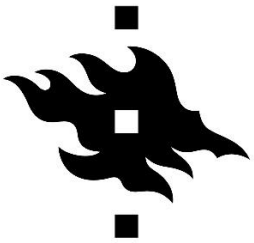

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FACULTY OF AGRICULTURE AND FORESTRY

ASSESSING EXPORT MARKET ATTRACTIVENESS FOR FINNISH INDUSTRIAL WOOD CONSTRUCTION SECTOR

MASTER'S THESIS

FOREST ECONOMICS AND MARKETING

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Tiivistelmä – Referat – Abstract

The aim of this study is to assess future export markets for the Finnish industrial wood construction sector. This is done by analysing secondary materials, previous studies and creating a future vision of Finnish industrial wood construction sector and particularly its exports by the year 2030. This analysis is based on qualitative individual expert interviews and a backcasting analysis using expert panel data. In addition, the study compares the current status of the forest industry exports and future assessments between Finland, Sweden and Estonia by analysing secondary materials, previous studies and expert views.

The study was implemented using two different qualitative data sets. Semi-structured thematic expert interviews were collected from Finland, Sweden and Estonia. Expert interviews were used to get an in-depth understanding of the current status of the domestic industrial wood construction sector and the related export opportunities in Finland, Sweden and Estonia. A panel made up of Finnish experts were invited to create an ideal vision of the industrial wood construction sector in Finland and its exports for the year 2030. The panel gathered at a workshop, where their visions were created. In addition, pre- and post-event-questionnaires were part of the expert panel data collection, and this data was used to identify the most promising export countries/regions and the entities of exports in the industrial wood construction sector (e.g., whether to export materials, modules or construction projects).

The results emphasised that concrete collaborative actions are needed as soon as possible in knowledge sharing and the industrial wood construction marketing. Based on the International market selection model (IMS), which is employed in this study and combining all the information from the workshop, interviews, literature and questionnaires have proven that the most promising future markets would be Central Europe, the UK and the Nordics by 2030. Otherwise the Finnish expert views of most promising export entities by 2030 varies between products, know-how and projects. During the research process it was realised that future markets need to take a closer look especially from the companies' perspective.

Finnish experts have varying views of the industrial wood construction export in their ideal vision for 2030. The study proved that the experts' views were divided. Many of them desired that Finland should export more know-how and projects in 2030. Others believed that Finland should concentrate on the export of value-added materials. However, all the experts agreed that Finland should activate the local market and harmonize the regulations, which has had a positive influence on competence and know-how. In the ideal vision for 2030 Finland has improved its networks and co-operation inside the forest industry but also together with other fields. Finland has an open digital platform for knowledge sharing and the standards and regulations are more advanced. The wood construction industry is ideally in 2030 more attractive for students and experts than now, domestic market is wider and Finland has gained more experience and knowledge in the field of industrial wood construction.

Finnish experts saw that the future exports markets for industrial wood construction are China, the Nordics, Germany, Russia and Central Europe. China was seen as an attractive market due to the size of the market, rising environmental awareness, wealthier middle class and increasing urbanization. However, China and other emerging countries have to be treated with caution, because they were not highlighted in the Estonian, Swedish or literature-based data analysis. Secondly, the Nordics construction culture is similar, location is nearby and the use of wood is increasing. Also, the harmonization of standards with Nordics came up in the expert data. Overall, the practise of industrial wood construction and environmental awareness are increasing in Europe, especially the countries where there are traditions in wood construction like countries in Central Europe. Swedish experts saw market potential and competitiveness in Central Europe and Eastern Europe, but the data from Sweden is limited to researchers' opinions. The Estonian experts saw market potential in the UK, Germany and Ireland by 2030. However, the future markets for industrial wood construction needs a closer look as well as export entities, which divided the expert's views.

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Industrial wood construction, Market research, Future studies, Backcasting, Value-added materials, Wooden multi-story construction

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Suomalaisen teollisen puurakentamisen vientimarkkinoiden vetovoima tekijöiden arviointi

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Tiivistelmä – Referat – Abstract

Tutkimuksen tarkoituksena on arvioida suomalaisen teollisen puurakentamisen tulevaisuuden markkinoita. Tutkimus on toteutettu analysoimalla sekundäärimateriaalia, aikaisempia tutkimuksia sekä luomalla tulevaisuuskuva suomalaisesta teollisesta puurakentamisesta ja erityisesti sen viennistä vuoteen 2030 mennessä. Tämä analyysi perustuu kvalitatiivisiin yksilöhaastatteluihin ja backcasting menetelmällä analysoituun asiantuntijapaneeli dataan. Lisäksi, tutkimus vertailee puutuoteteollisuuden tämän hetkistä tilannetta ja tulevaisuuden näkymiä Suomen, Ruotsin ja Viron välillä analysoimalla sekundäärimateriaaleja, aikaisempia tutkimuksia sekä asiantuntijoiden näkemyksiä.

Tutkimus toteutettiin kahden erilaisen kvalitatiivisen datasarjan avulla. Puolistrukturoidut temaattiset asiantuntijahaastattelut kerättiin Suomesta, Ruotsista ja Virosta. Asiantuntijahaastattelut käytettiin saamaan laajempi ymmärrys kotimaisesta teollisen puurakentamisen tämän hetkisestä tilanteesta ja vientimahdollisuuksista niin Suomesta, Ruotsista kuin Virosta. Suomalaisista asiantuntijoista koostuva paneeli kokoontui luomaan ideaali visiota teollisen puurakentamisen sektorista Suomessa ja sen viennistä vuonna 2030. Paneeli kokoontui työpajaan, missä ideaali visiot muodostettiin. Lisäksi, ennakko- ja jälkikyselyt olivat osa asiantuntijapaneelidataa. Tämä data käytettiin tunnistamaan lupaavimmat teollisen puurakentamisen vientimaat/alueet ja kokonaisuudet (esimerkiksi, viedäänkö materiaaleja, moduuleja vai rakennusprojekteja).

Tulokset korostavat, että tarvitaan mahdollisimman pian konkreettisia yhteisiä toimenpiteitä tiedonjaon ja teollisen puurakentamisen markkinoinnin osalta. Perustuen kansainväliseen markkinoidenvalintamallin, joka yhdistää datan workshopista, haastatteluista, kirjallisuudesta ja kyselyistä vuonna 2030 tulevaisuuden markkinat ovat Keski-Eurooppa, Yhdistyneet Kansakunnat sekä Pohjoismaat. Muuten suomalaisten asiantuntijoiden näkemykset lupaavimmista viennin kokonaisuuksista vuonna 2030 vaihtelevat tuotteiden, osaamisen ja projektien välillä. Tutkimusprosessin aikana tunnistettiin, että tulevaisuuden markkinat tarvitsisivat tarkempaa tarkastelua erityisesti yrityksien näkökulmasta.

Suomalaisilla asiantuntijoilla on vaihtelevia näkemyksiä teollisen puurakentamisen viennistä ideaali visiossa vuonna 2030. Tutkimus osoitti, että asiantuntijoiden näkemykset ovat jakautuneet. Useat heistä uskoivat, että vuonna 2030 Suomen tulisi viedä enemmän osaamista ja projekteja. Toiset taas uskoivat, että Suomen tulisi keskittyä jatkojalostetuiden materiaalien vientiin. Kuitenkin, kaikki asiantuntijat olivat samaa mieltä siitä, että Suomen tulisi aktivoida kotimaanmarkkinaa ja harmonisoida sääntöjä, millä on ollut positiivisia vaikutuksia kyvykkyyteen ja osaamiseen. Ideaali visiossa, vuonna 2030 Suomi on kehittänyt verkostojaan ja yhteistyötä metsäteollisuuden keskuudessa, mutta myös muiden toimijoiden kanssa. Suomella on avoin jaettu digitaalinen alusta tiedonjakoon, ja standardit sekä määräykset ovat kehittyneet. Vuonna 2030 puurakennusteollisuus on vetovoimaisempi opiskelijoille ja asiantuntijoille kuin nyt ja kotimaanmarkkina on laajempi. Lisäksi Suomi on kasvattanut tietotaitoaan ja osaamista teollisesta puurakentamisesta.

Suomalaiset asiantuntijat näkevät, että tulevaisuuden teollisen puurakentamisen vientimarkkinat ovat Kiina, Pohjoismaat, Saksa, Venäjä ja Keski-Eurooppa. Kiina nähtiin tulevaisuuden markkinana sen suuren markkina-arvon, nousevan ympäristötietoisuuden, vaurastuvan keskiluokan sekä lisääntyvän urbanisaation takia. Kuitenkin, Kiina ja muut kasvavat markkinat täytyy ottaa huomioon varauksella, koska niitä ei korostettu Viron, Ruotsin tai kirjallisuuteen perustuvassa data-analyysissa. Toisaalta, Pohjoismaissa on samanlainen rakennuskulttuuri, ne sijaitsevat lähekkäin ja puunkäyttö on lisääntymässä. Yleensä ottaen, teollisen puurakentamisen kulttuuri ja ympäristötietoisuus ovat kasvussa Euroopassa ja erityisesti maissa, joissa on puurakentamisen perinteitä, kuten Keski-Eurooppa. Ruotsalaiset asiantuntijat näkivät markkinapotentiaalia ja kilpailukykyä Keski-Euroopassa ja Itä-Euroopassa, mutta data Ruotsista on rajoittunut tutkijoiden näkemyksiin. Virolaiset asiantuntijat näkivät potentiaalia Yhdistyneessä Kuningaskunnassa, Saksassa ja Irlannissa vuonna 2030. Teollisen puurakentamisen tulevaisuuden markkinat ja vientikokonaisuudet, jotka jakoivat asiantuntijoiden näkemykset tarvitsisivat tarkempaa tutkimusta.

Avainsanat – Nyckelord – Keywords

Teollinen puurakentaminen, Markkinatutkimus, Tulevaisuudentutkimus, Backcasting, Jatkojalostetut materiaalit, Puukerrostalorakentaminen

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Pori, 4th of August 2019

Anna Lilja

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ABBREVIATIONS

CLT	Cross laminated timber
CO2	Carbon dioxide
EU	European Union
EWP	Engineered wood products
IMS	International market selection
LVL	Laminated veneer lumber
OECD	Organisation for Economic Cooperation and Development
UK	the United Kingdom
UN	the United Nations
VAWP	Value-added wood products
WMC	Wooden multi-story construction

ESSENTIAL TERMS

CLT: Multiple layers at least three layers of sawnwood, which are glued together from the right angles (Laguarda Mallo and Espinoza, 2015).

Engineered wood products (EWP's): PSL (Parallel Strand Lumber), LVL (Laminated Veneer Lumber), I-joint, Glulam, SIP (Structural Insulating Panel), CLT (Cross Laminated Timber) and Brettstapped (Ramage et al., 2017).

Glulam: manufactured from boards, which are laminated parallel to others (Ramage et al., 2017).

LVL: Rotary peeled veneers of spruce, pine or douglas fir of 3mm thickness (Ramage et al., 2017).

Wooden multi- story construction: The construction of more than two story high buildings, whose load bearing structure is mostly made of wood (Hurmekoski et al., 2018).

1 INTRODUCTION

1.1 Motivation for the study

Global drivers for using wood in construction

Drivers such as economic growth, urbanisation, trends in housing and construction, demographic and structural changes have an impact on demand for wood, including value-added wood products (VAMP'S) (Haapio, 2013; Gaston and Pahkasalo, 2018). Engineered wood products (EWP's), which are commonly used in construction are part of VAWP's, which comprise further processed secondary products (Hetemäki, et al., 2013).

