, its practices and its offerings, while *Active Supporters* were in favor of increased wood use and actively promoted timber constructions among peers. Subsequently, marketing implications were given to develop "preserving" into "supporting" clusters and to further involve *Active Supporters* in the communication of wood and timber construction related topics.

1. Introduction

Climate change is arguably the most significant challenge facing humanity in the 21st century (IPCC 2018). In the past two decades, it has become a topic of major public interest in general (Capstick et al., 2015), but also a cause that especially younger generations are actively engaging in (Wahlström et al., 2019). Understanding popular opinion towards the forest-based sector as a producer of renewable energy and material resources is highly important given the need for profound changes associated with climate change mitigation and adaption. Although studies (Canadell and Raupach 2008; Gustavsson et al., 2018; Hepburn et al., 2019; Schulze et al., 2020) have shown that the sector has high potential for providing long-lasting climate benefits through active forest management and the efficient use of forest products, public opinion seems to be skeptical about its environmental impact (Fabra-Crespo and Rojas-Briales 2015; Rametsteiner et al., 2009; Ranacher 2017). Timber construction specifically, which represents a rapidly growing market and shows significant potential as a way to use bio-based material on a large scale (Ramage et al., 2017), could provide long-term storage of carbon, substitute carbon-intensive mineral based materials and thereby significantly contribute to the mitigation of climate change (Churkina et al., 2020).

Research however, has yet to explore the perception of timber construction among younger generations. Studies examining the general communication of the forest-based sector in Europe

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https://doi.org/10.1016/j.jclepro.2021.126324

recommend more targeted and interactive forms of stakeholder communication (Lähtinen et al., 2017). Additionally, they recommend that the younger public should be addressed specifically (Fabra-Crespo and Rojas-Briales 2015; Rametsteiner 2009) as they represent the decision-makers, homebuilders and customers of tomorrow. Furthermore, studies have shown, that misconceptions concerning poor value stability, deficient longevity and robustness as well as combustibility of wood, are weaknesses that burdened the industry (Gold and Rubik 2009). With the advent and widespread use of modern mass timber construction methods and products in the past 25 years in Austria (such as Cross-Laminated Timber (CLT), Glue-Laminated Timber (GLT) and other Engineered Wood Products (EWP)), which represent a structurally new form of building with wood and have been called “disruptive technologies” (Kremer and Symmons 2016), it stands to be tested if those beliefs will continue to prevail. Austria’s development has the potential to be influential for other markets as well, since it not only is a country with a long-standing tradition of working with wood, but it is also considered innovative and advanced in the fields of forestry, wood processing and timber construction. In Austria, designers, architects and policymakers are eager to employ the advantages of the forest-based sector. Thus, there is a need to understand the attitudes and perception of the younger generation towards timber construction, so that future communication measures can be tailored appropriately. Against this background, this paper aimed to provide an up-to-date understanding of the young Millennial group’s relevant perceptions and attitudes, so that marketing implications for timber construction could be outlined. An exploratory approach was considered an appropriate method to explore the topic without a priori hypotheses. The research questions were:

(1) How do 20- to 29-year-old millennials in Austria perceive timber construction in general?
(2) How can the target group be divided into segments and how can those segments be categorized based on the attitudes toward timber construction and the forest-based sector?

The rest of this article is organized as follows: Chapter 2 explains the background of the role of wood in sustainable construction, why young millennials are a relevant target group and how wood as a building material is generally perceived. Chapter 3 describes the methods used to segment and analyze the study sample and the obtained results are presented in chapter 4. The paper concludes with a discussion of the results, marketing implications for the timber construction industry and the forest-based sector as well as topics for future research.

2. Theoretical background

2.1. The role of wood in sustainable construction

In 2019, the Austria Federal Government developed its Bioeconomy-Strategy as a cornerstone of the country’s energy and climate policies to advance the substitution of finite, fossil fuels and materials with renewable, domestic, bio-based resources in order to transition to a decarbonized economic system (BMNT 2019). An essential pillar of the strategy is the sustainable use of domestic forest resources (cf. BMNT 2019). As part of the natural carbon cycle, the use of wood plays a central role in the sequestering and storage of the most important greenhouse gas - carbon dioxide. Sustainably managed forests produce timber and serve as carbon sinks and can sequester more carbon dioxide from the atmosphere than forests, where no wood harvest takes place (Gustavsson et al., 2018). In addition, the use of wood contributes to emission avoidance through the substitution of products that are energy-intense in their production, use or disposal, through the cascading use of wood over time, the energy-efficient processing of the material as well as serving as a carbon-neutral energy source at the end of its service life (BMNT 2019; Geng et al., 2017).

From an ecological perspective, the use of wood as a construction material is considered especially beneficial due to its long product life compared to other wood products (e.g. paper or pallets). Conservative estimates predict a lifespan of 80–100 years for wood products in buildings which allows for a long-term carbon conservation effect (Lippke et al., 2011). Furthermore, timber construction is sometimes referred to as a "second forest" because of the higher volume of material used and the possibility to reuse or recycle the building components after the first product life cycle (Teischinger and Buksnovitz 2014). CLT especially has improved the competitiveness of wood compared to other construction methods, not only in ecological terms and with its inherent structural qualities and improved building physics, while also allowing for a new approach in the design of residential, commercial and industrial buildings. Despite the economic downturn, CLT production has grown at an average rate of 15% since 2007 and is expected to grow further in double digits in the coming years (Manninen 2014). 60% of the global production stems from Austria (Plackner 2015).

In the coming decades, the need for sustainable building will not only increase on a global scale due to population growth, urbanization and densification of cities (Seto et al., 2012), but also in Austria, where current forecasts estimate a population increase from 8.9 million to approx. 9.2 inhabitants million in 2030 (Statistik Austria 2015).

The share of timber construction in Austrian residential buildings (where at least 50% of load-bearing construction is made of wood or wood-based products) in relation to the total usable floor space rose from 10% in 1998 to 23% in 2018 (Teischinger et al., 2018). In order to ensure that timber construction continues this positive trajectory and becomes the construction method of choice, specific barriers must be overcome, one of them being the public perception of wood as a building material. Espinoza et al. (2016) showed that one of the biggest market barriers for civil engineers and researchers in timber construction, was the public misperception about wood and new technologies such as CLT. Likewise, Quesada-Pineda et al. (2018) see a continuing need to educate the general public about CLT as a construction material that performs equally or better than steel, brick and concrete systems.

2.2. Millennials as a decisive target group

Millennials represent an increasingly interesting target group because they will soon form a part of the economically strong middle class and represent around 2.3 million people in Austria, about one quarter of the total population (statista.at, 2019). Based on different sources which propose different time spans (US Census Bureau 2015; GfK 2019), millennials can be defined as people born between 1981 and 2000. In the coming years, this generation will increasingly assume decision-making and leadership positions, create their own households and gain purchasing power. Millennials influence their larger social circles, and therefore the purchasing behaviors and lifestyles of other generations as well (Forbes 2015). Several sources (Singal 2017; Lapidos 2015; Hoffower 2019) suggest that the millennial generation, which is based on a period of almost 20 years, can be divided according to psychographic characteristics into "young" (born in 1990 and later) and "older" (born before 1990) millennials. This study focuses on young millennials between the ages of 20 and 29. The average age at which Austrians purchase their first piece of real estate is 31 years (statista.at, 2012), which underlines the importance of raising awareness of timber construction within this market segment.

2.3. The perception of wood as a building material

Studies of the German market and other selected European countries (Gold and Rubik 2009; Wippel et al., 2017) have shown that timber construction is rated highly in terms of so-called "soft factors" such as well-being, aesthetics and eco-friendliness. However, people have doubts regarding its stability, modernity, durability, value stability, price, competitiveness, and fire resistance. The latter "hard factors" were also considered to be more decisive in the house-buying process. Furthermore, Wippel et al. (2017) showed that wood was considered an appropriate material for the construction of detached residential buildings or single-story commercial buildings, but less so for multi-story constructions. Lähtinen et al. (2019) provided similar findings, where high sympathy for wood as a building material did not equate to a willingness to live in multi-story wooden buildings.

In a focus group study, where the average participant age was 27 years old, the topic of multi-story timber construction was perceived positively in general. The participants especially considered health and ecological aspects as positive, but concerns were raised about fire resistance, durability, the potential for pest infestations, maintenance costs and little experience with this "not-yet-established" construction method. The origin of the raw material was important for the participants, as were other ecological aspects such as the building's CO_2 footprint (Ranacher et al., 2018). Similar findings from Toppinen et al. (2018) showed that younger people generally brought up sustainability-related concerns regarding multi-story timber constructions. These results indicate that wood as a building material is often considered together with the forest as its source, presumably more so than with other construction methods. Therefore, research examining the public perception of timber construction must take the perception of the whole value chain into account, starting with the forest. Here is where the difficulty of communicating the benefits of using forest resources to the public exists: the forest itself is a highly emotionalized and diverse concept; it provides several ecosystem services and functions, in addition to providing material. Recently, the pressure of finding the right balance between providing those services and functions has increased (Lähtinen and Myllyviita 2015) and has urged the forest-based sector to be more responsive to rising environmental and societal issues (Cohen et al., 2014). Especially in Austria, where 97% of the population see forests as a symbol of national identity (Rametsteiner et al., 2009), the sector has to deal with deeply rooted historical and cultural perceptions of forests.

