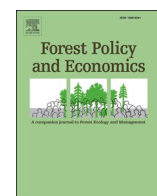


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## Future export markets of industrial wood construction – A qualitative backcasting study

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### ABSTRACT

The forest sector can play a major role in the transformation to a sustainable bioeconomy, driven by climate change, population growth, and accelerated urbanization. However, in most contexts, the industrial wood construction markets, as a promising field for sustainable bioeconomy, are still at a niche level. The analysis in this study concerns the preferred future export markets for industrial wood construction for the Finnish wood construction industry, as viewed by a panel of industrial, policy and academic experts. The aim is to identify promising export markets for Finland, and to identify required pathways by 2030. A qualitative participatory backcasting method was applied to explore the future visions of the industrial wood construction (IWC) sector and its export markets, as well as the pathways from the current towards the envisioned future. Thirty-five experts formed a panel which produced five visions of the development of industrial wood construction sector exports from Finland, covering the period 2020–2030. All the visions foresaw that the domestic market needs to develop first, to build up the competencies needed to fuel the growth in the exports. Asia, particularly China with its rapidly growing markets, and Europe, with its growing sustainability awareness, commonly appeared as the most promising areas for export growth. The resulting visions differed in terms of export portfolios, varying from more traditional wood materials and products to product-service-solutions. The policy measures identified to accelerate the envisioned growth included harmonization of product and building standards and regulations in the Nordic region and beyond, developing the educational base, and using of digital solutions in building new networks and communication in the IWC sector.

### 1. Introduction

The construction sector faces a pressing need to shift towards environmentally sustainable and climate smart, low-carbon solutions. This is because buildings are responsible for 39% of global carbon emissions (World GBC, 2019), combined with the common estimations of strong future population growth and urbanization. Wood-based urban building solutions are one of the options for addressing these challenges and the carbon storage capacity of harvested wood products is a sustainability benefit. The use of wood in construction reduces environmental and climatic impacts of construction, such as carbon emissions, energy and non-renewable material consumption, when compared with concrete or steel construction (Upton et al., 2008; Sathre and Gustavsson, 2009).

Due to its climatic and other sustainability benefits, wood construction has been assessed as having a growing market potential (Kibert, 2016; Kuzman and Sandberg, 2017), particularly in the urban contexts. In Europe, there are signs of actual growth in industrial wood

construction: new wood-based products suitable on an industrial scale in an urban context have been introduced within the past few decades. These include cross-laminated timber (CLT) which is also suitable for residential wooden multi-storey construction (WMC) (e.g., Brege et al., 2014). These new products and technologies have been the subject of growing attention in Europe, but also in countries such as Canada, Australia and the United States (e.g., Moriarty, 2018; Evison et al., 2018). There is significant potential for sustainable wood-based solutions on the construction sector. However, realizing this potential will call for new technologies and products suitable for urban construction and large scale industrial production, and major overall development in the wood industry and construction sector.

Future development of WMC markets, as a key sector of industrial wood construction (IWC), has been addressed in several studies, but at a rather general level (e.g., Riala and Iloa, 2014; Hurmekoski et al., 2015; Rebane and Reihan, 2016; Toppinen et al., 2018; Markström et al., 2019) or by focusing more on the external market and policy

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environment (Hurmekoski et al., 2015; Packalen et al., 2017). Regarding the demand drivers of residential side of WMC, Hurmekoski et al. (2015) highlighted that economic growth, urbanization and demographic development are the key influencing factors. The importance of consumer perceptions, industry attitudes and regulatory frameworks with regard to use of wood in construction have been emphasized in previous studies (e.g., Jonsson, 2009; Wang et al., 2014; Markström et al., 2019). However, the expected effects of such factors on future WMC markets, or more largely IWC markets, have not been systematically analysed. Overall, the role of international trade or marketing aspects for the future development of IWC have scarcely been studied so far, constituting a knowledge gap.

Despite many factors creating the potential for growth, and the emergence of new wood products and technologies suitable for urban markets, industrial wood construction solutions are still a niche in European and global construction markets. Finland is no exception in this regard: exports of wooden housing comprises mainly single houses (Hänninen et al., 2007). The domestic market is the largest market area for Finnish wooden (construction) products. However, the volume of the domestic markets has decreased during the period 2008–2014 due to a lengthy economic recession and the concentration of building activity in the urban areas, dominated by multi-storey building. The market share of residential WMC remains at around 5–6% of all residential multi-storey buildings (Franzini et al., 2018). Based on informal forest industry statistics, wooden houses account for only a couple of percent and building joineries less than one-tenth of the total export value of wood products in Finland. Investments in value-added engineered wood products (EWPs) have increased in the country, including new greenfield CLT plants, albeit slowly.

One cause of the persistently low market share of WMC in the construction business is the conservativeness of the building industry and the strong path dependency favouring concrete as a raw material (Hurmekoski et al., 2015; Matinaro and Liu, 2017; Hemström et al., 2017). In addition, while end-users may associate wood as a construction material in a positive way, “soft factors” like eco-friendliness, aesthetics or renewability of material are not sufficiently strong to trigger higher demand for WMC (Gold and Rubik, 2009; Viholainen et al., 2020). Additionally, end-users also have their prejudices about wood, related to perceived poor fire safety and higher maintenance costs of wooden materials (see for example Høibø et al., 2018; Larasatie et al., 2018).

WMC projects typically involve several partners with different expertise and interests (Hemström et al., 2011; Toppinen et al., 2019). This creates challenges, because traditional business ecosystems need to adapt to changes in markets and customer needs in order to function efficiently. Lack of knowledge about WMC technology among the construction sector experts, and absence of common standards for WMC construction also slow down the adoption of wood in urban and industrial scale construction (Franzini et al., 2018). If international markets are targeted, the knowledge base includes understanding of customer needs in export markets. In addition, marketing and international business skills are important for success (Hietala et al., 2019).