The United Nations (UN) estimates that in 2050 the global population will be 9.7 billion compared to 2017, when it was 7.5 billion (UN, 2017). More people will live in urban areas in the future than ever before. India, China and Nigeria alone are expected to account for 35% of the growth in the world´s urban population. In 2050, 68% of the world's population lives in urban areas compared to 2018 when it was 55 % (UN, 2018). Due to this urbanisation, there is continuing growth in the construction sector in urban regions. This stimulates a need to advance environmentally friendly construction investments towards more sustainable solutions such as wood construction (UN Environment and International Energy Agency, 2017).

The UN Environment Global Status Report 2017 states that over the next 40 years, 230 billion square meters in new construction is expected to be built in the world (UN Environment and International Energy Agency, 2017). There is increasing demand for construction activity in emerging economies, which can lead to 3-5% annual growth in the global construction sector for the next decade (Hansen et al., 2013).

Carbon emissions have more than doubled in the building sector between 1970 and 2010. Electricity consumption and production is one of the major growth factors, causing one-third of black carbon emissions. This will increase due to urbanisation and increasing level of wealth and lifestyle trends (Lucon et al., 2014). Construction materials are closely related to CO_2 emissions in the construction sector. For instance, wooden structures decrease CO_2 emission significantly compared to other materials like concrete (González and García Navarro, 2006). Also, wood products stored

carbon. Using more wood as a building material could decrease carbon emissions in the construction sector. Considering global carbon emissions, it is significant to note that wood is a more environmental friendly construction material than energy intensive materials such as aluminium, steel and concrete (Buchanan and Levine, 1999).

Wood construction decreases the energy use of buildings and reduces the main environmental impacts in construction, such as carbon emissions and non-renewable material consumption, when compared to concrete or steel construction (Upton et al., 2008; Sathre and Gustavsson, 2009; Hurmekoski and Korhonen, 2017) . Overall, there is great market potential for the use of wood in all types of buildings, and public trust in new wood buildings is growing, particularly in Europe (Kibert, 2016; Kuzman and Sandberg, 2016).

Technology development supports growth of industrial wood construction

There is a clear sign of growth in wood construction in Europe (Hurmekoski and Korhonen, 2017). Cross laminated timber (CLT) has been used in construction for over 20 years in Europe and in Canada, Australia and the United States (Moriarty, 2018). There is also a growing interest in CLT in the UNECE region (countries of Europe, Canada, United States, countries from Central Asia and Western Asia) (UNECE, 2019), but also in countries where there are long traditions of wood construction such as Japan. Globally, Europe is the largest producer of CLT. Many companies in Europe have plans to increase their capacity in production in the future (Gaston and Pahkasalo, 2018). Production volume of CLT has grown 15% annually for the last five years in Europe and it has raised global interest (Brandner et al., 2016; Hurmekoski and Korhonen, 2017).

During the last five years the use of wood in multi-story buildings has gained more attention (Moriarty, 2018). The production of wood elements is growing in Finland and it is noted that it produces more added value for Finland when the wood processing is executed domestically (Kniivilä et al., 2017; Sipiläinen, 2018). A low degree of product processing and high production of bulk products such as cellulose are two of the reasons for the decline in competitiveness in the wood products industry in Finland (Ruuska, 2013). Further processing of forest products domestically is also seen as the solution for the Finnish forest sector because the country's market competitive position

has been challenged due to high raw material and labour costs (Verkasalo and Karvinen, 2012).

There are many methods and products, which can be employed in wooden multi-story construction. One of the most commonly used WMC methods is a building system, which relies on CLT material. It is easily shaped into different architectural projects, which is one of the most advanced in CLT construction (Laguarda Mallo and Espinoza, 2015). Other commonly used methods are pillar-beam, light timber-frame and modular structural methods. Pillar-beam systems' load bearing structures can be made of Gluelam, Laminated Veneer Lumber (LVL) beams or panels (Karjalainen, 2002). The modular system is based on prefabricated modules, and its prefabrication percent varies between 75-95 % depending on the manufacturer and the system (Vabamäe, 2014). The modules comprised of wall, floor, ceiling and interiors, as well as the size of modules depends on transportation. The modules can be manufactured from solid wood or timber studs (Brege et al., 2014). For instance, EWP's products, which offer significant opportunities for wood construction, are commonly used in WMC construction (Laguarda Mallo and Espinoza, 2015; Gaston and Pahkasalo, 2018).

Industrial wood construction is expected to add value to the Finnish wood products sector

High value added products such as CLT and LVL are necessary for the growth and future success of the Finnish forest industry (Hänninen et al., 2007). EWPs and other wood construction products are one of the highest value products from trees (Ramage et al., 2017), these offer the possibility for Finnish forest industry. The reduction of sawnwood consumption may offer positive impacts on wood product markets such as multi-story residential buildings, bridges and industrial halls (Hetemäki and Hurmekoski, 2016).

In general, a building project involves many participants with different functions, goals and interests (Hemström et al., 2011). This creates a challenge in shifting from less value-added material production business closer to construction business, which may be considered service-business. Many different players are involved in any wooden multi-story building project, including architects, consultant engineers, constructors, contractors, subcontractors, and suppliers (Kuzman and Sandberg, 2016).

Numerous cities and states have developed regulations stating that new buildings must meet environmental standards (Hansen et al., 2013). In the long term, stricter environmental standards and carbon emissions taxes will be among key measures in boosting wood construction (Hurmekoski and Korhonen, 2017).

The lack of knowledge of industrial wood construction among structural engineers and architects is one reason for the slow start in the use of wood in constructions in Europe (Kuzman and Sandberg, 2016). Furthermore, WMC building lacks export expertise and general standards. Due to this, the industry is not able to make total offers which slows down their entry into export markets (Kniivilä et al., 2017; Sipiläinen, 2018). Also, the knowledge of construction culture in the possible export countries is important (Sipiläinen, 2018).

Policies influencing the development of industrial wooden constructions

Interestingly, WMC sector has developed more rapidly in Sweden than in Finland. Open-mindedness, support from government, along with greater and earlier investments have contributed to the successful growth of the sector in Sweden (Haapio, 2013). The growth of WMC markets has been slow between 2010 and 2015 in Finland and the WMC business volume is fairly small (Antikainen et al., 2017; Toppinen et al., 2019). Nevertheless, the market share of WMC has increased in Finland in recent years and the growth will continue if we base it on planned construction (Hurmekoski et al., 2018).

Sweden has long traditions of wood construction and the market share of wooden multi-story of the new buildings increased from 1 % in 2000 to 15% in 2012 (Kuzman and Sandberg, 2016). High productivity, competitiveness within the market, and speed of construction have led to the breakthrough in WMC in Sweden (Haapio, 2013). Sweden has a remarkable domestic market for wood construction. At the same time, Estonia is one of the leading exporters of prefabricated wooden buildings in Europe, with one of their main export markets being Sweden. Estonia has increased their export of prefabricated wooden buildings significantly from 2010 (Estonian Woodhouse Association, 2019a).

According to Hansen, Panwar and Vlosky (2013) changes in policy are often the immediate drivers of innovation. Bioeconomy and clean solutions were two of the key projects implemented by Finnish Prime Minister Juha Sipilä's (Sipilä's government between 29.5.2015 – 6.6.2019) government. Targets included diversifying the use of wood, including increasing the value-added sector and generating new business, employment opportunities and exports (Valtioneuvosto, 2015). The Ministry of Economic Affairs and Employment of Finland states that there are opportunities in the export of wood construction solutions. The aim should be export of more comprehensive wood construction solutions instead of products (Sipiläinen, 2018).

Political and economic environment, such as the United Kingdom's potential exit from the EU, can also have an impact on international value-added wood product markets (Gaston and Pahkasalo, 2018; Sipiläinen, 2018). Secondly, the Chinese economy is a question mark because of its accumulating debts (LUKE, 2018). Changes in environmental legislation have also important influences on the wood construction market in Europe (Hurmekoski and Korhonen, 2017).

The Finnish bioeconomy strategy describes that the expanding global markets offer new opportunities for exports of bioproducts and related expertise. The report implies that know-how in the wood construction sector can be turned into marketable export products (the Ministry of Employment and the Economy, 2014). The Finnish industrial wood construction sector is a rather new sector and there is not yet significant production in Finland or exports by Finnish companies. However, the political belief in its potential success, particularly in international markets, is high in the policy sphere. Expanding exports of wood construction products has been one of Finland's national policy targets since the 1990s (Karjalainen, 2002). This study assesses the future of exports of the Finnish industrial wood construction sector from two different perspectives; the development of industrial wood construction sector and its exports, and at the same time identifying the most promising export markets. This information is important but is has to be done by creating a vision of the future due to the fact that statistical or other quantitative data are not currently available for evaluation.

1.2 The aim and research questions of the study

The aim of this study is to assess future export markets for the Finnish industrial wood construction sector. This is done by analysing secondary materials, previous studies and creating a future visions of Finnish industrial wood construction sector and particularly its exports by the year 2030. This analysis is based on qualitative individual expert interviews and by performing a backcasting analysis using separate expert panel data. International market selection model (IMS) is employed in the study as a theoretical framework to identify characteristics of potentially attractive export markets for the future industrial wood construction sector in Finland.

The development of WMC has been significant over the last 25 years in Sweden since the construction of multi-story buildings was allowed in 1994 and the market share of wooden multi-story buildings has increased (Mahapatra et al., 2012; Kuzman and Sandberg, 2016). Today, the market share of wooden multi-story buildings is 10% of wooden multi-story construction in Sweden and interest in WMC is growing (Swedish Wood, 2019). Estonia was the 4th largest exporter in the world of wooden prefabricated houses in 2010 and the share of exports has steadily increased (Rebane and Reihan, 2016; Statistics Estonia, 2019). Based on these factors, this study compares the status of the forest industry exports and future assessments between Finland, Sweden and Estonia by analysing secondary materials, previous studies and expert views.

The study assesses the future of the industrial wood construction exports and the most promising future export markets for industrial wood construction in 2030. The year 2030 is decided for the future assessment because many European wood industry's promotional organisations' position papers and political enhancement strategies have been drawn up for 2030. This includes Manufuture Vision 2030: Competitive, Sustainable and Resilient European Manufacturing by Manufuture High-Level Group (2018), Revised vision 2030 for the European forest-based sector by the European Forest45 based Sector Technology Platform (2012), Architecture 2030 by Architecture 2030 organization (2018) and Government report on the National Energy and Climate Strategy for 2030 by Finnish Ministry of Employment and the Economy (2017) and .

The research aims to answer the following questions:

1. *How do experts from the wood construction sector in Finland assess the future of the industrial wood construction export in their ideal vision in 2030?*

2. *Which are the most promising future export markets for industrial wood construction from Finland in 2030 based on expert views and literature analysis?*

3. *How do Finnish expert's views on the prospects of Finland compare to Swedish and Estonian expert views about the prospects of these countries?*

2 THEORETICAL AND CONTEXTUAL BACKGROUND

2.1 Theoretical background

International market selection (IMS) model

There are several types of international market selection (IMS) approaches, which are utilized by business organisations to broaden their operations on new market areas. Traditional approaches include systematic and non-systematic approaches and relationship approach (Andersen and Buvik, 2002). Yip et al. (2000) and Brouthers and Nakos, (2005) define systematic approach as *using objective criteria to select export markets* such as the use of published statistical sources in evaluating the markets.

Political, cultural and economic environments are important in the IMS processes (Wood and Robertsons, 2000). Other significant characteristics are geographic location, language, political factors, demography, economy, industrial structure, technology, social organisation, religion and education (Baorakis et al., 2017). Despite this, the IMS study does have some limitations. For instance, lack of reliable sampling frames and limited cross-comparison studies (Malhotra and Papadopoulos, 2007).