Wippel et al. (2017) argue that the growing number of designated national parks, the increasing appeal of the concept of wilderness, and the success of books, which depict a romantic-emotionalized and even humanized view of trees (Wohlleben 2015) make it difficult to portray the use of forest resources and its effects positively. Furthermore, recent news about the destruction or poor condition of forest ecosystems (clear-cutting and fire-clearances in Brazil's tropical rainforests, forest fires in Australia, the discourse about Hambach forest and Dannenröder forest in Germany, bark beetle infestations in Austria) and their connection to climate change have been featured in mainstream media. This might have contributed to the public's rather critical view of the forest-based sector, especially among the younger generation of ecologically sensitized people, whose main concern is climate change and environmental protection (Deloitte 2020). Rametsteiner et al. (2009) state that the European public no longer sees the function of forests in isolation but connected on a global scale. This creates a communication challenge for the sector, as it needs to appropriately demonstrate that the sourcing of the raw material is a legitimate and necessary link between forests ecosystems and wood products. Additionally, the sector must clearly show that forest management practices in Austria differ fundamentally from ecologically highly destructive practices in other parts of the world. Earlier studies (Rametsteiner et al., 2009), as well as more recent studies (Lähtinen et al., 2019; Ranacher 2017), suggest that the public should not be considered a homogenous target group and that individual stakeholders need to be addressed more specifically and pro-actively. For example, Høibø et al. (2015) showed that urban housing made of wood is especially relevant for the younger public target group as they have strong environmental values and generally perceive wood as an eco-friendly material.

3. Methods

3.1. Sample and respondent characteristics

To reach a representative sample of young millennials in Austria an online survey was conducted in February 2020 with panel members of the international market research company Dynata (dynata.com). The total population size of people between 20 and 29 years of age in Austria was estimated to be 1.144.897 (statista.at, 2019). 757 panel members accurately representing the target group's ratio of women and men (48% male, 52% female) as well as the distribution across the nine different Austrian federal states completed the survey. To attain representativeness the survey participation was determined by quota sampling (Hair et al., 2006). The questionnaire consisted of three parts: (1) demo-/sociographics as well as environmental attitude and behavior, (2) the perception of the forest-based sector and timber construction and (3) media use. No background information on the topic was provided.

3.2. Two-step cluster analysis

A Two-step cluster analysis was applied to identify homogenous subgroups in the study population. This cluster analysis is an explorative interdependence analysis frequently used in market segmentation, where an inconsistent total market is subdivided into segments maximizing the in-group homogeneity and between-group heterogeneity (Hair et al., 2006). Other than hierarchical or k-means cluster analysis, two-step cluster analysis is able to handle large sample sizes, permits both categorical and continuous data to be analyzed simultaneously and it determines the number of clusters automatically (Tkaczynski et al., 2017), which supported the explorative character of this study.

3.2.1. Cluster factors

Based on expert interviews and discussions within the research team, the two factors *Opinion Leadership Wood* (OLW) and *Timber Construction Affinity* (TCA) were chosen as central variables determining possible clusters. The higher TCA, the more positive the perception of timber construction, the higher OLW, the more the respondents communicate about wood-related topics and can be regarded as opinion leaders in this field. Table 1 shows the composition of both these factors.

The term "opinion leaders" was coined by Lazarsfeld et al. (1944) and describes persons who show the greatest interest in a particular topic and express themselves most frequently about it. Through interpersonal communication they spread their views within their social network (in the physical and virtual world) and have a significant influence on the opinions of others and thus on the dissemination of trends (Kirchgeorg, 2018). Opinion leaders also are more open to innovation and act as early adopters (Chan and Misra 1990; Venkatraman 1989). In the context of this study

Table 1
Exploratory factor analysis and reliability tests for cluster factors (1) Opinion Leadership Wood and (2) Timber Construction Affinity.

Items	Factors		Reliability
	1	2	
	Opinion Leadership Wood (OLW)	Timber Construction Affinity (TCA)	Cronbachs Alpha (α)
In discussions about WPT I am able to tell others more than they tell me.	0.91		0.85
When it comes to WPT, I am often asked by friends and acquaintances for my opinion and advice.	0.86		
With friends I often talk about WPT.	0.85		
Building a house of wood is definitely NOT an option for me. (= reverse)		0.72	0.78
A house made of wood has a positive image.		0.70	
If I ever build a house, wood should be the building material.		0.69	
Houses made of wood compared to houses of other construction methods are:			
- cooler		0.68	
- more aesthetic		0.63	
- of higher quality		0.61	
- more climate-friendly		0.51	

Notes: Principal component extraction with Varimax rotation and Kaiser normalization; loadings below 0.5 are not shown, KMO 0.81, Bartlett Test p = 0.000***, Explained Variance 58.5%, Measurement: Five-point Likert scale (1 = 'strongly disagree' and 5 = 'strongly agree').

opinion leaders were expected to show the greatest interest in wood, wood products or timber construction (WPT) and express themselves most frequently about it. Based on Childers (1986) and Bearden and Netemeyer (1999) *Opinion Leadership Wood* (OLW) was captured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) with three items.

To determine an individual's attitude towards timber construction, the factor *Timber Construction Affinity* (TCA) was developed, consisting of seven items addressing (a) the general attitude towards a house made of wood as well as (b) the evaluation of specific characteristics of a wooden house, measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). These items were inspired by studies in the field of product design (Homburg et al., 2015), sustainability (Waage 2007), perception of wood and wood construction (Gold and Rubik 2009) as well as coolness (Ima et al., 2015). Since "coolness" has been the object of increased research within the last years showing its impact on the decision-making behavior of consumers (Warren and Campbell 2014; Mohiuddin et al., 2016; Warren et al., 2019), this concept was included.

With the help of an exploratory factor analysis (EFA) complexity could be reduced by merging several items into one factor. It had to be tested if the items of each dimension showed internal homogenity (i.e. correlation) and discriminated to each other (Hair et al., 2006). A principal component analysis with Varimax rotation and Kaiser normalization was conducted (Sarstedt and Mooi 2018). The analysis resulted in a two-factor solution exhibiting the factors OLW and TCA distinctly with an explained variance of 58.5%. To test the unidimensionality of a set of scale items the internal consistency was measured with Cronbach's Alpha, which is considered to be a measure of scale reliability, indicating how closely related a set of items are as a group (Cronbach 1951). There are several studies discussing the acceptable value of alpha. Cortina (1993) rates values above 0.7 as good, values between 0.6 and 0.7 can be seen as acceptable (Bagozzi and Yi 1988). The OLW-items showed a Cronbach's Alpha of 0.85, the TCA items of 0.78. Convergence validity was checked with applying an EFA for each dimension separately resulting in one-factor-solutions with explained variances exceeding 50% (Homburg and Giering 1996). Thus, the three OLW-items and seven TCA-items were merged into corresponding factors.

A two-step cluster analysis with OLW and TCA as continuous variables using Log-Likelihood distance measurement and Schwarz's Bayesian Criterion was conducted to identify latent segments (Georgii 2009). A four cluster solution was suggested showing best model fit and cluster quality in relation to silhouette measure for cohesion (similarity within clusters) and separation (differences between clusters). A value above 0.5 was obtained, which represented a "good" cluster quality (Kaufman and Rousseeuw 2005). All 757 cases could be assigned to one of the four clusters differing in size. One-way analysis of variance (ANOVA) showed a highly significant discrimination between the four segments. Bonferroni Post-Hoc-Tests revealed a highly significant discrimination of all four segments with each other.

3.2.2. Additional factors

To describe the four segments more accurately and assign appropriate names, different other assessments of attitudes, values and behaviors were analyzed (see Table 2 for an EFA giving an overview of factors and scales). All questions were answered on a 5-point Likert scale with 1 = strongly disagree, 5 strongly agree (exceptions are marked individually).

The attitude towards environmental responsibility of the participants in this study was measured with items based on the "Green Consumer Scale" (Haws et al., 2013), which were merged into the *Green Consumer Value* (GCV)" factor. To validate this factor and eliminate a possible "value-action gap, i.e. a difference between environmental attitude and behavior (Kollmuss and Agyeman 2002), three dichotomous no/yes-questions referring to the actual green behavior of the participant were asked. The answers were added to a score ranging from 0 = "no eco-action" to 3 = "high eco-action". Spearman's rank correlation showed a highly significant (p = 0.000) coefficient ρ (rho) with a medium strength of 0.35 (Corder and Foreman 2014) allowing to eliminate a distinct value-action-gap.