Modern industrial wood construction may be still considered to be innovative solutions which so far have had only a niche market segment. Hence, forecasting such complicated and multi-dimensional development like export markets of industrial wood construction is difficult due to lack of any historical empirical data, such as export statistics. Therefore, qualitative foresight approaches are needed.

In this paper we attempted 1) to build visions for the future pathways of the presently immature wood-construction-related export markets, and 2) to identify promising future target markets in the case of Finnish industrial wood construction sector. A qualitative, participatory backcasting approach with a comprehensive expert panel data has been used to produce alternative visions of the export market development, including the composition of a preferable export portfolio in most appealing market areas. We utilized an international market selection

(IMS) approach (e.g. Andersen and Buvik, 2002) in designing key elements to inform experts of critical aspects to be considered in assessing attractive export markets. Hence, our interest in the backcasting process was also to build experiences from applicability of this approach in the case of both new innovative products and immature niche markets.

## 2. Background for building development pathways and identifying export markets

Amara (1991) classified the approaches of futures research into three categories: identifying the possible, the probable and the preferable futures. We follow the latter approach through which futures research is characterised by understanding the future as something that can be influenced, rather than something that only needs to be predicted and accommodated in the form of various potential scenarios (Höjer et al., 2011). With this approach, we used the backcasting methodology, which is particularly applied in creating future visions of complex and immature phenomena, such as our research case. It differs from regular forecasting which predicts the future from the present using explorative scenarios (e.g. Vergragt and Quist, 2011). In the forest sector, quantitative scenario studies have been more predominant than applications of participatory backcasting. However, e.g., Hurmekoski and Sjølie (2018) and Sjølie et al. (2016) provide insight on the complementarity of the scenario and backcasting methods in the field of forest sector studies.

According to Dreborg (1996), backcasting methods are suited for long-term issues in comparison to the traditional forecasting approaches strengthening ongoing trends, which prevents observing alternative pathways or breaks in trends. Backcasting is particularly suitable for determining long-term future visions, and for analysing potential alternative developments of complex issues, e.g., such as technological changes (Phdungsilp, 2011; Doyle and Davies, 2013; Dreborg, 1996; Mont et al., 2014), and in creating visions of preferable future development, and in finding ways to adapt to or influence changes in the future (Quist and Vergragt, 2006). According to Bibri (2018), it is viewed as a natural step in operationalizing sustainable development within different societal spheres due to its normative, goal-oriented, and problem-solving character. In line with Wangel (2011), we thus benefit from applying backcasting as a participation-oriented workshop technique, but also having results-oriented view for identifying the future pathways.

In the context of depicting the ideal future, the backcasting process begins with defining a vision(s) of the future from normative perspective, and then identifying pathways to reach it (e.g., Höjer and Mattson, 2000). This is a clear difference compared with e.g. econometric forecasting models that use historical data to create a prognosis of the future based on a model of historic interlinkages between the underlying factors. In our study, we sought to create preferable future visions of the Finnish IWC sector and its export potential by applying a participatory backcasting approach. This approach helps to recognize future opportunities (e.g. Phdungsilp, 2011; Quist and Vergragt, 2006). In practice, the methodology used in this study comprises a systematic foresight visioning exercise of potential export development pathways by 2030 in the context of the Finnish IWC sector. This also enables systematically identifying measures to reach such preferable futures.

International market selection (IMS) approach (e.g., Andersen and Buvik, 2002; Brewer, 2001; Sakarya et al., 2007) has been employed to identify key elements and criteria for assessing potentially attractive export markets. IMS literature comprises of a variety of approaches (e.g. Papadopoulos and Martin, 2011). However, IMS research commonly draws attention to several important key issues for assessment, such as political, cultural, demographic, social and economic environments, geographic location and reachability, industrial structure and advancement of technology, religion and education (Baorakis et al., 2017; Brewer, 2001; Wood and Robertsons, 2000). The IMS approach may also include identification of potentially attractive customer segments (Papadopoulos and Martin, 2011). This is a relevant consideration

also in this study, focusing on new products which do not yet have well-established markets. The IWC business is rather fragmented and the firms tend to be small and medium sized, but small firms can also benefit from the systematic selection procedures of international markets (Brouthers and Nakos, 2005).

In this study, we applied the IMS approach, and used the key elements introduced by Brewer's (2001) process model. In practice, the key elements presented by Brewer (2001) were used as guidelines in framing the questions in the expert panel surveys and instructions and information given to the participants in the participatory workshop. The background information provided for the experts included statistics on exports of wood products from Finland. These key elements were tailored and made to fit the case of IWC/WMC markets with the help of the literature (see e.g. Nordin et al., 2010; Riala and Iloa, 2014; Hurmekoski et al., 2015; Toppinen et al., 2019), and three thematic Finnish IWC sector expert interviews.

### 3. Data and methods

In the study, our focus was on the exports of industrial wood construction products, technologies and services, and visions of the preferable future development of such markets. These products and technologies are not yet well-established in any market, including Finland. Statistical data to assess the future market potential were therefore limited regarding our research object. We chose to use backcasting as one of the normative approaches in futures research. The backcasting approach in this study relied on a panel of Finnish experts from wood industry and wood construction sector. The aim of the analysis was 1) to determine preferred future visions of exports of industrial wood construction products and services from Finland by year 2030, and 2) to capture an understanding of potential development pathways, including policy measures needed, for reaching the visions (Fig. 1).

The foresight visioning procedure is based on a backcasting exercise conducted with the panel of Finnish IWC sector experts (explained in more detail below). By relying on the IMS and the WMC literature cited above, the following factors were identified as important aspects to consider in assessing potential future exports and export markets for industrial wood products: 1) Acceptance of wood; including building regulations and consumer attitudes, and 2) Demographics; including market volume growth, urbanization, and population development.