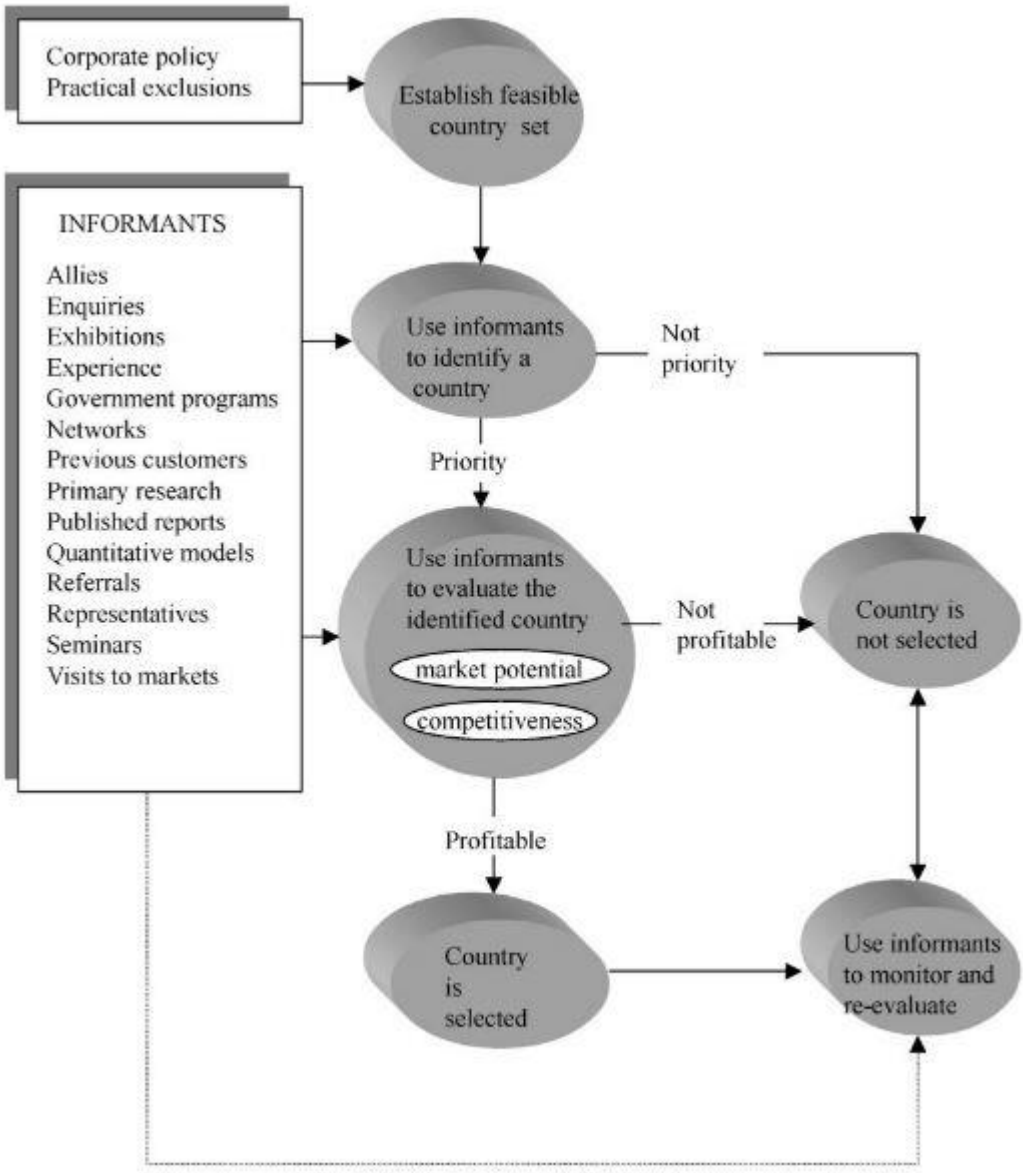

Figure 1: International market selection model (Brewer, 2001).

The Brewer's (2001) international market selection model identifies the potential markets by evaluating attractiveness of the market. The Brewer's (2001) international market selection model has identified informants, which evaluate the attractiveness of the selected country, as important actors in the process. The main informants, which are of interest for this study, are government programs, primary research and published reports. All informants are listed in figure 1.

In Haapio's (2013) study, there were perceived positive opportunities for wooden construction export opportunities. Opportunities were discovered in: concept

solutions, ecological solutions and reconstruction. Potential for exports from Finland and Sweden have also been seen in material solutions and know-how in the wood construction sector (Antikainen et al., 2017). The export opportunities in prefabricated houses, construction and decoration industry depend on the competence of delivering to adjust the products to building and culture in the country of interest (Hänninen et al., 2007).

Asia and Eastern Europe are potentially promising new markets for wood products. On the other hand, there are no considerable wood construction culture in Easter Europe or generally in Asia. The construction sector is growing rapidly in Chinese cities. Furthermore the construction activity is decreasing in Japan (Hänninen et al., 2007). Verkasalo and Karvinen (2012) have noted that wood product sector can grow only if exports grow, and exports of value-added materials will increase. The prospects for growth in Finland and globally are seen in wood construction solutions such as WMC (the Ministry of Employment and the Economy, 2014).

The Finnish bioeconomy strategy emphasises the importance of value-added products and services. In the forest sector, the share of export of new bio-based products is estimated to be one half of the export earnings by 2030 (the Ministry of Employment and the Economy, 2014). European EWP producers expect that the export of EWP will increase to France and Japan, and likely other places as well (Manninen, 2014).

Preliminary literature-based assessment of characteristics typical for attractive export markets

The changing regulations and positive attitudes towards using wood in construction were seen as driving forces for the wood construction in many previous studies (Riala and Ilola, 2014; Hurmekoski et al., 2015; Rebane and Reihan, 2016; Antikainen et al., 2017; Toppinen et al., 2018; Markström et al., 2019). The assessment of potential export markets regions is examined by following key drivers:

(1) Level of acceptance of wood;

"Changing building regulations"
"Positive attitudes"

(2) Demographic changes;

"Market volume growth"
"Urbanization"
"Ageing population"

Many previous studies support these key drivers. For instance, Hurmekoski et al. (2015b) have identified that drivers such as positive attitudes towards use of wood, urbanization and harmonization the regulations have positive impact of using wood in construction, on the other hand ageing population have negative impact on wood construction activity (Chapter 2.4 covers the Hurmekoski's key drivers). Hurmekoski (2016) and Gaston and Pahkasalo (2018) highlight that economic growth, urbanization and changes in demographic have an influence on consumption of wood construction products. The importance of attitudes and regulations have been emphasized in numerous previous studies such as Jonsson (2009), Wang et al., (2014), Kuzman and Sandberg (2016), Lindgren and Emmitt (2017) and Markström et al., (2019).

2.2 Contextual background: Finland, Sweden and Estonia

This chapter compares the current exports in the industrial wood construction sector, with a focus on wood products and wooden prefabricated houses from Finland, Sweden and Estonia. The industrial wood construction sector is still a quite new sector and therefore the data is limited, and it varies between the targeted countries.

Sweden was the first country where modern WMC building appeared in Europe in 1994. Furthermore, Sweden has been the market leader in the WMC sector and there has been strong growth in the Swedish domestic market for WMC (Brege et al., 2014; Kuzman and Sandberg, 2016). The political decisions like changes in building regulations are one of the reasons, which has led to this growth (Kuzman and Sandberg, 2016).

Estonia was the 4th largest exporter of prefabricated wooden houses in 2010, and the sector has rapidly grown since then (Rebane and Reihan, 2016). Understanding of the export volumes is important but it is also interesting to know the current export countries. Since assessing the future export countries for wood construction products is the aim of this study, it is essential to understand the current stage of the major exporting countries.

Exchange rates have an effect on the development of exports (Sipiläinen, 2018). In this study, Swedish crowns have been converted into euros by the annual average exhange rate from Bank of Finland. Exchange rates are seen in the Bank of Finland's webpage (Bank of Finland, 2019) and Appendix G.

Finland

The total value of forest industry exports from Finland was 12 080 M€ in 2017. The total value of pulp and paper industry exports was 9 080 M€ and the total value of wood product exports was 2 900 M€ (Aarne et al., 2018). Wood product exports increased by 10.7% in 2017. The main export countries of wood products were Germany, UK, USA, China and Belgium (Finnish Forest Industries, 2018). Generally, Europe covered 63% of the export value of forest industries by continent followed by Asia 22%, Africa 5%, Latin America 3%, North America 2%, and Oceania 1%. The main import countries were Estonia, Sweden, China, Germany and Poland (LUKE, 2018a).

Wood product industries consist of sawmilling, wood panels and other wood products industries. Other wood products industries include, among other things, joinery products and prefabricated wooden houses (Aarne et al., 2018). Figure 1 illustrates the exports of other wood products from Finland between 2007 and 2017.

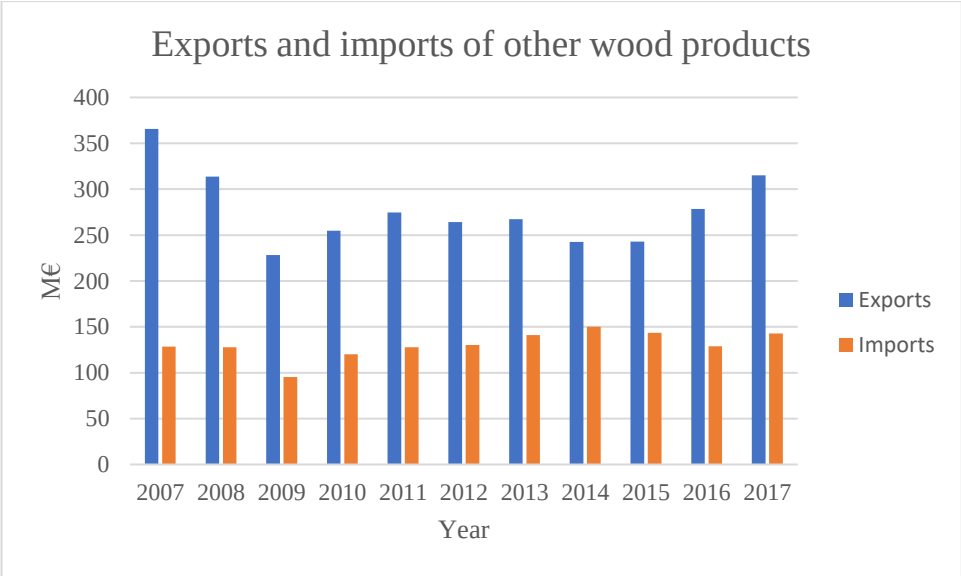

Figure 2: Exports and imports of wood products other than prefabricated houses from Finland between 2007 and 2017 (LUKE, 2018).

There have been major changes in wood product exports, particularly in the Asian markets. For instance, in 2017 the export value of wood products to South Korea increased by 49 % from the previous year (Tulli, 2018a). Wood product exports to China were 368 thousand tons in 2017. It decreased from the peak year of 2016, when they were 585 thousand tons (Tulli, 2018b).

In 2017, the export value of prefabricated wooden houses was 68 M€. In the previous year corresponding number was 66 M€. Between 2007 and 2017, the export value has decreased significantly (LUKE, 2018b). Exports of wooden house construction is mainly based on success in the export of log houses (Hänninen et al., 2007). The export values of prefabricated wooden houses between 2007 and 2017 are shown in figure 3. Wooden houses account for 2% and building joineries are 8% of the export value of the wood products industry in Finland (Metsäteollisuus ry, 2018).