The focus of this study was on timber construction and the forest-based sector, thus more specific questions were asked to identify the participants different attitudes and behaviors in respect to these topics. The factor *Engagement in Wood* (EIW) described professional or leisurely engagement in wood and measured if the participant was in contact with the material and therefore had a more specific relation to the survey topic. The factors *Attitude towards Austrian Timber Industry - positive* (ATI+) and *Attitude towards Austrian Timber Industry - negative* (ATI-) measured the sympathy and antipathy respectively towards the commercial utilization of forests in Austria. Finally, it was assessed how advertising measures of the sector were perceived through the factor *Advertising Perception of Austrian Timber Industry* (PTI).

Table 2
Fig. z: Exploratory factor analysis and reliability tests for additional factors.

Items	Factors							Reliability
	Green Consumer Value (GCV)[1]	Engagement in Wood (EIW)[2]	Attitude towards Austrian Timber Industry - positive (ATI+)[1]	Attitude towards Austrian Timber Industry - negative (ATI-)[1]	Advertising Perception of Austrian Timber Industry (PTI)[1]	Classic Media Use (CMU)[3]	Social Media Use active (SMUa)[3]	*Cronbach's Alpha (α)*
I'm worried about the environmental impact of my activities.	0.88							0.82
I consider myself ecologically aware.	0.84							
I consider climate change and its consequences threatening.	0.80							
I engage in wood professionally.		0.85						*0.63*
I engage in wood in my free time.		0.79						
Wood can substitute a lot of fossil-based materials (e.g. plastics).			0.74					*0.65*
Wood industry is important for the Austrian economy.			0.70					
The use of domestic wood for construction is active climate protection.			0.66					
The image of the Austrian wood industry is positive.			0.57					
The Austrian wood industry is harmful to forests in Austria.				0.84				*0.63*
It's better for the climate to leave the forests untouched, than to use them sustainably.				0.82				
I regularly notice advertisements by the Austrian wood industry.					0.86			*0.68*
Advertisements by the Austrian wood industry are very appealing.					0.80			
I listen to Radio.						0.81		*0.61*
I watch TV.						0.80		
I read (printed) Newspaper.						0.58		
I post on Instagram.							0.82	*0.72*
I post on Facebook.							0.81	
I post on Youtube.							0.73	

Notes: Principal component extraction with Varimax rotation and Kaiser normalization; loadings below 0.5 are not shown, KMO 0.72, Bartlett Test p = 0.000***, Explained Variance 66.1%, Superscripts: [1]Five-point Likert scale (1 = 'strongly disagree' and 5 = 'strongly agree'), [2]Four-point ordinal scale (1 = never, 2 = seldom, 3 = several times a month, 4 = several times a week), [3]Five-point ordinal scale (1 = never, 2 = seldom, 3 = several times a week, 4 = once a day, 5 = several times a day).

To identify how the four different clusters could be best reached by communication activities, a media use analysis was conducted in addition. Basically, media use was operationalized into two factors (1) *Classic Media Use* (CMU), comprising activities such as listening to radio, watching TV and reading (printed) newspaper, and (2) *Social Media Use active* (SMUa), comprising activities such as actively posting on Instagram, Facebook and YouTube. Since the Cronbach's Alpha-value of the three items intended to build *Social Media Use passive* (SMUp) was below 0.6, this factor could not be created (Bagozzi and Yi 1988).

4. Results

4.1. Total sample

4.1.1. Demo- and sociographics

The distribution of participants over the federal states corresponded with the actual distribution of 20–29-year-olds in Austria, and therefore, most participants (26%) came from Vienna. As the number of respondents from Vorarlberg (30) and Burgenland (23) was relatively low, these findings might be biased and must be reviewed critically. Most of the participants reported finishing A-levels (43%) or a university degree (25%) as their highest educational degree. A large portion were employed (58%) or studying (28%) and 64% reported living in an urban environment.

4.1.2. Forest-based sector and timber construction

The economical use of forests was seen critically: only 9% of young millennials thought the forest cover in Austria was increasing (Fig. 1) and 20% were in favor of increased economic use of forests (Fig. 2).

Table 3 presents the means for the perception of the forest-based sector and timber construction. The timber industry was seen as important (M = 3.57, SD = 1.05) and its image as positive (M = 3.54, SD = 0.92), yet the majority also saw it as harmful to forests (M = 3.06, SD = 1.06). Advertisements by the industry only reached a fraction of young millennials and when they did, they were generally not rated as "very appealing" (M = 2.57, SD = 1.06).

Regarding construction, 46% of all participants were willing to build a house in the future. The majority agreed that a house made of wood had a positive image (M = 3.49, SD = 1.14), and timber construction was rated as better than other construction methods

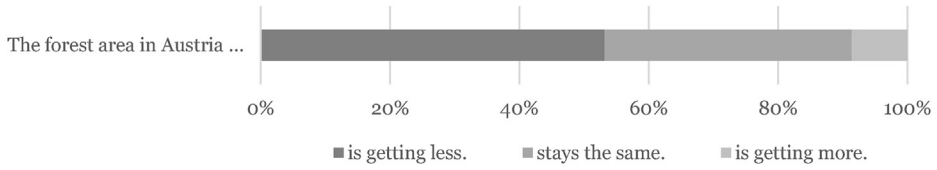

Fig. 1. Forest area in Austria (n = 757.).

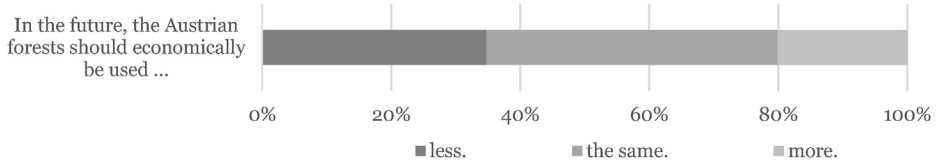

Fig. 2. Economic use of forests (n = 757).

in almost every aspect. Nevertheless, the agreement with the statement "If I ever build a house, wood should be the building material" was low (M = 2.80, SD = 1.2). Furthermore, timber construction was rated as slightly more expensive (M = 3.09, SD = 1.15) and less modern (M = 2.82, SD = 1.10). When asked about the primary uses for wood that come to mind, the most common responses were furniture (28%), firewood (26%) and construction material (22%).

4.1.3. Media use

The media that were used ~~at least~~ several times per week or more, were YouTube (84%), Instagram (71%), Facebook (70%) and television (70%). 47% of all participants used Instagram several times a day and among the social media platforms its active use was highest (21% posted at least several times a week). In an open question regarding other commonly used media channels, Spotify (21%) and podcasts (15%) were named most often.

4.2. Cluster analysis

4.2.1. Cluster descriptions through factors

Table 4 lists all surveyed demo- and sociographic information as well as the clustering factors TCA, OLW and additional factors. Regarding the two clustering factors, highly significant differences between the four clusters were found, which led to specific cluster names that describe their role in the development of the timber construction market. Cluster 2 and cluster 4 showed connotatively higher TCA values than clusters 1 and 3, justifying their denomination as timber construction "supporters," in contrast to "preservers" of the status quo. Analyzing OLW showed higher opinion leadership in clusters 3 and 4, which represents their more active communication about wood, wood products and timber construction compared to clusters 1 and 2. After combining these findings, the four clusters were labeled: (1) *Passive Preservers*, (2) *Passive Supporters*, (3) *Active Preservers* and (4) *Active Supporters*.

In the following section, an overview of each cluster is provided, in which the specific differences between (1) *Passive Preservers* and (4) *Active Supporters* (i.e., "signature clusters") are explained in more detail with the help of a One-way ANOVA comparison of means (Bonferroni Post-Hoc Test). These two groups represented the most polar attitudes and behaviors and can either hinder or respectively advance the widespread use of timber construction in Austria.

Looking at the geographical distribution, the federals states with the highest share of timber construction supporters (either active or passive) could be found in Styria and Tyrol (both 69%), Vienna (58%), Lower Austria (56%) and Salzburg (55%). Regarding age and gender, significant differences between the two signature clusters could be identified. *Active Supporters* were significantly older (M = 25.0, SD = 2.8) than *Passive Preservers* (M = 24.0, SD 2.8). Additionally, the overall share of Austrian women was 52%, although female respondents comprised 60% of the *Passive Preservers* cluster, but only 39% of the *Active Supporters* cluster - a highly significant difference. These clusters also showed a significant difference in the participants' living environment (rural or urban). *Passive Preservers* were more often living in an urban environment (72%) than *Active Supporters* (59%). *Active Supporters* showed a significantly higher *Green Consumer Value* (GCV) and a highly significant and more intense *Engagement in Wood* (EIW). Also, *Active Supporters reported a significantly higher Positive Attitude towards Timber Industry* (ATI+) and perception of the industry's advertising measures (PTI) than P*assive Preservers*. The value of aversion towards the timber industry (ATI-) was significantly higher with *Passive Preservers*. *Active Supporters* used classic media (CMU) significantly and more intensively than *Passive Preservers*. Regarding the passive use of social media (SMUa), no significant differences were detected.