To design the backcasting process in more detail, the current state of the Finnish industrial wood construction sector and its exports had to be assessed first. Background data for this included statistics and other secondary material (see Appendix 1). In addition, three thematic interviews with wood construction sector experts provided background data for the authors about the Finnish IWC sector. These results were used as a background in wording the IMS key elements more tangibly and relevant in the case of the Finnish wood industry for the backcasting panel exercise guidelines, and the pre- and post-workshop survey questionnaires. The backcasting workshop, and the pre- and post-workshop surveys constituted the core elements of the data-collection (see Fig. 1).

For the foresight backcasting workshop, 72 Finnish experts were invited via a personal email invitation in January 2019. The wide target group included experts employed in the public and private organizations related to the wood industry and wood construction including the whole value chain, which made the process participatory and open. In the end, 35 experts accepted the invitation and attended the backcasting workshop organized in Helsinki on 13 February 2019. Among the 35 workshop participants, 14 had industry background, 14 were academic experts from either wood based value chains or educational sciences, 6 represented either national or local policy makers and 1 was from media. As far as it was possible to assess, there was little difference in terms of the professional backgrounds and levels of experience between those who were invited and those who participated. The final

composition of participants was representative in terms of the rather specific area of expertise targeted, focusing on industrial wood construction markets and exports.

In addition to the backcasting workshop, the panel of experts received a survey questionnaire both before and after the workshop. These pre- and post-workshop survey questionnaires (thematic, semi-structured) were shared with the panel members through an electronic survey tool. The survey results served to introduce the panel members to the theme of the workshop, and supported the design of the themes to be addressed in the actual workshop (pre-workshop survey), and in deepening the visions created at the workshop (post-workshop survey), particularly regarding future export products and markets. The panelists answered the pre-workshop survey when they registered for the event (27 responses). The survey themes are shown in Appendix 2.

The backcasting workshop for the expert panel started with eight presentations providing various insights into wood construction exports and products in Finland and globally. The actual foresight envisioning activity started by dividing the panellists into five teams based on their various backgrounds. Each team had similar instructions and tasks: to envision the future of the exports of Finnish industrial wood construction in 2030 (including key products/services, and key export regions, and factors driving the changes) with the help of the pre-prepared guiding questions provided by facilitators.<sup>1</sup> The questions followed the international market selection model (IMS), which was built around our study context with the preliminary expert interviews (see composition in Appendix 1) and the pre-workshop survey results.

After coming up with the future vision, the teams concentrated on analysis of the current markets. Next, the teams identified the resources and measures necessary in 2020 in order to achieve the future vision by 2030.<sup>2</sup> Lastly, the teams drew up a development path leading from 2020 to the optimal vision in 2030, including the policy instruments and other actions needed to support the envisioned development. As part of this, an ideal mid-term condition of the Finnish wood construction industry and its exports in 2025, was also formulated. These time points were to help to address the themes being assessed or envisioned at different phases.

The facilitators assisted in documenting the outcomes, including the team's actions and comments, and kept track of the time. In the last hour of the backcasting workshop, two of the five teams presented and grounded their visions, including the development pathways and the identified the necessary actions to follow to this pathway from the current situation. Other teams commented on the foresight visions presented according to their own team's outcomes.

After the workshop, a follow-up questionnaire was sent to the experts who had attended the workshop to collect more detailed data about the key export countries and export volume development (11 responses) (Appendix 2). The backcasting process thus included collecting data from 1) the pre-workshop survey responses of 27 panel experts (individual responses), 2) the workshop data (five teams, in total 35 panelists), 3) the post-workshop survey responses of 11 panel experts (individual responses).

<sup>1</sup> A researcher/student familiar with the topic.

<sup>2</sup> The year 2030 is decided for the future assessment because many European wood industry's promotional organizations position papers and political enhancement strategies have been drawn up for 2030. This includes *Manufacture Vision 2030: Competitive, Sustainable and Resilient European Manufacturing by Manufacture High-Level Group* (2018), *Revised vision 2030 for the European forest-based sector by the European Forest Technology Platform* (2012), and *Government report on the National Energy and Climate Strategy for 2030 by Finnish Ministry of Employment and the Economy* (2017).

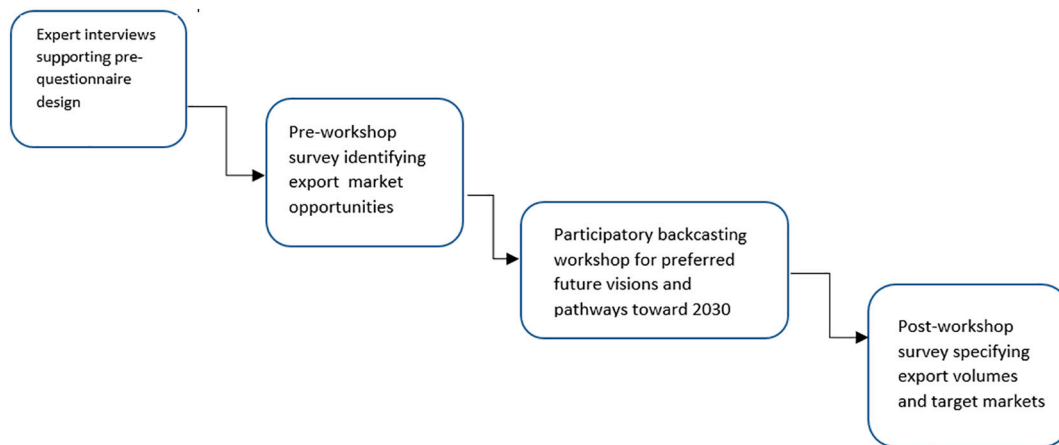


Fig. 1. Participatory backcasting process of the study.

4. Results

4.1. Expert visions on industrial wood construction sector and exports by 2030

The future visions about the Finnish industrial wood construction sector, exports and the development pathways towards 2030 are

presented in this section as projected by the experts participating in the backcasting workshop. The data from the expert panel pre- and post-workshop surveys were used to create a more nuanced and in-depth understanding about the variations in the visions and the related pathways. These insights are authenticated by using citations from the participants.