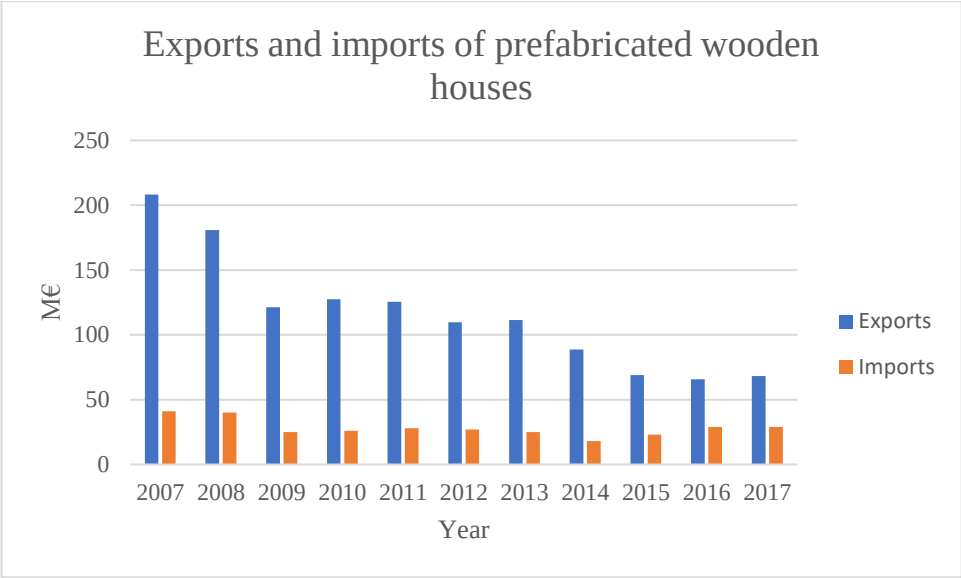

Figure 3: Prefabricated wooden house exports from Finland between 2007 and 2017 (LUKE, 2018).

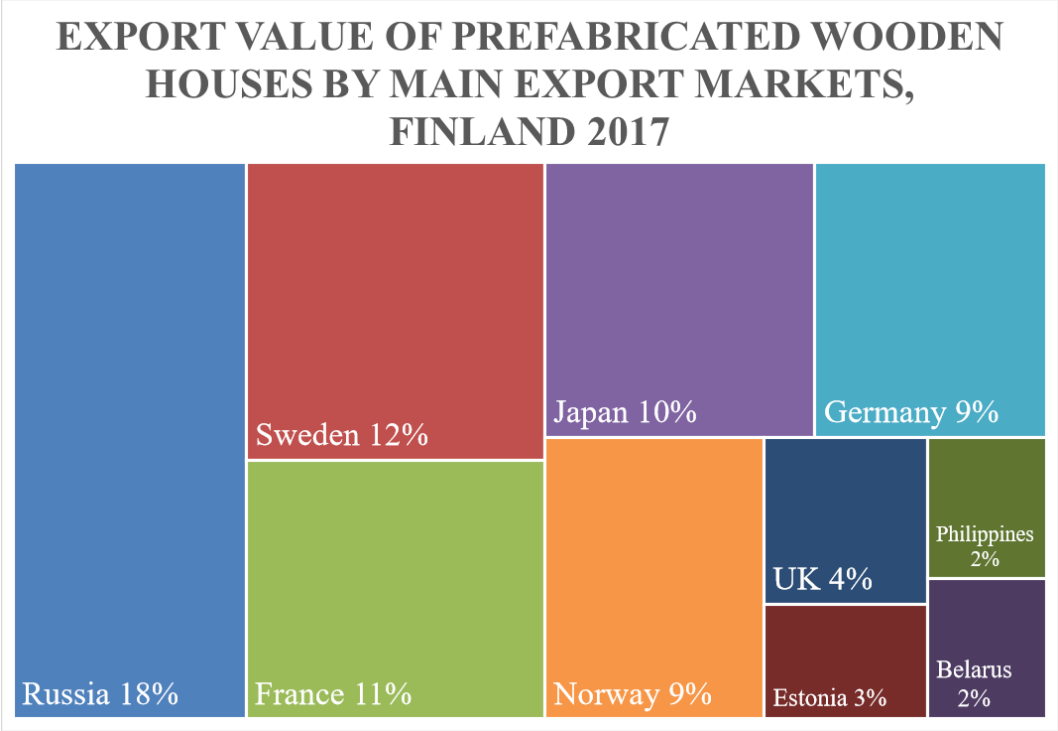

Figure 4: The main export countries for prefabricated wooden houses by value from Finland 2017 (LUKE 2018).

Many Finnish companies have invested in engineered timber products (LVL and CLT) capability including CLT Finland, CLT Plant, Stora Enso and Metsä Wood. In Europe the capacity of CLT will increase (Luke, 2017). Japan is the third largest buyer of

Finnish lumber after Egypt and China. Finland exported glued wood to Japan almost 69 tons in 2017 (Tulli, 2018c).

Sweden

Overall, Sweden is an export-oriented country when it comes to the forest industry. The export of forest products has steadily increased since the 20th century (Lindahl et al., 2017). The total value of forest industry exports was 13 200 M€ in 2016 (Skogs Industrierna, 2017). However, Sweden imports more manufactured wood than it exports. The main import countries of manufactured wood were Poland, Denmark, Latvia, Estonia, Norway, China, Romania and Finland in 2018. The main export countries were Norway, Denmark, Germany, Finland and the UK in 2018 (Statistics Sweden, 2019).

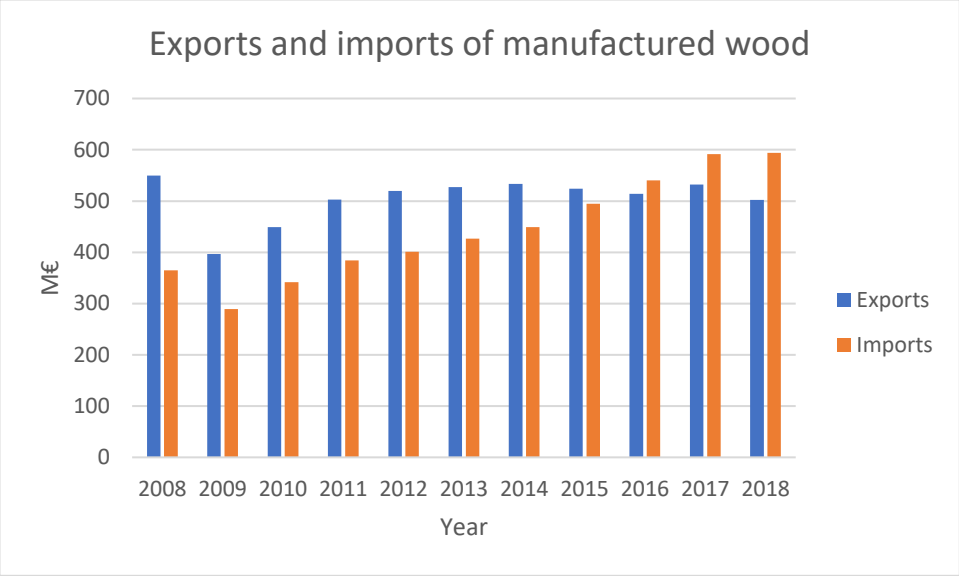

Figure 5: Exports and imports of manufactured wood (Statistics Sweden 2019).

In 2016, prefabricated wooden buildings were the most domestically sold construction product by value in Sweden. The value of prefabricated houses share in the domestic sales of construction products was 29,3% in 2016 (European Commission, 2018). The production value of prefabricated wooden houses in Sweden was 1 880 M€ [1] in 2016 (UNECE, 2018a) 1 590 M€ [2] in 2015 (UNECE, 2017), and only 1 307 M€ [4] in 2014, thus the value increased by 50% in two years (UNECE, 2016). In recent years the

export value of prefabricated wooden houses has decreased, and the import value of prefabricated wooden houses has increased (UNECE, 2018a, 2017, 2016).

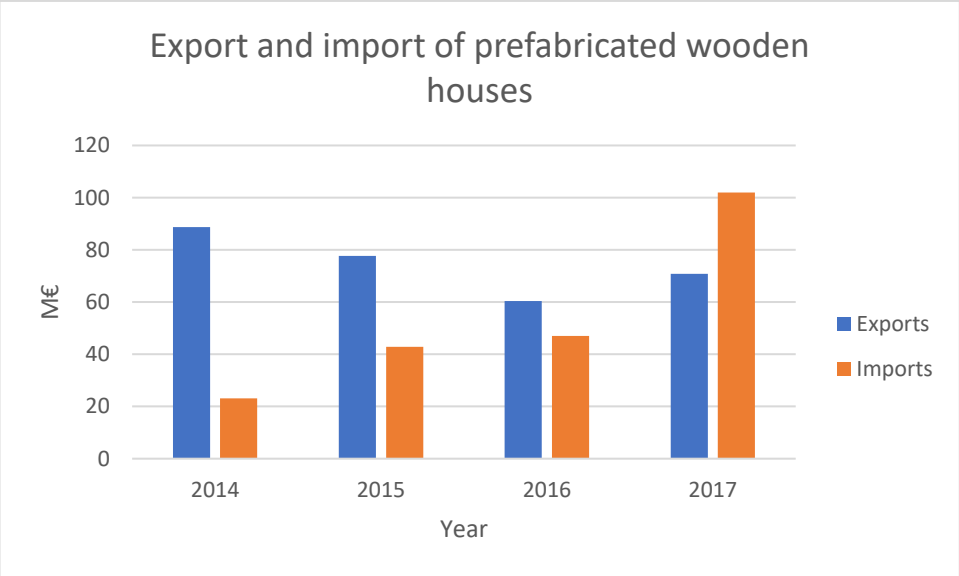

Figure 6: Exports and imports of prefabricated wooden houses (UNECE, 2018a, 2017, 2016, 2014).

Sweden mainly exports prefabricated wooden houses to Norway, Japan, Finland, Germany, Denmark and the United Kingdom (Antikainen et al., 2017; UNECE, 2018a, 2017, 2016). Due to the high demand for domestic industrial wood construction materials, Sweden imports more prefabricated wooden houses than it exports. The main import countries are Estonia, Norway and Finland (UNECE, 2017).

Estonia

Exports of wooden buildings rose approximately 23% in 2018 compared to the previous year. Export of wooden buildings includes prefabricated wooden buildings and garden cottages. Sweden, Norway and Finland are the major export market countries for the growth, but also exports to the Netherlands, France and Denmark increased (Estonian Woodhouse Association, 2019b). Figure 8 illustrates the main exports countries, which are at least 1 percent of the value of the exports. Each of the four last countries (Denmark, Iceland, Switzerland and Japan) cover 1 percent of the total value of the exports (Statistics Estonia, 2019).

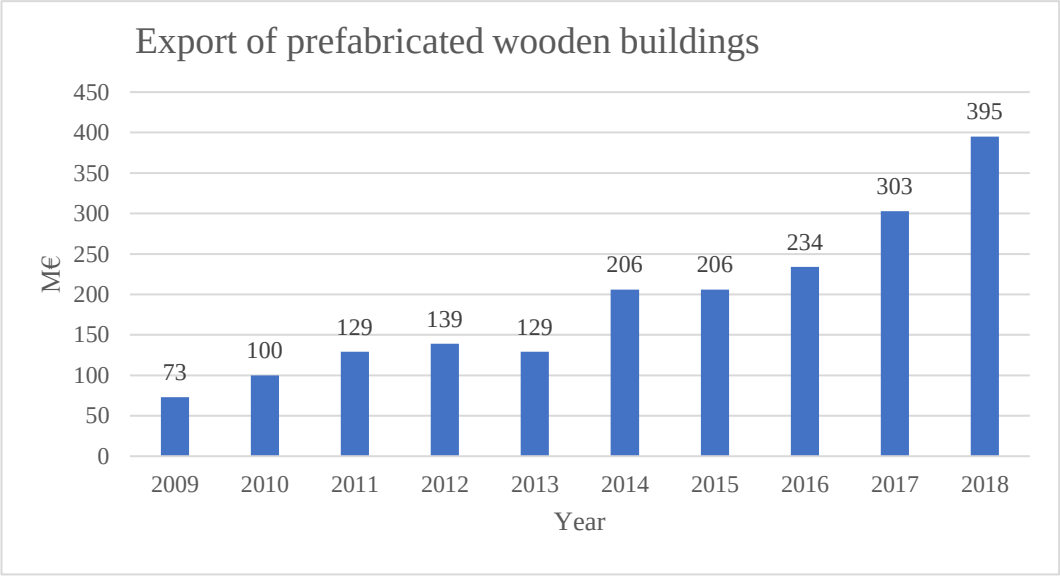

Figure 7: Export of prefabricated wooden buildings from Estonia by value (Statistics of Estonia 2019).