4.2.2. Perceived advantages and disadvantages of timber construction

Two open questions ("Which advantages/disadvantages come to mind, when you think about timber construction?") yielded positive and negative responses regarding timber construction. Thematically similar answers were qualitatively grouped into categories (Mayring 2010). Fig. 3 shows the perceived advantages for the signature clusters *Passive Preservers* and *Active Supporters* which showed major differences with regards to the benefits of timber construction. The ecological aspect was an advantage of timber construction for 37% of *Active Supporters* in contrast to only 26% of *Passive Preservers*. At the same time, the unsustainable procurement of wood ("deforestation") was the biggest disadvantage, as shown in Fig. 4. Again, the two signature clusters showed noteworthy differences. The answers that exemplified concern of deforestation were: "Ending lives, even if they are only trees", "The forests are getting less, which means less oxygen for us" and "Wood in Austrian forests is getting less and less and animals have no protection anymore". Other disadvantages that were mentioned are the so-called "hard-factors" (Gold and Rubik 2009) such as stability, fire-hazard and weathering (Fig. 3 and 4).

4.2.3. Cluster characterization

Below, a comprehensive overview of the clusters, based on the

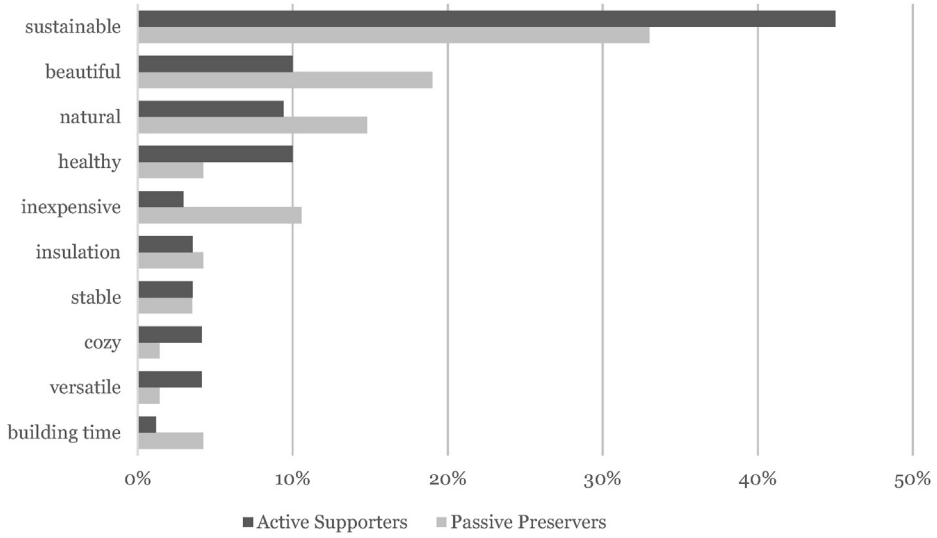

Fig. 3. Ten most named advantages of timber construction for signature clusters (n = 312).

Table 3
Assessment of statements related to the forest-based sector and timber construction on a 5-point Likert scale (1 strongly disagree, 5 strongly agree).

Item	Agreement	
	Mean	SD
Forest-based sector		
The timber industry is important for the Austrian economy.	3.57	1.05
Wood can substitute a lot of fossil-based materials (e.g. plastics)	3.54	1.10
The image of the Austrian timber industry is positive.	3.54	.92
The use of domestic wood for construction is climate change mitigation.	3.32	1.06
It is better for the climate to leave the forests untouched, than to use them sustainably.	3.18	1.22
The Austrian timber industry is harmful to forests in Austria.	3.06	1.06
I find advertisements by the Austrian wood industry very appealing.	2.57	1.06
I regularly notice advertisements by the Austrian wood industry.	2.23	1.18
Timber Construction		
A house made of wood has a positive image.	3.49	1.14
If I ever build a house, wood should be the building material.	2.80	1.20
Multi-story buildings (>5 floors) should be increasingly built of wood.	2.48	1.08
Compared to other construction methods, a house made of wood is more:		
aesthetic	3.74	1.04
climate-friendly	3.58	1.08
cooler	3.41	.99
high-quality	3.31	.96
expensive	3.09	1.15
modern	2.82	1.10

abovementioned findings can be found.

The *Passive Preservers* group represents 24% of young millennials in Austria. Not only was their attitude towards timber construction and the forest-based sector the most negative, they also communicated very little about wood-related topics. More than the other clusters, they saw timber construction as "old-fashioned" and "low quality." They perceived the Austrian timber industry as harmful to domestic forests and saw little connection between the use of wood and climate protection. Only 2% of them strongly agreed or somewhat agreed with the statement: "If I ever build a house, wood should be the building material" and 70% strongly disagreed or somewhat disagreed with the statement "Multi-story buildings (>5 stories) should be increasingly built in wood". Furthermore, they were the least aware of the industry's advertising measures. Of all clusters, they were the youngest (M = 24.0) and showed the highest proportion of women (60%) and urban population (72%). They were the least ecologically aware group and showed the lowest engagement in wood.

The *Passive Supporters* group represents 31% of young millennials in Austria. This group had a positive image of timber construction and the forest-based sector but communicated little about wood related topics. They are the "silent facilitators" of increased wood use for construction purposes. 77% of them strongly agreed or somewhat agreed to the statement "A house made of wood has a positive image". This cluster had the strongest perception of timber construction as "high-quality" and the second strongest of being "climate-friendly" and "cool". The majority of *Passive Supporters* was female (54%) and mostly live in urban environments (68%). They showed the second highest ecological awareness, the highest percentage of higher education degrees but a low engagement with wood.

Active Preservers make up 19% of the Austrian millennials. They showed a similar negative perception of timber constructions and the forest-based sector to the *Passive Preservers* but were nevertheless more communicative regarding wood-related topics and can be regarded as influential for their social circle. Their

Table 4
Overview of cluster composition and their evaluation of clustering and additional factors.

			Total	Cluster 1 Passive Preservers	Cluster 2 Passive Supporters	Cluster 3 Active Preservers	Cluster 4 Active Supporters	ANOVA Cluster 1 Cluster 4
			100% n = 757	24%[1] n = 184	31% n = 235	19% n = 140	26% n = 198	
Demo-/Sociographics			M (SD)	M (SD)				
Age			24.6 (2.8)	24.0 (2.8)	24.7 (2.6)	24.7 (3.0)	25.0 (2.8)	p = 0.002**
Residence		n	%	%				
	Vienna	196	26	26[2]	34	16	24	
	Low.-Austria	127	17	23	28	21	28	
	Up.-Austria	118	16	28	26	25	21	
	Styria	106	14	18	42	13	27	
	Tyrol	66	9	17	42	14	27	
	Salzburg	47	6	32	21	13	34	
	Carinthia	44	6	23	23	25	30	
	Vorarlberg	30	4	27	23	20	30	
	Burgenland	23	3	35	17	26	22	
Gender	male	365	48	40	46	54	61	p = 0.000***
	female	392	52	60	54	46	39	
Living Environment	rural	272	36	28	32	48	41	p = 0.031*
	urban	485	64	72	68	52	59	
Education	no schooling	4	1	50[3]	25	25	0	
	min. schooling	63	8	26	18	24	32	
	prof. training	182	24	25	27	21	27	
	A-level	323	43	26	33	17	24	
	university degree	185	25	21	35	17	27	
Profession	in education	215	28	25[4]	37	17	24	
	employed	442	58	24	29	19	27	
	self-employed	23	3	0	35	17	48	
	other	77	10	3	25	18	27	
Clustering Factors			M (SD)	M (SD)				
OLW (Opinion Leadership Wood)[5]			2.0 (1.0)	1.2 (0.2)	1.3 (0.4)	2.7 (0.5)	3.3 (0.7)	p = 0.000***
TCA (Timber Construction Affinity)[5]			3.2 (0.6)	2.7 (0.4)	3.7 (0.3)	2.8 (0.3)	3.7 (0.4)	p = 0.000***
Additional Factors			M (SD)	M (SD)				
GCV (Green Consumer Value)[5]			3.6 (0.9)	3.5 (1.0)	3.7 (0.9)	3.5 (0.9)	3.8 (1.0)	p = 0.011*
EIW (Engagement in Wood)[6]			1.7 (0.7)	1.4 (0.5)	1.5 (0.5)	1.9 (0.7)	2.1 (0.7)	p = 0.000***
ATI+ (Attitude Timber Industry - pos.)[5]			3.5 (0.7)	3.2 (0.7)	3.7 (0.6)	3.1 (0.7)	3.8 (0.7)	p = 0.000***
ATI- (Attitude Timber Industry - neg.)[5]			3.1 (1.0)	3.4 (0.9)	3.0 (1.0)	3.2 (0.9)	3.0 (1.0)	p = 0.003**
PTI (Advertising Perception)[5]			2.4 (1.0)	2.0 (0.9)	2.2 (0.9)	2.6 (0.8)	2.9 (1.1)	p = 0.000***
CMU (Classic Media Use)[7]			3.0 (1.0)	2.8 (1.0)	2.9 (0.9)	3.1 (0.9)	3.3 (1.0)	p = 0.000***
SMUa (Social Media Use - active)[7]			1.8 (0.7)	1.7 (0.7)	1.6 (0.6)	2.1 (0.9)	1.8 (0.7)	n.s.