Five visions resulted from the backcasting workshop to foresee

Table 1

Key features of the visions created by five teams of the industrial wood construction sector in Finland, and its exports in 2030.

	Team 1	Team 2	Team 3	Team 4	Team 5
Key characteristics of the Vision 2030, including type of exports, target regions (T), drivers of change (D)	Export of expertise and services T: <i>Cities in Europe, seismic activity regions, Japan, China and Australia</i> D: Existing networks and strong co-operation with the key players in the sector, high levels of knowledge on concepts of wood construction	Export of concepts and projects, specialty service buildings (e.g. kindergartens, luxury multi-story buildings) T: <i>The Nordic countries, Russia and China</i> D: High quality and speed of wood construction projects, in-depth understanding of the customers	Export of value-added materials, know-how, integrated projects T: <i>China, Africa, Germany, France, the UK and the Nordic countries</i> D: Well-established ecosystems among the industry and the sector, and Smooth communication, information on wood construction is well available	Export of materials, (service) concepts and projects (e.g. combining building and education), know-how, wooden multi-storey buildings Value-added materials have a higher proportion of exports than projects T: <i>Increased exports to China and Africa</i>	Export of value-added materials and projects T: <i>China</i> D: Customers and society are familiar with wood construction, IWC industry is well-developed
Milestones reached and additional measures needed (A) at Mid-term (2025)	Consumer demand has increased for wooden apartment buildings Finnish companies invest in specialization such as hybrid construction solutions, retrofits with wood, and providing wood-based solutions to cities A: <i>Co-operation with neighbouring countries, open digital platform for connecting wood construction operators</i>	Building regulations are increasingly harmonized between the Nordic countries, ideally also between the EU countries A: <i>Activation of international students for branding Finnish wood construction for export markets</i>	Export (volumes) have increased, growth continues Finnish WMC companies operating internationally Companies provide also concept-type solutions to the markets, not only materials Finland exports more value-added materials to Asia than in 2020 Global increase in carbon emissions provides a boost for the IWC growth	Pilot projects have been successfully exported, export of concept-type projects has increased Architectural competence has widened, international students have been involved in the business and export More suitable funding instruments have been developed that provide opportunities to the IWC sector	Wood construction projects have increased in the domestic markets, export of value-added materials has increased Increased exports especially to Asia The competence of international students in marketing and branding of wood construction internationally has been tapped into
Key measures needed presently (2020)	Co-operation between relevant operators and stakeholders to be accelerated, particularly ministries (the Ministry of Education and Culture and the Ministry of Environment), construction industry companies, education sector and investors Development of new business concepts, expertise and capacity in the IWC sector to be accelerated	Domestic market activation, more wood construction projects to be initiated nationally Building regulations (and implementation) to be harmonized, at least in the domestic market and between municipalities, including land use planning Co-operation between the Nordic countries to be increased, e.g. in the field of regulation harmonizing	Co-operation between the key players in the IWC sector to be extended Specific education programmes to be launched for building capacity Business networks for open communication and peer learning to be created	Level of education in wood construction to be increased and widened, including knowledge on raw materials	Co-operation and trust between the players in the wood construction sector in Finland to be increased Understanding of market specific standards in WMC to be increased

growth and exports of the IWC sector, by 2030 and Table 1 describes the key elements of each of the five visions produced at the workshop. The pathways from the current (2020) to 2025 and finally to 2030 have also been described in each case. However, assessing the pace of growth, i.e., the volume or value growth of exports in numeric terms was challenging and remained open. This challenge was also demonstrated in the post-workshop responses, which included a wide range in the prospected growth ranging between 30% and 500%, and a quote from a participant:

*“It is difficult to imagine the numbers. However, I assume that the increase will be considerable, if we are able to add production capacity, which at the moment is quite small.”* [Panellist, Research 1].

The preferred future visions created by the expert teams varied, e.g. in terms of export products – particularly the degree of emphasis on value-added products and projects. There were also variations regarding the type of projects or end-uses of buildings to be provided to export markets. While the wood construction literature tends to focus on the residential segment, the resulting visions commonly indicated various kinds of specialty or service-related buildings as potential areas of export growth, such as schools, kindergartens, or senior care homes.

The most attractive markets for future exports, as foreseen in the five visions, included the developed markets in Europe. For instance, the Nordic countries, France, the UK and Germany were identified as particularly interesting regions within Europe. Asia, and particularly China, was highlighted almost unanimously. Africa was also mentioned, but only in some of the visions.

The envisioned growth of the Finnish IWC sector, both on domestic and export markets, was seen to incorporate building up new partnerships and business ecosystems, also with the construction industry in neighbouring countries. The lack of specific industrial wood-construction-related education was commonly noted as one of the key challenges for accelerating growth in domestic markets, and of the sector generally (with a similar finding emerging recently from Korhonen et al., 2021). The need for harmonizing product and building regulations, foremost between the Nordic countries, but also more broadly, was clearly underlined. These changes are assessed as being necessary in promoting growth of service-based solutions, which are designed to meet customer needs. An example of new service-based solutions was the concept of combining early childhood education (kindergarten care or pre-school education services) with building solutions. The preferred vision (largely shared by the all teams) was that wood products might play an increasingly facilitative role in providing more intangible and broader benefits (such as sustainability) than mere buildings or renewable building materials (see also Häyriinen et al., 2020).

The workshop visions also highlighted that it would be necessary to create growth in the domestic market first, which already requires several of the development actions identified necessary for export growth. The results also underlined how it is critical for the partners in the Finnish IWC industry to find new non-wood construction industry partners to build competitive and capable business ecosystems (e.g., industrial operators from other sectors, builders, designers and others in

**Table 2**

Summary of the visioned future (2030) of IWC exports from Finland, and the actions needed to reach the envisioned state from current towards 2030, as viewed by the expert panel.