The value of exports increased significantly from 2017 to 2018. The export value of prefabricated wooden buildings from Estonia was 395 M€ and the export value between January and March in 2019 was 99 M€, so 25 per cent of the 2018 export value (Statistics Estonia, 2019).

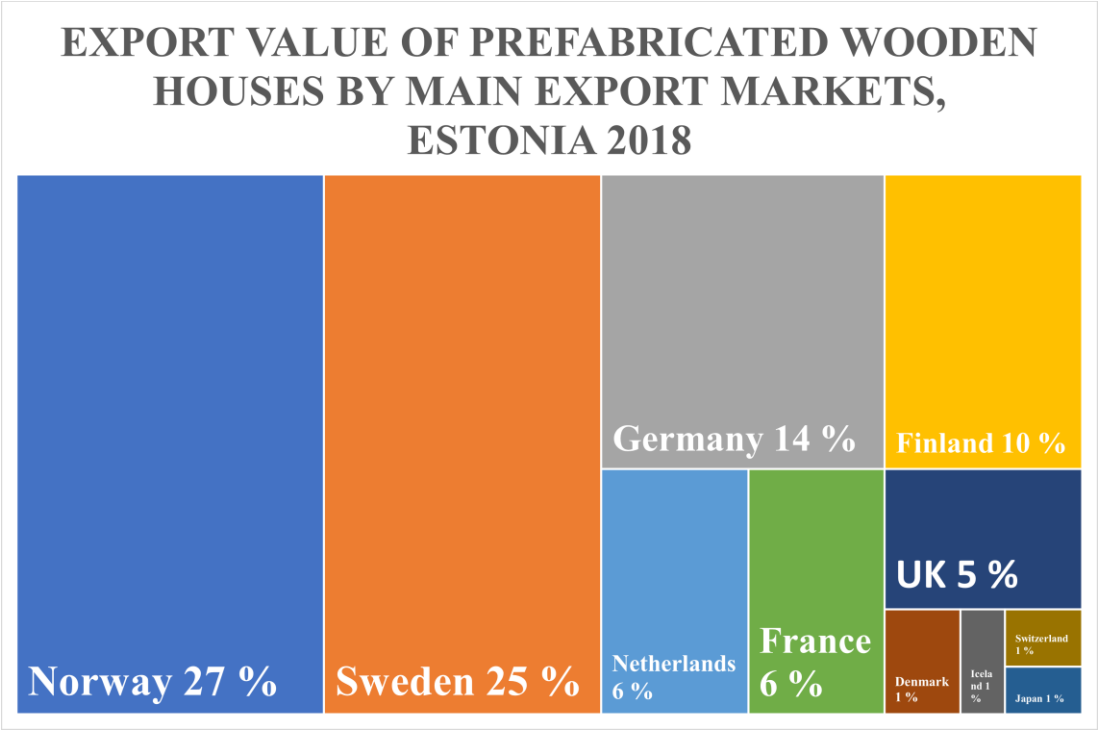

Figure 8: Export value of prefabricated wooden houses by main export markets, Estonia 2018 (Statistics Estonia, 2019).

Norway was the most important export country by value for Estonian prefabricated wooden houses in 2018. It was also the main export country in 2017. In 2017, the main export countries were Norway (31%), Sweden (23%), Germany (17%), Netherlands (7%), Finland (6%), UK (6%), France (6%), Iceland (2%), Denmark (1%) and Italy (1%). For instance, the export value has increased 52% to Finland, 26% to Sweden, 21% to Japan, 20% to France, 15% to Norway and 12% to Netherlands comparing the data from 2017 and 2018 (Statistics Estonia, 2019).

2.3 Current exports of industrial wood construction sector: Finland, Sweden, and Estonia

Examining the exports of industrial wood construction from Finland, Sweden and Estonia, it becomes evident that there are significant differences between the three countries. Table 1 sums up the key findings from the export of wood products and WMC between these countries.

Table 1: Comparison of exports in wood construction sector and main export countries between Finland, Sweden and Estonia

	Finland	Sweden	Estonia
Key features of domestic and export markets	✓ Exports of log houses and wood products ✓ Increasing domestic demand ➢ Investing more in value-added products	✓ Export of wood products ✓ Significant local market for WMC ➢ Importing more wooden prefabricated houses than exporting	✓ Export of prefabricated wooden houses ✓ No/very small domestic market ➢ The main exporter of wooden prefabricated houses in Europe
Main export countries	✓ Sweden, Russia, France, Japan, Germany, Norway, UK	✓ Norway, Japan, Finland, Germany, UK	✓ Norway, Sweden, Germany, Finland, France, UK

Table 1 is compiled based on the statistics from each country and previous studies. One of the limiting factors in exact comparisons between the countries, and the future development estimations, is the lack of detailed and comparable statistical data for instance in the field of EWP's exports.

2.4 Potential export markets for industrial wood construction: a literature-based analysis

Potential export markets are identified with previously mentioned key drivers. Because of the limited number of key drivers, the analysis of potential export markets for industrial wood construction has to be interpreted with caution. The key drivers are limited because of limited resources and the research focus. For instance, economic growth is not taken into account although it is also important factor. These key drivers "Changing building regulations", "Positive attitudes", "Market volume growth", "Urbanization" and "Ageing population" were identified based on previous research such as Jonsson (2009), Wang et al., (2014), Hurmekoski et al., (2015), Kuzman and Sandberg (2016), Lindgren and Emmitt (2017) and Markström et al., (2019).

Fast growing regions: Asia and Africa

In general, the floor area (new construction) is growing rapidly in countries such as China and India (Qinfen, 2006; Abergel et al., 2017; Chang et al., 2018). In addition, India, China and Nigeria have announced new sustainability related building regulations between 2016 and 2017. China aims to reduce carbon emissions in its construction sector, due in part to an urgent need to meet environmental targets (Qinfen, 2006; Cao et al., 2015; Chang et al., 2018). India introduced new energy saving targets and Nigeria introduced minimum standards for energy efficient building construction (UN Environment and International Energy Agency, 2017). Popularity of wood structures is expected to increase in China because of the benefits in prefabrication and in the earthquake zones, the goal is that 30% of the new constructions are prefabricated by 2025 (Qinfen, 2006; Hansen et al., 2013; Chang et al., 2018).

Population growth and other significant factors like ageing of the population have an influence on construction. Ageing in Asia (particularly in China) will be rapid in the

next 50 years and it will decrease the construction activity. In addition, the working population in India, one of the emerging economics, will increase over the next 50 years (Johansson et al., 2012; United Nations, 2017). The market growth in construction will be most significant in India and China (Garcia, 2011). Changes in market share can lead to new possibilities like the increase in demand for wood products in China and India (Verkasalo and Karvinen, 2012; Hetemäki and Hurmekoski, 2016) .

Vietnam, Thailand, Indonesia and the Philippines are also fast growing economies and there is export potential for the engineered wood products in the future (Hetemäki, et al., 2013). Overall, Asia is an increasingly important trading partner for the Finnish forest industry (Aarne et al., 2018). The awareness of the benefits of wood building products is growing in Asia and several universities have started to offer timber structure studies (Qinfen, 2006).

Europe

One of the key aspects influencing the rate of construction activity globally and regionally is population growth. In Europe, population is assumed to be decreasing in the long term; Europe is the only region where the population will be smaller in 2050 than it was in 2017 (UN, 2017). Ageing in Eastern European countries like Poland and in Southern European countries will be rapid in the next 50 years (Johansson et al., 2012; United Nations, 2017).

EU countries are, however, growing markets for wood retrofitting (Verkasalo and Karvinen, 2012) and the trend towards increasing use of wood is clear, although the level of wooden multi-story construction in Europe are at different levels. Potential for growth in industrial wood construction is expected to be in all types of buildings; residential, public, office space, commercial, industrial and buildings for education (Kuzman and Sandberg, 2016). Most Europeans live in urban areas while residential buildings make up 75% of the existing building stock in Europe (Márton et al., 2014).

In Europe, the countries which have traditions, culture and know-how in wood construction are likely to be countries where WMC will grow in the future. These countries are; the Nordics (Sweden, Norway and Finland), Central Europe (Austria,

Northern Italy, Southern Germany, Switzerland) and the UK (Scotland and England) (Hurmekoski et al., 2015). Also, Mahapatra et al., (2012) have seen potential market growth for WMC in Sweden, the UK and Germany. Table 2 shows estimated market potential of wood constructions by selected regions in Europe (Hurmekoski, 2016).

Table 2: Market growth potential of wood construction in selected regions in Europe (Hurmekoski, 2016).

Region	Northern Europe	Central Europe and the UK	Western Europe	Southern and Eastern Europe
Market potential by 2030	High	Intermediate	Low to intermediate	Low
Countries	Finland, Norway, Sweden	Austria, Northern Italy, Southern Germany, Switzerland, The UK	France, Ireland, the Netherlands, Northern Germany	the Czech Republic, Hungary, Poland Southern Italy, Spain

Austria, Germany and Switzerland have increased their production volume of CLT since 2010 (Manninen, 2014). Austria and Germany are two of the biggest producers of glulam in Europe, which is commonly used in the industrial wood construction industry (Gaston and Pahkasalo, 2018). Most German wood construction companies are located in southern Germany, which has led to a concentration of wooden buildings there (Mahapatra et al., 2012). In Germany, 13 % of all new residential building permits were for prefabricated buildings in 2013 (Steinhardt and Manley, 2016), which supports the idea of the increasing use of wood in constructions there (Brege et al., 2014).

The UK Government's plans to reduce carbon emissions contributes to potentially growing the use of wood products in the construction sector (UNECE, 2018b). The UK Government has also announced that all new homes from 2016 have to meet environmental standards and their target is to construct 300,000 homes a year (Mahapatra et al., 2012; UNECE, 2018b). Growth opportunities have emerged in Russia and in some parts of Central Europe as well (Hänninen et al., 2007; Heino, 2011).

Other regions of potential interest

The interest in CLT is growing in many regions, where there are traditions of wood construction like Japan and Australia (Gaston and Pahkasalo, 2018). In Japan and the United States, wood is a major building material in single family residential constructions, representing approximately 90% (Hansen et al., 2013). Japan is one of the most developed countries in Asia and it is located in a seismic area; studies have indicated that CLT-based construction performs well in seismic areas (Hetemäki et al., 2013; Laguarda Mallo and Espinoza, 2015; Brandner et al., 2016).

The first wooden multi-story building was finished in Japan in 2007. Ecological drivers are among the reasons for the growing interest of WMC in Japan (Matsumura, 2008). The population is ageing in Japan, so the construction may not be expected to grow significantly in quantity, but there is a growing market for reconstruction in Japan but also in North-America (Hänninen et al., 2007; Verkasalo and Karvinen, 2012). Environmental awareness has also risen in Australia, Canada and US. Some of the international green building systems have been established there (Wang et al., 2014).

The countries were evaluated by using the key drivers, which raised up from previous researches: **level of acceptance of wood;** "Changing building regulations" "Positive attitudes" and **demographic changes;** "Market volume growth" "Urbanization" "Ageing population" They key drivers are explained in chapter 2.1.