Notes: ANOVA Post-Hoc-Test: Bonferroni; ***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$; (n.s.): not significant; [1]n/total in %; [2]n/totalResidence in %; [3]n/totalEducation in %; [4]n/totalProfession in %; [5]Five-point Likert scale (1 = 'strongly disagree'/5 = 'strongly agree'), [6]Four-point ordinal scale (1 = never, 2 = seldom, 3 = several times a month, 4 = several times a week), [7]Five-point ordinal scale (1 = never, 2 = seldom, 3 = several times a week, 4 = once a day, 5 = several times a day).

perception of wood can be best described as ambiguous: they showed a rather high engagement with wood (only 18% never engage with wood in their free time) and were more aware of the industry's communication measures but did not ascribe positive aspects to the material. 62% strongly disagreed or somewhat disagreed with the statement "If I ever build a house, wood should be the building material," and only 13% agreed to "A house made of wood has a positive image." The majority of *Active Preservers* was male (54%) and this group had the lowest percentage of people living in an urban environment (52%). They showed low ecological awareness and the lowest percentage of higher education degrees. Their media use was highest among all groups, especially regarding the active use of social media.

26% of Austrian millennials can be considered *Active Supporters.* Of all the groups, they had the most positive perception of timber construction and the forest-based sector and communicated about wood-related topics most often. They can be regarded as opinion leaders and thus influential within their social circles. They were most in favor of increased forest resource use and 68% of them strongly agreed or somewhat agreed with the statement "The use of domestic wood for construction is active climate protection." They saw timber construction as more "aesthetic" and "climate-friendly" than any other groups and showed the highest willingness to build with wood. 77% strongly agreed or somewhat agreed to the statement "A house made of wood has a positive image" and 65% strongly agreed or somewhat agreed that if they ever build a house, wood should be the building material. The majority of *Active Supporters* was male (61%) and mostly live in an urban environment (59%). This group had the highest ecological awareness as well as the highest engagement with wood professionally or as a leisure activity. *Active Supporters* were the most aware of the industry's advertising measures. Furthermore, this group was the second

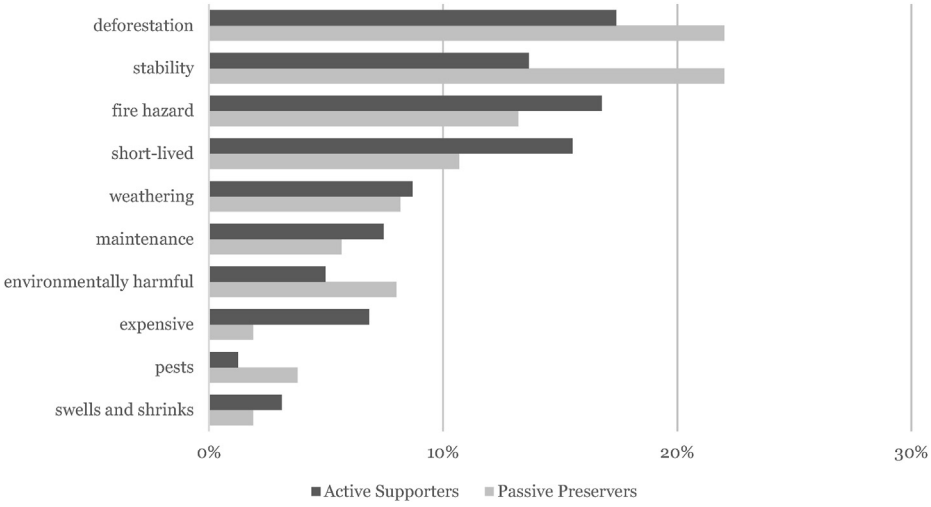

Fig. 4. Ten most named disadvantages of timber construction for signature clusters (n = 320).

most active group on social media in posting their own messages but also reported the highest use of classical media.

5. Discussion

5.1. Total sample

Although the findings showed that timber construction is generally perceived positively, it still has significant hurdles to overcome to achieve widespread acceptance. A clear disparity existed between the mostly advantageous assessment of timber construction against other construction methods and the actual willingness to build with wood. Only about a quarter of all participants (27%) would choose wood when building a house, which would only be a slight improvement to the current quota of timber buildings in Austria (Teischinger et al., 2018). Only 14% thought that

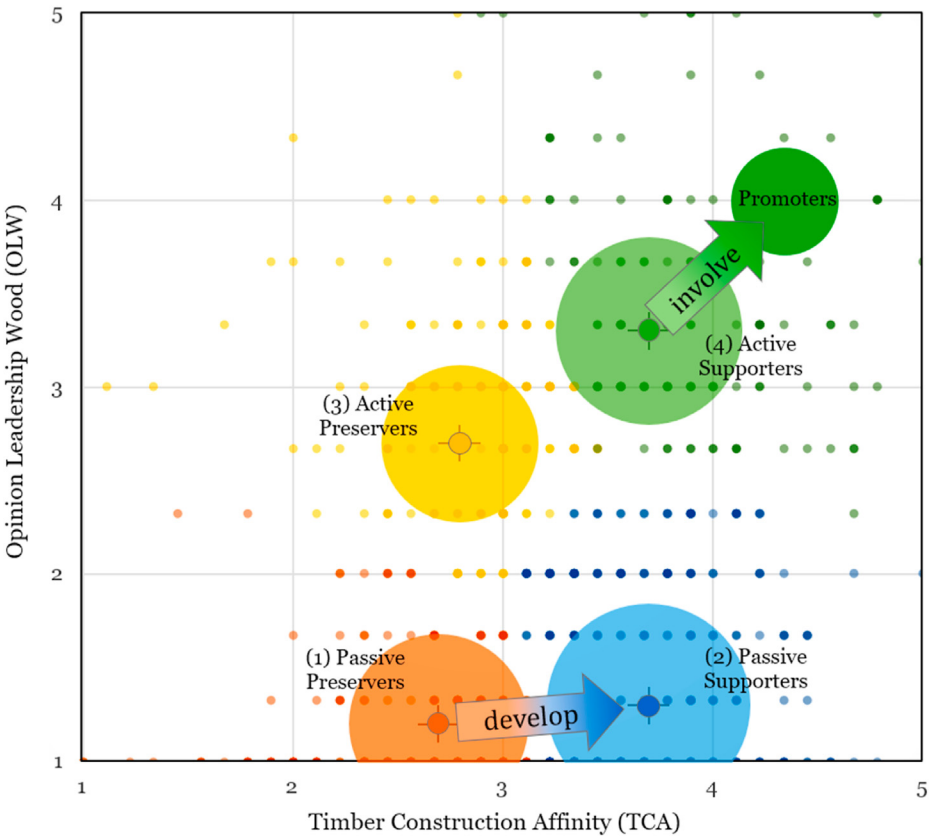

Fig. 5. Suggested development for the young millennials market. Clustering factors OLW and TCA were measured on a 5-Point Likert Scale (1 = strongly disagree, 5 = strongly agree). Higher values represent a more active communication about wood-related and timber construction topics (OLW) and a higher affinity towards timber construction (TCA). n = 757.

multi-story buildings should be increasingly built out of wood. This seemingly contradictory outcome is similar to results of Lähtinen et al. (2019), where high sympathy for wood as a building material did not equal the willingness to live in multi-story wooden buildings. Also, the perceived advantages and disadvantages confirmed Gold and Rubik's (2009) findings, as timber construction scored high in "soft-factors" (aesthetics, naturalness, living comfort etc.), but low in "hard factors" (durability, fire-safety, value-stability), which are more relevant for buying decisions.

Furthermore, timber construction was rated as more old-fashioned than other construction methods which showed that a modern image of timber construction might not yet have reached the young millenial generation. This creates a challenge in a country like Austria, where in some regions, building with wood has been a common construction method for centuries and those buildings remain omnipresent. Regarding the perception of timber construction, this creates a "competition" between the traditional and the modern image, therefore making it difficult to communicate technological advancements in the sector that challenge the prejudices (e.g. massive timber building in CLT and glue-laminated timber structures that allow a broad range of aesthetical possibilities). This might be even harder in the case of timber construction, where the structural material itself is very often hidden behind planking that leaves no clue to know which material the building is truly made of.