	Key characteristics of the markets, industry and exports at different phases	Approaches and activities needed to reach development from one phase to the next	Examples
Current 2020	Co-operation and building of business networks for growth and the development of new business concepts	Domestic market activation and network building to scale up operations	Activation of ministries, the education sector
	Carbon storage or emission reduction options of WMC identified	Development of standards and regulations (domestic)	Creating entirely novel business networks to support the development of service-solutions based on wood materials
	Consumer and public interest in WMC at initial level (climate and well-being background)	Attracting both large and small companies to WMC business	Encourage large Finnish cities to take up wood building
		Harmonizing domestic (municipal) land-use planning and city-planning regarding WMC	Education programmes to increase the expertise in the WMC sector
Mid-term 2025	Clear growth of volume occurring in the domestic market	New models for co-operation with neighbouring countries	Value-added materials exported in larger volumes to Asia
	Industry has shifted from pilot phase to operating at an industrial scale	Open digital platforms	Branding of WMC, especially to the Asian markets
	Increased consumer demand for WMC/IWC products domestically and in the export markets	Methods for calculating Carbon storage/sequestration in wood buildings	Building well-functioning WMC ecosystems, several of these active and operational
	A system for assessing Carbon sequestration/storage of WMC solutions in place	Harmonized building regulations, at least between the Nordic countries, and ideally within the EU	Making use of international students to support brand and concept building suitable for export markets
Vision 2030	Clearly more developed industry and higher exports value c.f. previous stage	Open, harmonized standards for products (systems) of WMC	Export of service projects: Schools and kindergartens combined with pedagogical or educational systems, care buildings, e.g. elderly people's homes and hospitals
	Value-added products further developed	Customer insights well incorporated in the design of buildings and in the projects	Multi-story residential buildings as an export concept
	<u>Export of:</u> Know-how and services (solutions)	Flexibility in the design of buildings based on customer preferences	Value-added products, modules and materials
	Projects integrating materials or modules	Speed of the construction has increased considerably (WMC) and reached competitive BAU level in the general construction sector	
Future export countries/ areas:	Wooden buildings as solutions to city development		
	<b>Asia/China</b> - large growth market and growth-economy, growing environmental emphasis <b>The Nordic countries</b> - well-known markets with a wood building culture, similar cultures to Finland, geographical closeness, well-developed economies <b>Germany / the EU countries</b> - culture to build with wood in some regions / overall emphasis on environment, well-developed economies <b>Japan</b> - environmental awareness, exports of value-added materials from Finland exists, ageing population and need for service buildings <b>Russia</b> - export of log houses from Finland, possible interest in other wood construction concepts		

service business, such as education experts). Overall, shifting towards new business ecosystems and inclusion of new actors characterizes the future vision for the wood products and related solutions for wood construction industries.

Increasing the competitiveness of industrial wood products and the business was underlined as a necessary step for future export market growth. This is based on improving cost efficiency and the ability to respond to industrial clients but also to consumer needs. This presumes shifting to industrial-scale operations in production. The results indicated an overall need to broaden the education and expertise needed in the wood products industry, echoing the results by Korhonen et al. (2021). Table 2 combines the five future visions and pathways described in Table 1, followed by a more nuanced description of the actions needed for market development, as well as points out the identified key challenges.

All the visions considered that Finnish wood products and the wood construction industry has potential and should target international market growth. Climate benefits, particularly the ability of wood to provide carbon storage, and overall environmental and health issues were identified as important drivers for growth of the use of wood in construction, particularly in the urban contexts. The challenges slowing down growth were identified similarly in the visions: the lack of an educational base and thus skilled people in the sector currently, the absence of harmonized standards, and impetus for competition rather than partnerships by the Finnish actors.

How about the discussed measures to reach the envisioned development paths? Domestic market uptake of IWC was clearly presented as the first and necessary stage for export growth in the visions, and it was also considered possible during the next five years. However, strong development of educational capacities was considered as a necessary step regarding the growth of exports. Building stronger networks and co-operation between countries, particularly Finland, the other Nordic and Central European countries, were considered to be a promising way to achieve a broader scope of know-how and international market access (also, e.g., Hietala et al., 2019).

Digital communication and networking platforms were considered to be important to facilitate a new kind of business collaboration, for instance between industrial and service business actors. For example, establishing open digital platforms were considered important for sharing knowledge on themes such as building systems, and for the development of common building standards, or to avoid multiplying mistakes in trial and pilot phases. Some of the workshop teams mentioned that harmonizing standards within the Nordic countries would be beneficial for the business and export growth. This harmonization will need to have advanced considerably by 2025 in order to reach the future visions in 2030.

Regarding the policy measures to accelerate the pathways leading to the 2030 visions, the view that government bodies, particularly relevant ministries needed co-ordination in enhancement policy, was unanimously shared by the five teams. Developing the education system was also considered crucial in each vision: gaining fresh expertise covering themes relevant to IWC were seen necessary for enhancing the innovativeness of the sector and to fuel the growth of the exports. Launching additional policy programmes to enhance wood construction were also indicated, e.g. through developing common standards and facilitating changes in the building regulations in Finland. Furthermore, harmonization of the practices of the zoning in the Finnish municipalities was suggested as one option to enhance the growth of domestic wood construction market, in line with Lähtinen et al. (2019). As examples of other tangible activities, several visions included the idea of integration of international students and the use of their potential in developing understanding of export markets and to activate marketing would be a new opportunity to explore.

All the visions included improved communication to be a prerequisite for more efficient co-operation within the IWC sector. On the other hand, improved cultural and country-specific know-how of the

potential export countries, knowledge of the housing and planning concepts, and better understanding of the customer segments were identified as immediate targets for accelerating WMC-related exports.