Figure 9 presents the potential export markets for industrial wood construction in matrix. This picture is based on previous literature and secondary data, which were presented in the previous chapters. The matrix is created using the identified key drivers, which were mentioned previously.

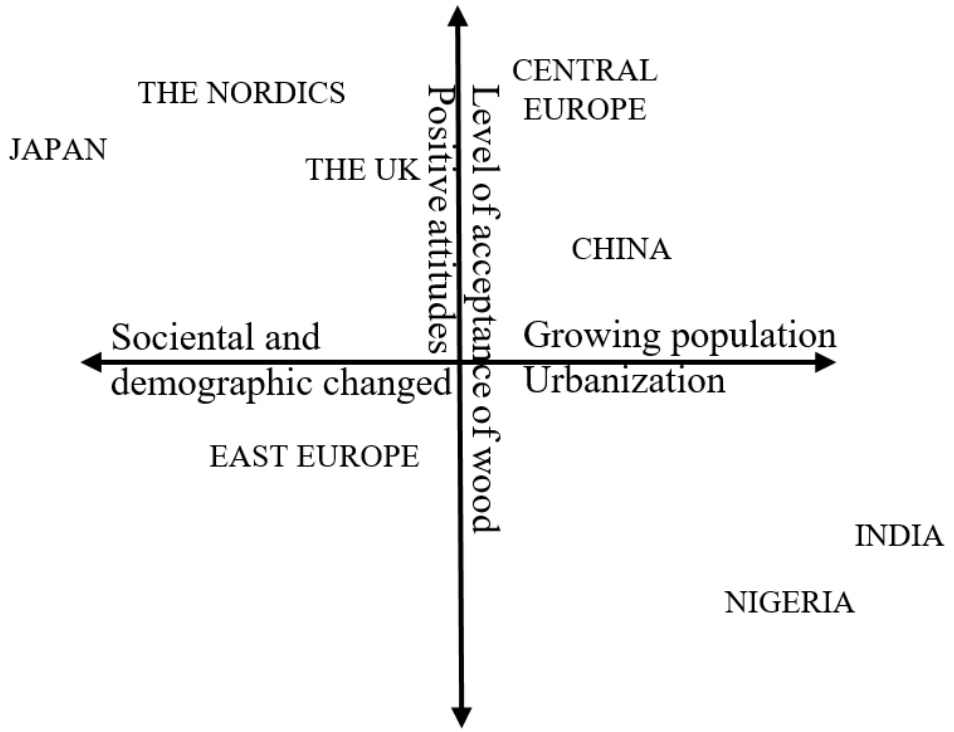

Figure 9: Assessing the potential new markets for industrial wood construction by expected demographic chances and societal attitudes towards wood in constructions.

Figure 9 presents a preliminary assessment of potentially interesting markets for industrial wood construction (and exports). The figure is created based on the literature review and available data from the countries presented earlier in this report. The figure does not take into account or estimate/compare the volume of the various markets, or the growth rate of these, or the export potential in quantity.

3 DATA AND METHODOLOGY

Method

The study was implemented using two different qualitative data sets. Semi-structured thematic expert interviews were collected from Finland, Sweden and Estonia. Expert interviews were used to achieve a better understanding of the current status of the domestic industrial wood construction sector, future prospects in industrial wood construction, and the related export opportunities in Finland, Sweden and Estonia.

In addition, a panel including Finnish experts was invited to create an ideal vision of the industrial wood construction sector in Finland and its exports, and the most attractive export markets in the year 2030. The vision creation was performed using a backcasting method during an expert panel meeting event (a specific visioning workshop), arranged in Helsinki in February 2019. In addition, pre- and post-event questionnaires were part of the expert panel data collection. This data was used to identify in more detail the most promising export countries/regions and the entities of exports in the industrial wood construction sector (e.g., whether to export materials, modules or construction projects).

Typically, qualitative studies are case studies, which are empirical by nature and should not be generalized to a larger population. This also applies to this study and the expert interview data used.

The empirical data collection and analysis of the data in this study follows the steps and approaches described below:

(1) Assessing the current markets of industrial wood construction sector, especially WMC, and their future prospects by using data from expert interviews from Finland. This data and its analysis are also utilized as background material in designing the backcasting panel pre-questionnaire and workshop tasks. Table 3 shows details from the interviews.

(2) Creating future visions of wood construction export from Finland using the backcasting method and the expert panel data, including pre- and post-questionnaires for the panel members. Figure 11 presents the model of data design and collection procedure.

(3) Identifying the most promising export countries, entities and applications by using the data from the panel.

(4) Assessing the current prospects and future aspects of industrial wood construction in Sweden and Estonia and comparing it with Finland by using the aforementioned data from Finland and the data from expert interviews from Sweden and Estonia. Table 3 illustrates the data collection from Finland, Estonia and Sweden.

Backcasting method

The aim of future studies is to create future visions and to get better understanding of future opportunities (Phdungsilp, 2011). There are several different approaches to analysing future possibilities, opportunities and to develop visions of potential futures (Höjer and Mattson, 2000). Otherwise, perceiving and planning the future vision is important (Burt and Van Der Heijden, 2003). The goal is to find the most important, relevant and significant agendas by narrowing the opportunities with the selected tools (Amara, 1991).

Future studies can be divided into three categories. Amara (1991) determines three different approaches; the possible, the probable and the preferable. Backcasting is a method to analyse possible future visions and is mainly used in sustainability future studies. Höjer and Mattson (2000) described that backcasting studies begin with a vision of a desirable future and one or more paths to reach this vision.

Backcasting is also used in analysing long-term complex issues, taking into account technological changes (Dreborg, 1996). Backcasting is a promising method in creating future visions, in finding ways to the future approaches and in adapting to changes in the future (Steen and Åkerman, 1994; Quist and Jacobus, 2007). Directional studies, which probably lead to sustainable development, are usually based on a backcasting approach, starting from goals and working backwards to the current prospect (Steen

and Åkerman, 1994). Backcasting method is used to create a long-term vision , as demonstrated in the following studies: Phdungsilp, (2011) Doyle and Davies, (2013) and Mont et al.,(2014).

In this study, backcasting methodology was employed because the markets for industrial wood construction exports are still very niche and relatively new markets. There is political interest for growth of exports in the industrial wood construction sector. Backcasting method is suitable for complex issues, which take into account the pathways to the desirable visions.

The backcasting methodology is comprised of three phases, which are described below:

(1) Defining the ideal future vision for the exports of industrial wood construction sector from Finland in 2030; analysing export entities (value-added materials, projects, semi-finished products such as modules, know-how/service), application types (service buildings, multi-story building, sport/culture buildings or others) and potential export countries (markets).

(2) Identifying the key market factors in 2019/2020; specifying operators/actors, success factors and the most important changes in operation modes, which are needed to achieve the future vision.

(3) Exploring the pathways to the future vision in 2030 and finalising the vision.

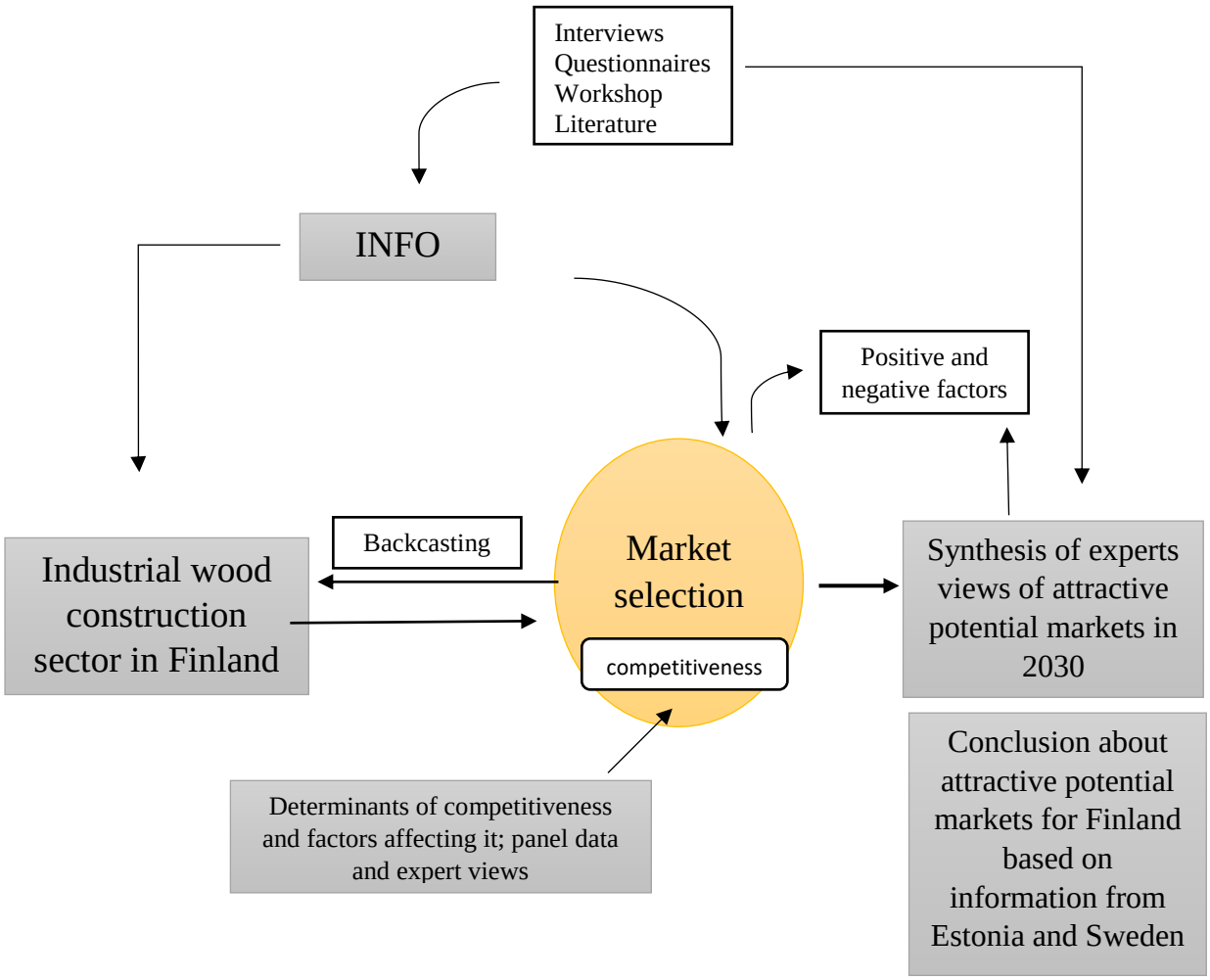

Figure 10: The country market selection model applied in this study.

This study employs the country market selection model by performing the following steps:

(1) Collecting market information from expert interviews, post- and pre-event-questionnaires, the expert Panel and literature, previous research, published non-scientific reports and policy papers.

(2) Creating the overview of the prospects of industrial wood construction sector in Finland based on expert interviews.

(3) Evaluating the potential future export countries by competitiveness factors from the panel data.

(4) Comparing various expert views with expert views from Sweden and Estonia.

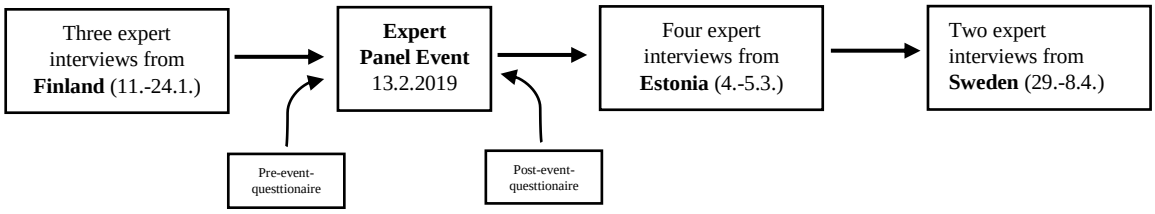

Figure 11: Model of data collection procedure.