Another major challenge for future communication is the sourcing of wood as a raw material and the related sustainability issues. Participants mentioned "deforestation" most often as a disadvantage of timber construction. However, the forest area in Austria has continually been increasing over the last decades, but only a fraction of young millennials saw it that way and was in favor of increased economical use of forests. This poses a challenge for the successful implementation of a bioeconomy-strategy that relies heavily on public acceptance. Although the perception of the forest-based value chain varies depending on the different stages. As mentioned above, the procurement of wood raised concerns, yet the final product, that is the wooden house, was perceived as "sustainable," "natural" and more "climate-friendly" than other construction methods. This seemingly contradictory outcome suggests that the "Slaughterhouse-Paradox" might also apply here: *"The cow in the pasture, the steak on the plate are positively associated. The slaughterhouse, however, is mentally blanked or associated with negative aspects, true to the motto: 'Everyone loves the products; no one loves the production'"* (Pauli et al., 1998). This study reflects findings from Toppinen et al. (2018) and Ranacher (2018) which showed that younger people generally brought up more sustainability-related concerns regarding multi-story timber constructions. As Larasatie (2018) mentioned, these concerns about harvesting practices and forest sustainability also present communication opportunities for the whole sector to raise awareness, be clear about terminologies and highlight the connection between the sourcing and the consumer product.

5.2. Clusters

As previous studies have shown (Ranacher 2017; Rametsteiner 2009), the broader public is a non-homogenous group and the forest-based industry needs to address different stakeholders specifically. From the results of this study, it can be concluded that among stakeholder groups such as the broader young public, there are subgroups that can be clustered using psychographic factors, thereby rendering communication measures more accurate and effective.

The results indicate that the majority (57%) of Austrian millennials were supportive of timber construction and had a positive attitude towards it. This study did not investigate where this positive image stems from, although it can be speculated that in Austria, a country where the forest-based sector plays a major role in the country's economy, a large portion of the population come in contact with the sector, either through ownership (145.000 private citizens own 82% of forests in Austria (Statistik Austria 2012)), through employment (the forest-based sector employs roughly 300.000 people in Austria (FHP, 2019)) or through friends and family. Furthermore, the national association *proHolz Austria,* the industry's most important proponent, continually communicates the benefits of using forest-based and wood-based products.

However, 43% of Austrian young millennials were not convinced that building with wood is a modern, high-quality and sustainable construction method. The industry's goal should primarily be to implement a coherent communication strategy for the younger public. It should take existing attitudes towards the sector and its offerings into consideration to further strengthen a positive image and to increase the Timber Construction Affinity (TCA), thereby increasing the willingness to build with wood.

6. Conclusions

Timber construction and the forest-based sector in general are not only a vital part of Austria's economy, they are also key to the transition towards a bio-based economy. There is however a new generation on the rise, which is regarded as being more ecologically aware and pursues a lifestyle that differs radically from previous generations. From the perspective of the forest-based sector, this presents a massive opportunity to anchor timber construction in the minds of the next generation stakeholders not only as the way to build in the future but also to position itself as "part of the solution" regarding ecological challenges. This study has shown that there are still preconceived notions in the minds of the young millennials, that are not in congruence with the nature of modern timber building, especially concerning technical aspects as well as questions regarding sustainability. It aimed to supplement existing research on the public perception of timber construction and the forest-based sector and generate insights into the young millennial market, so that communication measures can be tailored towards this group and its subgroups more effectively. In the authors' opinion the following activities should be pursued to support positive market development:

- Timber construction-related communication needs to merge sustainability aspects with technical aspects and use this as its unique selling proposition. Eco-friendliness and high-performance of a modern timber building should not be perceived as a contradiction, but as a given fact. Thus, young consumers should be educated about technical qualities (primarily: fire safety, durability, stability) and less about soft factors of modern timber construction. Engineered wood products show that wood can be regarded as an optimized high-tech material, that can be used for specialized purposes and compete based on its structural properties, while also being superior from an ecological perspective. By depicting other modern wood-based innovations (composites, bioplastics, bio-based chemicals, textiles etc.) the image of forest products could be broadened as well as the belief in their technical capabilities and their versatility.
- Concerns regarding forests as providers of raw materials must be addressed. The ongoing trend of emotionalizing and humanizing trees could be used to show the "bigger picture" in which sustainably managed forests are a key factor in decarbonizing the economy. Efforts to educate the younger public about the concept of a circular bioeconomy and the role of

forests and wood use within it should begin as early as possible. Only by perceiving the domestic forest-based industries as a necessary and valuable intermediary between nature and humans, the remorse about buying a wood product and thereby the slaughterhouse paradox can be eradicated.

- Higher visibility should be achieved through more captivating and even provocative messages, that are communicated in a style that speaks to the younger public. Communication should convey emotion, not only information. The use of striking visuals and clear and comprehensive messages could widen the reach of communication measures. Furthermore, this generation has been confronted with a dystopian story of a "climate catastrophe" since their early childhood and lacks an optimistic outlook for their future. The use of a positive and engaging narrative, that embeds modern timber construction as the architectural pillar of a sustainable bioeconomy should be communicated by all players in the forest-based value chain. This study has shown that YouTube, Instagram and Facebook are the platforms that reach the most young millennials, the specified target audience.

6.1. Passive Preservers and Active Supporters

As mentioned before, the signature clusters of *Passive Preservers* and *Active Supporters* are the most promising in terms of communication measures. They should be addressed as follows: communication towards *Passive Preservers* should focus on the technical qualities of modern timber construction, its versatility and architectural possibilities, instead of the well-known "feel-good" aspect of wood. Furthermore, sustainability issues regarding the forest-based value chain and especially how forestry in Austria differs from other parts of the world should be emphasized. A stronger focus on sustainability certifications and labels could support this. Regarding *Active Supporters,* the involvement of this group is vital to promote benefits of wood use in society. They already show high TCA and OLW values, thus a platform to further inform themselves about forest- and wood-related topics, engage with others and get involved could be a valuable tool to actively spread those topics among their social circles.

Fig. 5 shows the measures that should be pursued to ensure positive market development: *Passive Preservers* should be developed into *Passive Supporters*, while *Active Supporters* should have the opportunity to be more actively involved, thereby raising TCA and OLW values and transforming them into *Promoters* of timber construction and wood-related topics in society.

This study's limitations include the survey's question format, which could not yield reasons as for why young millennials had a certain attitude about timber construction. The results would benefit from other socio- and psychographic variables, that would enrich their explanatory power, which in turn would allow for more targeted communication for each segment. Through the utilization of an online survey, the potential for selection bias of the participants was unavoidable. In order to further investigate their motives, qualitative research, e.g., focus groups and the use of timber construction-specific questions, should be based on the results of this study. Furthermore, a cluster analysis of the total Austrian population would be interesting to see if similar clusters exist among different generations and if clustering using similar factors would lead to similar findings.

In addition, this study could be extended to a European level. The question items as well as clustering Factors TCA and OLW could be adapted to country-specific issues regarding timber construction, such as seismic performance in the Mediterranean regions, raw material procurement in regions with little domestic forest resources, or the perception of modern (CLT and EWP) construction versus traditional methods in countries with a high percentage of traditional timber buildings such as the Scandinavian countries.

CRediT authorship contribution statement

Markus Petruch: Conceptualization, Investigation, Writing - original draft, Writing - review & editing, Visualization. **Dominik Walcher:** Project administration, Funding acquisition, Formal analysis, Supervision, Methodology.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The survey on which this paper is based has been carried out within the research project "*Open Innovation Competence Platform Salzburg*" (*Open Innovation Kompetenzplattform Salzburg* (OIKS)), Förderkennzeichen/Grant-ID: WISS-2025. This project is funded by Innovations-und Technologietransfer Salzburg GmbH (ITG), Austria. The authors express their special thanks for this funding, without which the implementation of the survey would not have been possible. Further thanks to Anneli Eddy, BA, for reviewing the drafts.