#### 4.2. Potential export products and markets for the Finnish IWC sector

The future visions resulting from the backcasting workshop varied regarding which products and services were foreseen to dominate exports in 2030, and in which specific markets. Thus, the identification of interesting markets was combined with identifying both the promising (new) products and services and the underlying varying demand factors. However, all the visions included the idea of shifting towards more value-added and knowledge-incorporating products and services. This implies that the degree of processing within the Finnish IWC sector should increase by 2030, which would then be reflected in export value.

At its extreme form, the envisioned future exports mainly incorporated wood construction projects that facilitate the provision of services. For instance, these services could include (early) childhood education services, other education services or senior care. The envisioned service concepts could thus incorporate both building facilities and the core services accommodated by the buildings. Construction projects could incorporate design or other know-how in combination with wood-based materials, and even the actual construction service of the buildings. Some teams drew a growth vision for 2030 in which wood products and materials would be a major proportion of the exports. The following comments were collected from the pre-workshop questionnaire and demonstrate variations in the expert views.

*"[Exports will be] Know-how and materials. Construction is local."* [-Panellist, Producer of Wood Modules].

*"It is not sustainable to achieve the export of construction projects, because the quality of construction is so low in Finland."* [Panellist, Officer, public sector].

*"The development of the export of know-how, solutions and innovation activity. Increase of degree of processing in the products: prefabricated elements and modules for export."* Panellist, Wood Construction/Product Company 2].

When identifying potential export growth products, schools and kindergartens were frequently mentioned throughout the process. Residential multi-storey wood construction was also mentioned by several expert panel teams as one of the promising applications. The data used in this study could unfortunately not address the applications in more detail, e.g. the type of structural systems or choice of wood-based (or hybrid) materials.

Interestingly, the ageing population was not considered to be a hindrance for IWC market development in Europe, but in some teams, this was even seen as establishing a positive demand factor. This was reasoned on the one hand through the anticipated need for new specialty service buildings and elderly homes, and their positive environmental/climate mitigation impacts, and on the other hand by consumers' increasing awareness of environmental and climate issues. The potential for future export growth was also considered within solutions to special situations or regions, such as housing solutions for seismically active regions. The following comments are examples from the pre-questionnaire responses

*"Care buildings, the population is ageing in all developed countries."* [-Panellist, Promotional Organization 2].

*"Construction after catastrophes, permanent, transferable, cosy and adjustable solutions."* [Panellist, Architecture Sector 1].

The most interesting future export regions for IWC sector products, as identified in the backcasting workshop, varied to some degree. However, China was mentioned by all teams as an attractive market. Reasoning for considering the Chinese markets included the large size of the market, urbanization and the growing middle-class with assumed growing environmental awareness. The other Nordic countries, with a similar culture, traditions of building with wood (in most countries), and geographical proximity, were considered to have the potential to grow

as export markets for the Finnish IWC sector. Europe in general and particularly Central Europe (e.g. Germany, France), and the UK by some teams, were assessed as potential market areas for growing exports. The reasons included growing environmental and climate concerns, ongoing urbanization, and in some countries, a strong tradition of building with wood.

Some markets were assessed as having potential only in one of the visions. Geographical proximity, and the tradition of building with wood, were mentioned as characteristics making Russia a potentially attractive export region. In addition to China, some other Asian countries were identified as interesting, such as Japan, or India. The reasons were the high-volume growth potential of the markets, and in some areas, increasing environmental awareness, or tradition in wood building. However, varying construction standards, regulations and building culture were identified as being likely to remain challenges for export market growth generally, as elaborated by some panellists in the post-workshop survey:

*“China is a huge market from which a tiny small block can be significant. Furthermore, the green politics in control.”* [Panellist, Official, Public sector 1].

*“Growing a wood construction culture and environmental awareness in Europe (for instance Germany and France)”* [Panellist, Wood Construction/Product Company 2].

*“The need for apartments in an ecological way, speed is an advantage due to the shortage of labour – Eastern Europe and developing countries globally.”* [Panellist, Wood Construction/Product Company 3].

## 5. Discussion

The aim of this backcasting study was to explore preferred visions on the development of the industrial wood construction sector and particularly its exports by 2030 in the case of Finland. However, the authors recognize that it would have been possible to combine backcasting approach with other foresight methodologies (e.g. Mont et al., 2014), such as using Delphi panels or exploratory scenarios (see e.g. Zimmermann et al., 2012). From the methodological perspective, e.g. Börjeson et al. (2006) and Burt and van der Heijden (2003) state that futures studies are mainly based on a qualitative approach with a focus on complex or novel topics lacking explicit data, whereas in the forest sector, the quantitative scenario studies have been more predominant (see e.g. Sjølie et al., 2016). The openness of a participatory backcasting approach chosen should sufficiently safeguard reliability and validity of the data, particularly when the panellists had solid expertise in the sector, its markets and the terminology used. The final composition of participants was representative in terms of the required, specific area of expertise focusing on WMC exports.

More precisely, this backcasting study drew insights from a panel of 35 Finnish IWC sector experts. In the backcasting process, future visions of wood industry exports and the development paths from 2020 to 2030 were produced through the foresight workshop and complemented with participant responses before and after the workshop. The international market selection (IMS) approach, and more precisely, the IMS process model presented by Brewer (2001), was employed to guide the selection of key elements to be assessed. In our opinion, there is indication that the data collected were likely to cover the phenomena related with the research themes adequately, since no new issues were brought up during the third round of data collection (the post backcasting workshop survey). The results are also logically based on earlier research (e.g. Toppinen et al., 2019) and aligned with the conceptual background of IMS.

It should be noted that although a single-country qualitative backcasting study cannot be directly transferred to other countries, we may assume that similar demand-side characteristics could show up if a similar approach was implemented in other countries especially those in the Nordic area. The results may also provide interesting implications

for other countries, particularly in northern Europe (e.g. Sweden, Norway), regarding lucrative export market areas and segments, even though the results should not be generalized as such. However, in Sweden the focus may be even more strongly on the domestic market due to its general growth trend.