Figure 11 presents the empirical data collection details in this study. All the activities related to data collection were held between January and May 2019. The data collection steps are presented in more detail in the following sections; *interviews and the expert panel data*

Method for the interviews

The interviews were analysed using content analysis which is a widely used qualitative research method. Qualitative content analysis is one of the methods used to analyse text data which is often transcribed into text (Hsieh and Shannon, 2005). The aim of the content analysis is to organise the data and concise summary of key results (Erlingsson and Brysiewicz, 2017).

In the content analysis the texts are classified into fewer content categories. Classification in the content analysis depends on the purpose; classification procedures have to be reliable, meaning that different people should be able to classify the text the same way (Weber, 1990). The data was classified under the identified main themes, which described the current stage/future prospects of industrial wood construction and the prospects of exports and export markets. Main themes, which were identified earlier, were repeated many times in the interviews.

The sampling strategy was chosen based on the purposive sampling. Purposive sampling involves identification and selection of individuals which are proficient in the topic and have a willingness to participate (Wu Suen et al., 2014). In this study purposive sampling is applied through the following steps (Tongco, 2007; Bagshaw, 2009).

(1) The definition of the research aims/questions

(2) Analysing the type of information needed – identify the sample

Information is needed only from certain members

(3) Definition of the qualities of the informants

(4) Determine the way of collecting the responses

The design of the survey form – run a test survey

(5) Analysing data and interpreting results – *classification under the main themes*

Interviews

Three industrial wood construction experts from the Finnish private sector were interviewed in January 2019 (Appendix A). The wood construction experts from Finland represented the actors, which are part of the wood construction process. The questionnaire was slightly modified depending on the interviewee. Two interviews were face-to-face, and one interview was by phone. All the interviews were in Finnish. The interviews were held between 11. – 24.1.2019 and were recorded and transcribed afterwards word by word. One interview took 40 minutes and the other two took approximately one hour.

The data from the Finnish expert interviews were used for assessing the current position of the industrial wood construction sector in Finland. Also, the experts' views and ideas about the prospects of future exports in this sector is presented. It was easy to schedule the interviews and all the participants were interested in the topic.

Interviews for comparative purposes were conducted in Estonia. I interviewed four wood construction experts from Estonia both from the private and the public sectors to get a better understanding of the industrial wood construction sector in Estonia. The experts were selected from different sides of the value chain. One was selected from a construction company, which revenue comes mostly from exports, one expert was from a local real estate development company, one expert represented a political perspective and another were from a promotional association. These experts were chosen to get a broad view of the current stage of wood construction exports from Estonia and domestic views as well. All interviews were face-to-face interviews in English and were held in Estonia between 4. – 5.3.2019 (Appendix D).

The questions were slightly modified to get the best possible result related to the interviewee and his/her position and background. All interviews were recorded, and part of the interviews were transcribed word-for-word afterwards. It was easy to schedule the interviews and all the interviewees were positive and interested in the topic. Interviews took between one and two hours. The data from the interviews was used to get a better understanding of the industrial wood construction sector overall, and the industry's approach to wood construction exports from Estonia.

I had difficulties contacting Swedish industry experts for interviews. I sent over 20 emails to industry experts and followed up with a phone call, but no one responded. However, I interviewed two researchers via Skype between 29.3 – 8.4.2019. One interview was in English and the other was in Swedish. Both of the interviewees have considerable experience in the wood construction field. The interviews were approximately 45 minutes. Both of the interviews were recorded and transcribed afterwards. Data from these interviews is presented in the results part of this report, and the future aspect of WMC in Sweden.

Table 3: Table of expert interviews

Interviewees' organisation	Date	Method	Duration (minutes)	Language	Title/organisational position
Finland, Construction Group (a test interview)	11.1.	Face to face	59	Finnish	Manager
Finland, Wood Manufacturing Company	16.1.	Phone	32	Finnish	Director 1
Finland, Construction Group	24.1.	Face to face	45	Finnish	CEO
Estonia, Construction Company	4.3.	Face to face	98	English	Developer 1
Estonia, Real Estate Developer	4.3.	Face to face	64	English	Developer 2
Estonia, State	5.3.	Face to face	76	English	Policy Official
Estonia, Organisation	5.3.	Face to face	107	English	Director 2
Sweden, University	29.3.	Skype	47	Swedish	Research 1
Sweden, University	8.4.	Skype	34	English	Research 2

The expert panel for performing backcasting analysis

The expert panel event was held in the Porthania building at the University of Helsinki on the 13th of February 2019, from 1pm - 4pm. The event was organized by the University of Helsinki, Wood Vision 2025-project team. 35 experts of industrial wood construction from the Finnish public and private sector organisations participated in the event.

Before the pre-event-questionnaire, an invitation and "save the date" email was sent to Wood Vision 2025-project funders and major influencers in wood construction sector, which have attended similar events before. The invitation was sent to 72 people in total at the beginning of January. A reminder was sent three times to the same list. The list of invitees included people who were somewhat related to wood construction

from the public and private sectors. The list was created by using previous contacts from similar events, personal contacts, and internet searches.

The expert panel event started with 8 speeches from people representing different sides of wood construction export products. After the speeches, the participants were organized into five different teams. The division of the teams is seen below. The mission of the teamwork was to build a vision for the future exports of Finnish industrial wood construction. The goal was to organise the teams so that there would be people from varied backgrounds in each team. The team exercise was 45-minutes and after the exercise, two of the teams presented their ideas and other teams commented their outcome.

Team 1; experts from *private sector and public sector (universities and ministries)*

Team 2; experts from *architecture sector, promoter organisations and private sector*

Team 3; experts from *promoter organisations, research organisation and private sector*

Team 4; experts from *promoter organisations, public sector (universities), private sector and media*

Team 5; experts from *promoter organisations, public sector (ministries), private sector and research organisation*

Facilitators coordinated the teams so that they were on schedule. Facilitators were researchers and students from the University of Helsinki. The facilitators also took notes from the discussion.

The teamwork was divided into three sections;

(1) Creating visions for 2030

(2) Describing the starting point 2020

(3) Assessing the "mid-term" prospects in 2025, in order to reach the ideal vision by 2030.

The results were documented in grids, where the ideas were posted by post-it notes. The questions are in Appendix E. Two of the grids are presented in the research. The rest of the grids are presented in Appendix F. These two grids were selected to present in this study because they included most of the points and new ideas.

The backcasting method was used in the organisation of teamwork. The first teams envisioned the future of export of Finnish industrial wood construction in 2030 with the help of guiding questions provided by facilitators. After coming up with the future vision, the teams tackled the current circumstances. Teams identified resources needed in 2020 to achieve the future goal by 2030. Lastly, the teams drew up an action plan for the necessary development position in 2025 and the required support measures to reach the vision by 2030.

The expert panel - pre-event- and post-event-questionnaires

The expert panel answered the pre-event-questionnaire when they registered to the event; responses from 27 experts to the pre-questionnaire were collected. The pre-event-questionnaire was designed based on the research questions and the identified themes in the expert interviews.

The following questions were asked in the questionnaire:

(1) What should Finland try to achieve in industrial wood construction exports in 2030, in the exports of materials (like CLT), in know-how or construction projects?

(2) Which are the most 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?

After the event the post-event-questionnaire related to the envisioned export countries and export volume growth was sent to all the participants. Eleven participants answered to this questionnaire. The post-event-questionnaire was designed based on the results from the panel data.

The questions in the post-event questionnaire were;

(1) Which are the three 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 do you think the export value of value-added materials (CLT and LVL etc.) will increase (by percent) between 2020 and 2030 under ideal conditions?

(3) How much do you think the export value of projects will increase (by percent) between 2020 and 2030 under ideal conditions? Which questions/themes should be studied, in relation to wood construction exports in the future?

The answers from the post-event-questionnaire and pre-event-questionnaire were used to create word clouds figures 9, 10 and 11.

Validity and reliability

Future studies are often based on qualitative approaches, which is also utilized in this approach due to the complexity and the novelty of the study topic (Börjeson et al., 2006; Burt and Van Der Heijden, 2003). The method of the data collection was structured, and the themes were based on analysis of previous studies. The expert interviews before the panel were used to ensure the validity of the panel questions.

The outcomes from the expert panel and expert interviews were understandable, relevant and logical. Results are reported systematically and carefully and there is a clear connection between the data and the results. Quotations are used to get transparency of results and maintain the true meanings of responses (Elo et al., 2014). The data also clearly presents the examples of quotations from as many participants as possible, which shows the connection between the data and the results. The findings reflect the experts' voice and opinions on the topic.

Peoples' backgrounds, positions and professions could be unintentionally reflected in the collected data. The outcomes from the panel and the expert interviews were

translated into English, which could also have an effect on the meanings. Furthermore, some interviews were in English and Swedish, which are not the mother language of the interviewer and in some cases not the interviewees' either. All these matters in data have been taken into account in the data processing. These factors do not necessarily affect the reliability of the data, but these are identified risks.

The expert interviews were structured, and in some cases the questions were sent to the interviewee beforehand. This may have impacted the data, but these factors have also been considered in the data analysis process. Also, the research level of the preparation and knowledge related to the field, which increased along the process, could influence the outcome.

All these aforementioned limitations are to be taken into consideration when assessing the results of this study and were considered in data collection and analysis. Secondary data is used as background for this study; data from statistical databases such as LUKE, Tulli, Statistics Sweden, Statistics Estonia and OECD, and this data also must be interpreted with relevant caution. There can be contradictions in the export and import data, and differences in how similar terms are defined in different countries.

All data was collected anonymously, which the participants were aware of beforehand. No new themes came up after the post-event-questionnaire, so it can be concluded that the data was saturated. Richness and saturation of the data shows that the data indicate satisfactory sample size.

4 RESULTS

4.1 Expert views of industrial wood construction sector in Finland

The Finnish expert interviews

Three expert interviews from Finland were used to assess the current stage of industrial wood construction in Finland and to get a better understanding of the themes in industrial wood construction exports. All interviewees reported positive signals in the industrial wood construction sector in Finland, but they mentioned that there are always challenges, which need improvements. Challenges were seen, for instance, in the lack of modular element suppliers and designers. Need of improvements in some of the processes like wood construction product approval and building supervision were identified.

Overall, the Finnish experts highlighted that the WMC sector in Finland has grown over the last ten years, and interest in the sector has increased. New operators have come to the wood construction sector and there is more variability and opportunity in the industry, like different products (CLT and LVL), compared to ten years ago.

> *"Ten years ago, it was only single buildings, someone had ambition and enthusiasm to try it. Now, ten years on, more and more operators have come, interest has grown, and more industry has come."*
>
> [Finland, Construction Group, Manager]

> *"Most of the municipalities has wooden construction program […] and the need of wood construction has increased during the last ten years."*
>
> [Finland, Construction Group, CEO]

The growing interest towards wood construction has increased the expertise and at the same time, demand of certain expertise in industrial wood construction sector has increased. Also, the different methods of WMC brings challenges in the field of wood construction expertise and it has impacted the WMC markets in Finland. The challenges in the domestic market in Finland are usefully to identify before going deeper into the main research topic of export markets and future visions of exports. Many companies have their own systems to build wooden multi-story buildings like

massive elements, modules and CLT and LVL based solutions. There are many WMC systems compared to traditional concrete-based construction.