References

Bagozzi, R., Yi, Y., 1988. On the evaluation of structural equation models. J. Acad. Market. Sci. 16, 74–94.
Bearden, W.O., Netemeyer, R.G., 1999. Handbook of Marketing Scales – Multi-Item Measures or Marketing and Consumer Behaviour, second ed. London.
BMNT, 2019. Bioökonomie - Eine Strategie für Österreich [Online]. Bundesministerium Für Nachhaltigkeit und Tourismus. Retrieved from. https://www.bmlrt.gv.at/umwelt/klimaschutz/biooekonomie/Bio%C3%B6konomie-Strategie-f%C3%BCr-%C3%96sterreich.html. (Accessed 27 December 2019).
Canadell, J.G., Raupach, M.R., 2008. Managing forests for climate change mitigation. Science. [Online] 320 (5882), 1456–1457. https://doi.org/10.1126/science.1155458.
Capstick, S., Whitmarsh, L., Poortinga, W., Pidgeon, N., Upham, P., 2015. Wiley Interdisciplinary Reviews: Climate Change 6 (4), 435–461. https://doi.org/10.1002/wcc.321. (Accessed 22 May 2020).
Chan, K., Misra, S., 1990. Characteristics of the opinion leader: a new dimension. J. Advert. 19 (3), 53–61.
Childers, T., 1986. Assessment of the psychometric properties of an opinion leadership scale. J. Market. Res. 23 (May), 184–188.
Churkina, G., et al., 2020. Buildings as a global carbon sink. Nat. Sustain. 1–8. https://doi.org/10.1038/s41893-019-0462-4.
Cohen, D., Mathey, A.-H., Biggs, J., Boyland, M., 2014. Corporate social responsibility in the forest sector. In: Hansen, E., Panwar, R., Vlosky, R. (Eds.), The Global Forest Sector—Changes, Practices, and Prospects. CRC Press. Taylor & Francis Group.
Corder, G.W., Foreman, D.I., 2014. Nonparametric Statistics: A Step-by-step Approach. Wiley.
Cortina, J.M., 1993. What is coefficient alpha? An examination of theory and applications. J. Appl. Psychol. 78 (1), 98–104.
Cronbach, L.J., 1951. Coefficient alpha and the internal structure of tests. Psychometrika 16 (3), 297–334.
Deloitte, 2020. The 2020 Deloitte Millennial Survey. Austria [Online] Deloitte.com. Retrieved from. https://www2.deloitte.com/content/dam/Deloitte/at/Documents/presse/Austria-2020-Deloitte-Millennial-Survey.pdf?utm_campaign=HC_Millenial_Survey0702&utm_source=newsletter&utm_medium=newsletter. (Accessed 20 May 2020).
Espinoza, O., Trujillo, V.R., Mallo, M.F.L., Buehlmann, U., 2016. Cross-laminated timber: status and research needs in Europe. BioRes 11 (1), 281–295.
Fabra-Crespo, M., Rojas-Briales, E., 2015. Comparative analysis on the communication strategies of the forest owners' associations in Europe. For. Pol. Econ. 50