Based on the resulting visions of the Finnish IWC sector exports in 2030, the expert views could foresee growth in the Finnish industrial wood construction sector and its exports by 2030. However, there was variation in the envisioned composition of export portfolios by 2030, as well as the potentially attractive market areas. In other words, identifying and assessing potential future export markets includes not only geographical markets as in the case of traditional IMS approach, but also identifying potential user/client segments for new products/services. In summary, the envisioned future was geared towards increasing value-added products and materials, and accordingly towards increasing exports of know-how and services in addition to materials and products. A shared assessment was that the domestic market needs to develop and grow first, importantly serving as a test bed for the new products and services. The domestic market is also an important platform for developing necessary new business models and partnerships for new product and service concepts.

In terms of geographic regions for future exports, Asia, the Nordic countries (especially Sweden and Norway), Central European countries (France, Germany), and the UK were seen as having growth potential. In Asia, China was particularly considered to be an interesting potential export market by the backcasting expert teams. The reasons include the large volume and the continuing growth trends of the market, rising environmental awareness, an increasingly-wealthy middle class, and rising urbanization.

On the other hand, construction and the overall culture are similar in Finland and in the other Nordic countries, along with the benefit of being geographically closer. Even though the Nordic countries are relative low in population and small regarding the volume of the construction market, the backcasting panel experts shared the assessment that the culture of industrial wood construction, and high acceptance of wood construction in society, were important characteristics of an interesting export market area. This is in accordance with the literature on wood products and construction markets (Hurmekoski et al., 2015; Rebane and Reihan, 2016; Markström et al., 2019). This is also the case when the panel results identified highly-populated and wealthy countries as interesting (Hurmekoski et al., 2015). Rising (or already high) environmental awareness was considered to be a particularly important characteristic for an interesting export area, which supports the assumption of sustainable bioeconomy being a key driver for industrial wood construction and WMC (e.g., Toppinen et al., 2018). For this reason, Europe was considered to be interesting and a potential region for export growth despite the stagnating population growth and ageing population.

Interestingly, the results from the backcasting process indicated more opportunities than threats connected with countries having an ageing population. Most likely such a result might not have been received if the study had been based on analysis of statistics or structured surveys. Generally, the backcasting procedure resulted in identifying a number of lucrative future export regions, such as countries where cultural, political and economic characteristics are significant and there are growth expectations in the market volume due to geographic location, industrial structure or other factors like demographics or level of education. Lack of resources in marketing and brand-building were also identified as a challenge for the growth of the sector, in line with the results by Hietala et al. (2019).

The policy measures identified as being required to reach the envisioned future exports include harmonizing domestic land-use and construction regulations first, and then international, at least at the Nordic or EU levels. Harmonizing standards were also underlined, even though it is not necessary an issue for public policies. A third important measure identified by the experts was developing the education base, which is

expected to lead towards an increase of competence and know-how in the sector. The consensus was that the domestic market needed to grow and develop first, and only based on this experience and new partnerships would exports grow.

Several of the measures identified have been considered to be important for the growth of the WMC sector and wood industry in previous research focusing on Finland (e.g., Hurmekoski et al., 2018; Toppinen et al., 2019). Limited availability of well-educated experts and professionals has been highlighted in previous research as one of the more important factors influencing the development of the wood construction sector (Hurmekoski et al., 2018; Toppinen et al., 2019). Interestingly, the potential for utilizing international students to open up an understanding of export markets or building the capacity base quickly was highlighted by several expert teams.

The international market selection (IMS) approach, and the process model presented by Brewer (2001) were utilized to create a set of key elements for systematically assessing the attractiveness of export markets for guiding the backcasting data collection. The IMS approach was developed to capture firm-level decision making, while our study was based on an industry sector level and focused on new or innovative products with immature markets. However, the IMS approach supported the backcasting data-collection and procedure design appropriately, while we utilized the IMS process model as a guideline on a sector-level export market potential assessment. The IMS approach has been designed into well-established products while in the case of assessing potential future export market development of newly designed products having the status of immature niche markets, the approach of viewing market segments in combination with market areas seems more relevant (e.g., Papadopoulos and Martin, 2011). Firm-level market investigation in the case of new innovative products with a niche market position remains an interesting area for future research. For example, in construction industries, company-level path dependencies can slow down the possibility to adopt new industrial building technologies (Stehn et al., 2020). In addition, our results indicate emerging markets deserving growing attention in future IMS research, as suggested by Sakarya et al. (2007) more than a decade ago.

Overall, several specialty service buildings were identified as interesting exports opportunities, along with WMC residential buildings, or materials or modules needed in construction. Issues that may not have been brought up previously regarding the development agenda of the wood industry include completely new business concepts for exports, such as combining early education services or care services and tailor-made buildings. In this respect, the method of backcasting may have opened up new and non-traditional solutions to facilitate a positive market development for the wood industry. It is important to note that such new (export) concepts will require new business partnerships and ecosystems that cross sectoral boundaries. Overall, new business networks, partnerships and digital communication were strongly underlined in this study, compared with earlier research.

Considering the complexity of the research topic and limited knowledge on some issues, the results of this study need to be treated with caution, as in any qualitative study. A key challenge for this study was the focus on identifying and assessing potential future development pathways for products and services that are still in a niche in the construction sector. The opportunity for context-related bias has been diminished by focusing the data collection on Finnish experts with a

solid background in the wood construction sector. However, this selection criterion also means that the views do not necessarily represent those of the construction industry as a whole, and the representatives of wood industry and academic community dominated the sample. Similar challenges have been documented in an expert workshop based study by Korhonen et al. (2021), focusing on wood construction, packaging and biorefinery value networks. It also seemed easier for the experts to create an understanding of future visions than specify the pathways to get there and by what measures, a similar finding to that of Sandström et al. (2020). Finally, the allocated time for building visions was a single foresight workshop, and therefore time limitations could be a limiting factor to building sufficiently in-depth visions or the description of the measures needed to facilitate the development path-way.