(2015), 20–30. https://doi.org/10.1016/j.forpol.2014.06.004. ISSN 1389-9341. (Accessed 20 May 2020). http://www.sciencedirect.com/science/article/pii/S1389934114001142 [Online] Retrieved from.
FHP, 2019. Einkommensbezieher Wertschöpfungskette Holz. Forst-Holz-Papier [Online] Retrieved from. https://www.forstholzpapier.at/images/FHP-Abeitskreise_/AK_Datenservice_und_Holzbilanz/Einkommensbezieher_Wertsch%C3%B6pfungskette_Holz.PNG. (Accessed 20 June 2020).
Forbes, 2015. Millennials and the Power of Influence. Forbes Magazine [Online] Retrieved from. https://www.forbes.com/sites/jeancase/2015/06/24/millennials-influence/#636007235095. (Accessed 16 March 2020).
Geng, A., Yang, H., Chen, J., Hong, Y., 2017. Review of carbon storage function of harvested wood products and the potential of wood substitution in greenhouse gas mitigation. For. Pol. Econ. 85, 192–200. https://doi.org/10.1016/j.forpol.2017.08.007. (Accessed 19 May 2020).
Georgii, H., 2009. Stochastik. Einführung in die Wahrscheinlichkeitstheorie und Statistik, fourth ed. Walter de Gruyter, Berlin. 2009.
GfK, 2019. Millennials. Gesellschaft für Konsumentenforschung [Online]. Retrieved from. https://www.gfk.com/de/landing-pages/landing-pages-de/millennials/. (Accessed 24 December 2019).
Gold, S., Rubik, F., 2009. Consumer attitudes towards timber as a construction material and towards timber frame houses – selected findings of a representative survey among the German population. J. Clean. Prod. 17 (2), 303–309. https://doi.org/10.1016/j.jclepro.2008.07.001. ISSN 0959-6526.
Gustavsson, L., Haus, S., Lundblad, M., Lundström, A., Ortiz, C.A., Sathre, R., Le Truong, N., Wikberg, P., 2018. Climate change effects of forestry and substitution of carbon-intensive materials and fossil fuels. Renew. Sustain. Energy Rev. 67, 612–624. https://doi.org/10.1016/j.rser.2016.09.056. Retrieved from. (Accessed 20 May 2020). http://www.sciencedirect.com/science/article/pii/S1364032116305500.
Hair, J.F., Black, B.C., Babin, B.J., Anderson, R.E., Tatham, R.L., 2006. Multivariate Data Analysis, sixth ed. Pearson International Edition, New Jersey.
Haws, K., Winterich, K., Naylor, R., 2013. Seeing the world through GREEN-tinted glasses: how green consumers' use motivated reasoning to prefer environmentally friendly products. J. Consum. Psychol. 24 (3) https://doi.org/10.1016/j.jcps.2013.11.002.
Hepburn, C., Adlen, E., Beddington, J., Carter, E.A., Fuss, S., Mac Dowell, N., Minx, J.C., Smith, P., Williams, C.K., 2019. The technological and economic prospects for CO_2 utilization and removal. Nature 575, 87–97. https://doi.org/10.1038/s41586-019-1681-6.
Hoffower, H., 2019. The Great Recession Split the Millennial Generation Down the Middle, Creating 2 Groups with Very Different Financial Habits. Business Insider [Online]. Retrieved from. https://www.businessinsider.com/millennial-generation-gap-great-recession-financial-crisis-money-habits-2019-3. (Accessed 19 March 2020).
Høibø, O., Hansen, E., Nybakk, E., 2015. Building material preferences with a focus on wood in urban housing: durability and environmental impacts. Can. J. For. Res. 45 (11), 1617–1627. https://doi.org/10.1139/cjfr-2015-0123, 2015.
Homburg, C., Giering, A., 1996. Konzeptualisierung und Operationalisierung komplexer Konstrukte. Ein Leitfaden für die Marketingforschung. Marketing ZFP 18 (1), 5–24.
Homburg, C., Schwemmle, M., Kuehnl, C., 2015. New product design: concept, measurement, and consequences. J. Market. 79 (3), 41–56.
Ima, S., Bhat, S., Lee, Y., 2015. Consumer perceptions of product creativity, coolness, value and attitude. J. Bus. Res. 68, 166–172.
IPCC, 2018. Summary for policymakers of IPCC special report on global warming of 1.5°C approved by governments. Intergovernmental Panel on Climate Change [Online] Retrieved from. https://www.ipcc.ch/site/assets/uploads/2018/11/pr_181008_P48_spm_en.pdf. (Accessed 5 June 2020).
Kaufman, L., Rousseeuw, P., 2005. Finding Groups in Data: an Introduction to Cluster Analysis. John Wiley & Sons, Inc., New York.
Kremer, P., Symmons, M., 2016. Overcoming Psychological Barriers to Widespread Acceptance of Mass Timber Construction in Australia [Online] Retrieved from. https://www.researchgate.net/publication/307963460_Overcoming_Psychological_Barriers_to_Widespread_Acceptance_of_Mass_Timber_Construction_in_Australia/citation/download. (Accessed 5 June 2020).
Kirchgeorg, Manfred, 2018. Meinungsführer. Gabler Wirtschaftslexikon. https://wirtschaftslexikon.gabler.de/definition/meinungsfuehrer-38313/version-261737. (Accessed 20 May 2020).
Kollmuss, A., Agyeman, J., 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior. Environ. Educ. Res. 8 (3), 239–260.
Lapidos, J., 2015. Wait, what, I'm a Millennial? New York Times [Online] Retrieved from. https://www.nytimes.com/2015/02/05/opinion/wait-what-im-a-millennial.html. (Accessed 20 May 2020).
Lähtinen, K., Myllyviita, T., 2015. Cultural sustainability in reference to the Global Reporting Initiative (GRI) guidelines—case forest bioenergy production. J. Cult. Herit. Manag. Sustain Dev. 5 (3), 290–318. https://doi.org/10.1108/JCHMSD-06-2013-0025, 2015.
Lähtinen, Katja, et al., 2017. Forest Sector Sustainability Communication in Europe: a Systematic Literature Review on the Contents and Gaps. Curr Forestry Rep 3, 173–187. https://doi.org/10.1007/s40725-017-0063-2. In press.
Lähtinen, K., Harju, C., Toppinen, A., 2019. Consumers' perceptions on the properties of wood affecting their willingness to live in and prejudices against houses made of timber. Wood Mater. Sci. Eng. 14 (5), 325–331. https://doi.org/10.1080/17480272.2019.1615548.
Larasatie, P., Guerrero, Jose, Conroy, K., Hall, T., Hansen, E., Needham, M., 2018. What does the public believe about tall wood buildings? An exploratory study in the US pacific northwest. J. For. 116 (5), 429–436. https://doi.org/10.1093/jofore/fvy025. September 2018.
Lazarsfeld, P., Berelson, B., Gaudet, H., 1944. The People's Choice. New York.
Lippke, B., Oneil, E., Harrison, R., Skog, K., Gustavsson, L., Sathre, R., 2011. Life cycle impacts of forest management and wood utilization on carbon mitigation: knowns and unknowns. Carbon Manag. 2, 303–333. https://doi.org/10.4155/cmt.11.24.
Manninen, H., 2014. Long-term Outlook for Engineered Wood Products in Europe. European Forest Institute. Technical Report 91, 2014.
Mayring, P., 2010. Qualitative Inhaltsanalyse: Grundlagen und Techniken. Beltz, Weinheim.
Mohiuddin, K., Gordon, R., Magee, C., Lee, K.J., 2016. A conceptual framework of cool for social marketing. J. Soc. Market. 6 (2), 121–143.
Pauli, B., Suda, M., Mages, V., et al., 1998. Das Schlachthausparadox oder das Dilemma der forstlichen Öffentlichkeitsarbeit. LWF aktuell 19, 10–14 [Online] Retrieved from. https://www.lwf.bayern.de/mam/cms04/service/dateien/a13_testbetriebsnetz_96_gesamtheft.pdf. (Accessed 3 January 2020).
Plackner, H., 2015. Brettsperrholz wächst global. Holzkurier [Online] Retrieved from. https://www.holzkurier.com/schnittholz/2015/02/brettsperrholz_waechstglobal.html. (Accessed 20 January 2020).
Quesada-Pineda, H., Smith, R., Berger, G., 2018. Drivers and Barriers of Cross-Laminated Timber (CLT) Production and Commercialization: A Case Study of Western Europe's CLT Industry. Bioproducts Business [Online] Retrieved from. https://cfpb.vt.edu/wp-content/uploads/2020/01/2018_Quesada_Smith_Berger_BioProducts_CLT.pdf. (Accessed 20 May 2020).
Ranacher, L., 2017. Where Sector and Society Meet: Empirical Research to Tailor the Communication of the Forest-Based Sector to the General Public. Doctoral Thesis. [Online]. Institute for Marketing and Innovation, University of Natural Resources and Life Sciences Vienna (BOKU) 130, pp. 19–27. Retrieved from. http://permalink.obvsg.at/bok/AC12609648. (Accessed 20 May 2020).
Ranacher, L., Höfferer, K., Lettner, M., Hesser, F., Stern, T., Rauter, R., Schwarzbauer, P., 2018. What would potential future opinion leaders like to know? An explorative study on the perceptions of four wood-based innovations. Bodenkultur: Journal of Land Management, Food and Environment 69 (1), 47–59, 2018.
Ramage, M., Burridge, H., Wicher, M., Fereday, G., Reynolds, T., Shah, D., Wu, G., Yu, L., Fleming, P., Densley Tingley, D., Allwood, J., Dupree, P., Linden, P.F., Scherman, O., 2017. The wood from the trees: the use of timber in construction. Renew. Sustain. Energy Rev. 68, 333–359. https://doi.org/10.1016/j.rser.2016.09.107.
Rametsteiner, E., Eichler, L., Berg, J., 2009. Shaping forest communication in the European Union: public perceptions of forests and forestry [Online]. Retrieved from. http://www.forstwirtschaft.com/sites/default/files/userfiles/1file/Shaping_forest_communication.pdf. (Accessed 10 January 2020).
Sarstedt, M., Mooi, E., 2018. A Concise Guide to Market Research: the Process, Data, and Methods Using IBM SPSS Statistics. Springer.
Schulze, E.D., Sierra, C.A., Egenolf, V., Woerdehoff, R., Irslinger, R., Baldamus, C., Stupak, I., Spellmannet, H., 2020. The climate change mitigation effect of bioenergy from sustainably managed forests in Central Europe. GCB Bioenergy 12, 186–197. https://doi.org/10.1111/gcbb.12672.
Singal, J., 2017. Are You an Old Millennial or a Young Millennial? CNN [Online]. Retrieved from. https://www.cnn.com/2017/05/01/health/young-old-millennial-partner/index.html. (Accessed 11 January 2020).
Seto, K.C., Guneralp, B., Hutyra, L.R., 2012. Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. Proc. Natl. Acad. Sci. Unit. States Am. 109 (40), 16083–16088. https://doi.org/10.1073/pnas.1211658109.
statistaat, 2012. Immobilienkauf - durchschnittsalter beim Ersterwerb im Ländervergleich 2012. Stat [Online] Retrieved from. https://de.statista.com/statistik/daten/studie/247816/umfrage/durchschnittsalter-beim-ersten-immobilienkauf-im-laendervergleich/. (Accessed 25 February 2020).
statistaat, 2019. Österreich - bevölkerung nach Altersgruppen und Geschlecht 2019. Stat [Online] Retrieved from. https://de.statista.com/statistik/daten/studie/718077/umfrage/bevoelkerung-in-oesterreich-nach-altersgruppen-und-geschlecht/. (Accessed 25 December 2019).
Statistik Austria, 2012. Der Österreichische Wald: Datensammlung Zum Waldbericht 2012. Lebensministerium; Statistik Austria 2012. [Online] Retrieved from. https://www.proholz.at/zuschnitt/51/der-oesterreichische-wald. (Accessed 23 June 2020).
Statistik Austria, 2015. Bevölkerung im Jahresdurchschnitt [Online] Retrieved from. http://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/bevoelkerung/index.html. (Accessed 25 June 2020).
Tkaczynski, A., Rundle-Thiele, S., Beaumont, N., 2017. Destination segmentation: a recommended two-step approach. J. Trav. Res. 49, 139–152.
Teischinger, A., Buksnovitz, C., 2014. Verbautes Holz - der „zweite" Wald als zukünftiger Sekundärrohstoff. LIGNOVISIONEN 28. [Online]. Retrieved from. https://www.researchgate.net/publication/339001436_Verbautes_Holz_-_der_zweite_Wald_als_zukunftiger_Sekundarrohstoff_Timber_in_Construction_-_a_secondary_Forest_as_a_raw_Material_Resource_of_the_Future. (Accessed 1 March 2020).
Teischinger, A., Stingl, R., Praxmarer, O., 2018. Holzbauanteil in Österreich. Statistische Erhebung aller Holzbauvorhaben in den Jahren 1998-2008-2018. [Online] Retrieved from. https://www.holzistgenial.at/fileadmin/user_upload/Studie_Holzbauanteil_in_Oesterreich_1998_bis_2018.pdf. (Accessed 30 May

2020).
Toppinen, A., Röhr, A., Pätäri, S., Lähtinen, K., Toivonen, R., 2018. The future of wooden multistory construction in the forest bioeconomy – a Delphi study from Finland and Sweden. J. For. Econ. 31, 3–10. https://doi.org/10.1016/j.jfe.2017.05.001. ISSN 1104-6899.
US Census Bureau, 2015. Millennials outnumber baby boomers and are far more diverse [Online] Retrieved from. https://www.census.gov/newsroom/press-releases/2015/cb15-113.html. (Accessed 2 January 2020).
Venkatraman, M.P., 1989. Opinion leaders, adopters, and communicative adopters: a role analysis. Psychol. Market. 6 (1), 51–68.
Waage, S., 2007. Re-considering product design: a practical "road-map" for integration of sustainability issues. J. Clean. Prod. 15 (7), 638–649, 2007.
Wahlström, M., Kocyba, P., De Vydt, M., De Moor, J. (Eds.), 2019. Protest for a Future: Composition, Mobilization and Motives of the Participants in Fridays for Future Climate Protests on 15 March, 2019 in 13 European Cities [Online] Retrieved from. http://eprints.keele.ac.uk/6571/7/20190709_Protest%20for%20a%20future_GCS%20Descriptive%20Report.pdf. (Accessed 24 May 2020).
Warren, C., Batra, R., Loureiro, S., Bagozzi, R., 2019. Brand coolness. J. Market. 83/5, 36–56.
Warren, C., Campbell, M., 2014. What makes things cool? How autonomy influences perceived coolness. J. Consum. Res. 41 (August).
Wippel, B., Hehn, C., Viergutz, M., Dieguez, L., 2017. Wirksame Kommunikationsstrategien zu mehr gesellschaftlicher Akzeptanz von Holzverwendung und forstlicher Nutzung - Abschlussbericht [Online] Retrieved from. https://www.unique-landuse.de/images/publications/vereinheitlicht/2017-04-30_Schlussbericht_W3B_final.pdf. (Accessed 2 March 2020).
Wohlleben, P., 2015. Das geheime Leben der Bäume: was sie fühlen, wie sie kommunizieren - die Entdeckung einer verborgenen Welt. Ludwig.