## 6. Conclusions

The results of this study suggest that the backcasting method and combining it with the IMS approach may be appropriate for foresight analysis in such a multi-dimensional and complex case as future market development of industrial wood construction products. The resulting visions by five expert teams differed from one another in terms of export portfolios, varying from emphasis on more traditional value-added wood products to service-based solutions. Overall, the resulting visions from the backcasting process anticipated IWC growth. However, the envisioned growth presumes major changes within the domestic IWC sector, and a shift towards more value-added products and combining products with service elements. This more intense collaboration calls for developing not only products but also business ecosystems. Domestic market support in building up competencies and experience is crucially needed to fuel the exports.

Still, using richer data (e.g. more comprehensive range of building experts) and applying the IMS approach in the context of more product-specific cases would be important in the future research. In the future, a systematic analysis of the future export market selection in the case of more specified new products/services and firm-level approach would be interesting, complementing the sector-level foresight focus highlighted in this study. More comprehensive research on potential buyer segments would be also an avenue for future research, especially since the results of this study indicated variations in terms of underlying demand drivers in the various potential market areas.

## Declaration of Competing Interest

We declare no conflict of interest.

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## Appendix 1: Table of background expert interviews

Organization type	Method	Duration (min)	Title/ position
Construction Group	Face to face	59	Manager
Wood Manufacturing Company	Phone	32	Director
Real Estate Developer	Face to face	45	CEO



## Appendix 2: Questionnaire themes

Questionnaire for thematic interviews:

1. What challenges have you faced in the industrial wood construction markets in Finland?
2. Which matters lead to competitiveness in the planning of wood construction buildings?
3. How do you see that industrial wood construction markets have developed in the last ten years in Finland?
4. How do you see that the WMC markets will change in the next ten years?
5. What came to mind concerning the export of wood construction??
6. What will be exported from Finland (wood products, know-how, value-added materials) in 2025 or 2030?
7. What is needed for Finland to become an exporter of WMC in 2025/2030?
8. Where will the growth opportunities for Finnish industrial wood construction be in 2025 or 2030?
9. Who are the buyers of WMC in export markets now, and who will be in the future (2030)?
10. Which actors or networks are needed to export WMC?
11. What exports of WMC are we likely to see from Finland in 2030?

The Backcasting Panel Questionnaires:

### 1. Pre-backcasting workshop panel survey

\*WMC = Wooden Multi-storey Construction, meaning two floors or more, with either wood frames or hybrid wood elements and materials

- (1) What should Finland try to achieve in industrial wood construction exports in 2030, in the export of materials (like CLT), in know-how or construction projects?
- (2) Which are the more promising export countries for industrial wood construction products/projects/know-how from Finland in 2030?
- (3) In which entities do you see the greatest potential for wood construction exports in 2030?

### 2. Post Backcasting Workshop - Panel Survey

- (1) Which three countries will be the most significant export countries for export of industrial wood construction and its value chain in 2030?
- (2) Why do these countries have the greatest market potential? Analyse this by country. How much would the export value of value-added materials (CLT and LVL etc.) increase by percent between 2020 and 2030 in ideal conditions?
- (3) How much will the percentage export value of projects increase between 2020 and 2030 in ideal conditions? Which questions/themes should arise or be studied related to wood construction exports in the future?
- (4) In your opinion, which questions/themes should be brought up in future research on industrial construction of wooden houses and on the favourable development of their exports?

The Backcasting Panel - Thematic questions for directing the backcasting panel workshop process.

### 1. 2030 - Creating the vision

The group created the vision of desired prospects of industrial wood construction exports in 2030, describing the desired stage by following questions:

#### 1. Which of the following entities are exported most by value?

- Value added materials (CLT, LVL etc.)
- Entire industrial wood buildings (projects)
- Half-finished solutions (for instance, modules, large panels)
- Know-how/service of industrial wood construction?

#### 2. Which of these values will have increased the most between 2020 and 2030? Why these?

#### 3. What are three main entities for exporting industrial wood construction? And why these?

- Service buildings (school, kindergartens, hospitals)
- multi-storey buildings (for residents and companies)
- one-family houses
- culture/sports etc.
- other, like like catastrophe objects

#### 4. Which countries will be the five most significant export countries for export of industrial wood construction in 2030? And why these (briefly)

Crystallize the vision in one sentence or motto.

### 2. Starting point

Create the picture of actions needed in the starting point (2019/2020) to reach the 2030 vision.

- Which are the most important actions and changes in methods, which is needed to reach the 2030 vision?
- for instance, new co-operation models
- actions in private and public sectors
- How are the main actors related to these? List the actors and the actions.
- Which are the competitive factors for the companies at the starting point?

### 3. Status in 2025 (intermediate stopping point)

The group created a picture of the status of exports in industrial wood construction in 2025

1. Which of the following entities will be exported the most by value?
  - Value added materials (CLT, LVL etc.)
  - Entire industrial wood buildings (projects)
  - Half-finished solutions (for instance, modules, large panels)
  - Know-how/service of industrial wood construction?
2. Which three entities for export of industrial wood construction will be the most notable? And why these?
  - Service buildings (school, kindergartens, hospitals)
  - Multi-story buildings (for residents and companies)
  - one-family houses
  - culture/sports etc.
  - other, like catastrophe objects
3. Which are the five most significant export countries for export of industrial wood construction in 2030? And why these (briefly)

The group creates the picture of actions needed in the intermediate stopping point to reach the ideal prospect in 2030

- Which actions and changes in methods will be the most important, which will be needed to reach the 2030 vision?
- for instance, new co-operation models
- actions in the private and public sectors
- How are the main actors related to these? List the actors and the actions.

What are the competitive factors for the companies at the starting point?

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