> *"Ten years ago, wood construction did not have established models. Concrete construction already had models in the 60´s. There are no national rules/instructions, so wooden construction sector can not develop like concrete did. "*
>
> [Finland, Wood Manufacturing Company, Director 1]

> *"The traditional way to build is to build concrete multi-story houses, they have details, planning, type structures and everything. Everything is ready for it. "*
>
> [Finland, Construction Group, CEO]

We have excellent engineering knowledge in Finland, but the knowledge could use more efficient methods of communication. One interviewee mentioned that the industrial wood construction industry does not listen to customers enough when creating the technical details. Although, during the last two years, new wooden construction opportunities have emerged. There is a growing interest in wooden construction and municipalities have implemented wooden construction strategies, making wood construction easier than before. This may be one of the reasons that some construction firms have come along in the wooden multi-story business.

> *"The Finnish industrial wood construction developer should listen more customer."*
>
> [Finland, Construction Group, Manager]

> *"The market share of wooden construction is predicted to increase in the future. As was mentioned before, all the big cities have building slots for wooden multi-story houses in their on-going plans."*
>
> [Finland, Construction Group, CEO]

"In the last two years, developers, in addition to construction firms have come along."

[Finland, Wood Manufacturing Company, Director 1]

General economic development in society is commonly brought up in construction activity discussion. One interviewee said that wood construction activity would slow down in Finland if the general economic situation, and thus markets for construction, became weaker. Otherwise, all the interviewees showed positive attitudes regarding the future of wood construction markets due to climate challenges and consumer demands and they didn't see the materials competing.

"I believe in wood construction. I don't want to put materials against each other but let people have options to choose. The regulations have developed thereby I believe that wood construction will grow. Climate challenges are so tough, and customers are more interested in environment issues and they start wanting them more. "

[Finland, Construction Group, Manager]

"I don't see that we need the materials to compete with each other. People buy the location they prefer, and it is a nice-looking house, these other aspects are adding values, which are in the same basket as price. Future should be good."

[Finland, Wood Manufacturing Company, Director 1]

The lack of expertise, i.e., education and knowledge in the wood construction sector was also highlighted as a barrier to the growth of the sector in Finland in the interviews. Lack of designers were mentioned many times and securing the knowledge via education was seen as an important factor.

"It is good to continue from the point where municipalities and cities press for wood construction, through this, it creates know-how. We need to get more wood construction into education programs. "

[Finland, Construction Group, CEO]

"Todays' wood construction barrier is that we do not have enough designers. The reason being that not so many buildings have been erected."

[Finland, Wood Manufacturing Company, Director 1]

The question of industrial wood construction exports brought up different ideas and opinions. Some of the experts believed more in the exports of the materials and some of the experts were more positive regarding the exports of projects as the main type of solution. The cost-effectiveness in Finnish industrial wood construction and the knowledge of local norms and construction regulations were some of the main questions in the discussions. Getting more experience from Finnish markets first were seen important before thinking the export business. Different ideas of the WMC exports came up in the interviews:

"The slowing factor for exports is that we should get more expertise from domestic markets before it (…) It could (idea of exporting WMC) be a cardboard box with assembling instructions and CLT-shipment with a partner, who delivers pre-assembled CLT-boards made of Finnish timber. So, exporting like Ikea style; the assembling instructions and walls abroad."

[Finland, Construction Group, Manager]

"I believe that we export timber and CLT-boards from Finland in 2030, because it is the easiest way. I don't believe that we will export concepts."

[Finland, Construction Group, CEO]

Overall the future of wood construction in Finland looks positive based on the expert interviews in this study but gaining more expertise and know-how from the domestic markets first were seen as important. These expert interviews were used to get a better understanding of the current situation of the industrial wood construction sector and identify the discussion themes of industrial wood construction, which was used to create the workshop questions.

4.2 An expert panel's vision of exports of Finnish industrial wood construction sector in the year 2030 – a backcasting analysis

The expert panel data

The methods and team organisation are presented in Chapter 3. The five teams came up with the image of wooden construction exports in the ideal condition in 2030 based on the previously mentioned questions. Figure 12 and figure 14 show the results of teams 1 and 3. These results are shown in the body of this report because they present a rich set of ideas and examples compared with the visions by the other teams. Grids by all the teams are presented in Appendix F. The background of the panel members is presented in Chapter 3.

The outcome of the ideal future vision of wood construction sector and its exports varies depending on the team. Team 1 outlines that in the ideal future vision in 2030, Finland should export know-how and services to developed cities in Europe and to Australia. Their motto was open design, specialized platform carbon/wood platform.

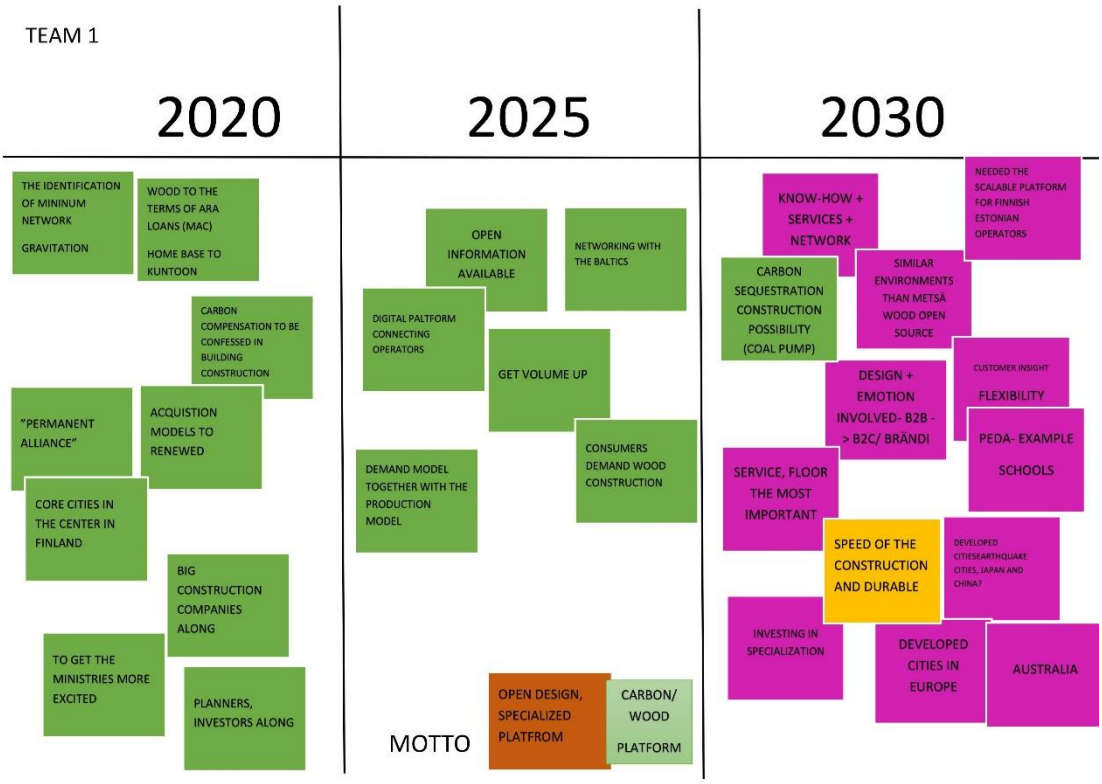

Figure 12: The workshop grid from team 1.

Team 3's future vision: export of concept/project like kindergartens to countries, which are located close by and the culture is similar to Finland. They mentioned the Nordics, Russia and China. They saw that China, Africa, Germany, France, the UK (question about Brexit) and the Nordics are the future markets for projects, value-added products and know-how.

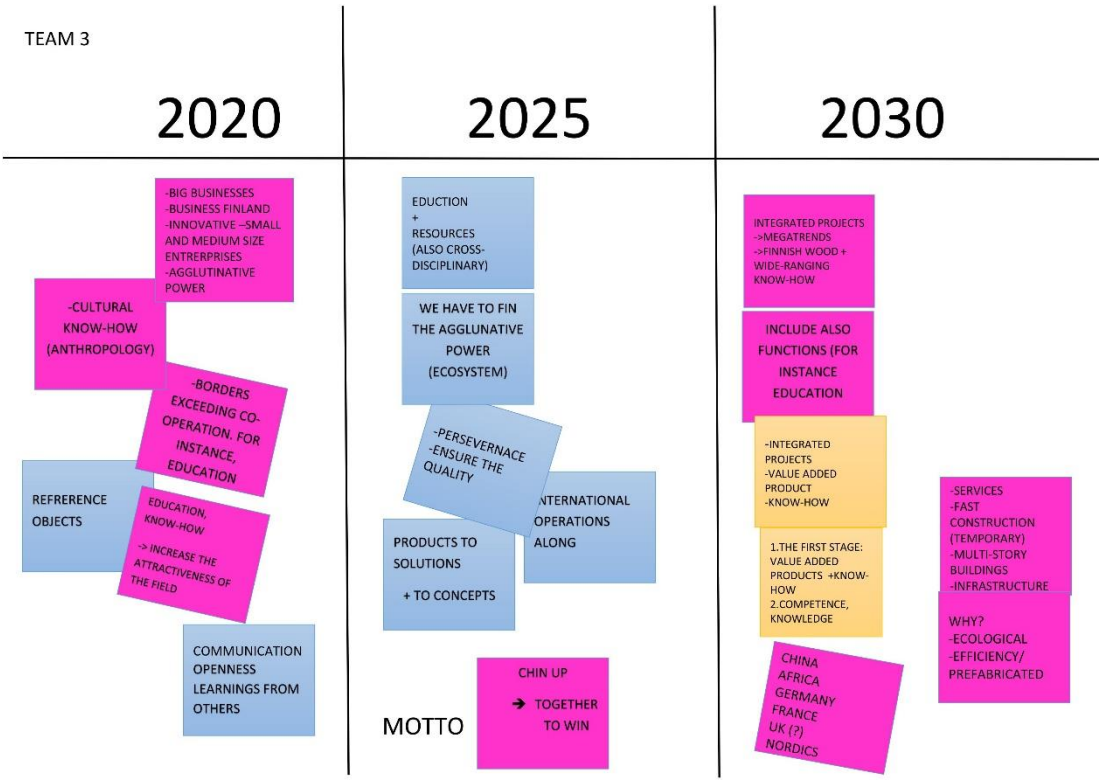

Figure 13: The workshop grid from team 3

Table 3 summarises the outcomes from the expert panel data regarding the vision of future vision in 2030 and steps to reach the vision. The most commonly presented assumptions are mentioned in the key pre-conditions (2020/2025) and characteristics (year 2030 of industrial wood construction sector). The bolded words came up in at least four grids. Method and actions are mentioned in the table 4 based on the panel data and some examples from the grids are presented in the examples section. This table is created based on the expert panel data.

Table 4: The future vision 2030 of WMC exports from Finland, and actions needed to reach the vision.

	2020	2025	2030
Key pre-conditions (2020/2025) characteristics of future exports from Finland (2030)	✓ **Co-operation** ✓ **Network**	✓ **Open information/ system available** ✓ Digital platform (1)	*Export of:* ✓ **Know-how** ✓ Projects ✓ Value-added products ✓ Services
Methods/actions	➢ Domestic market activation ➢ **Development of standards and regulations** ➢ Education ➢ Communication	➢ Get volume up (1) ➢ Co-operation with other (the Nordics, Baltics) (1,2	➢ Customer insight ➢ Flexibility ➢ Specialization ➢ Involved B2B and B2C ➢ Speed of the construction and durable
Examples	✓ **To get Ministries more excited** (environment and education) ✓ Increase the attractiveness of the field	✓ Lot of value-added materials to Asia ✓ Branding (to Asia) ✓ We have to find the agglunative power (ecosystem)	✓ Schools ✓ Kindergartens ✓ Service buildings ✓ Multi-story buildings *Export countries/areas:* 1. China 2. Nordics *3.* Europe

Year 2030

Environmental awareness will be higher in 2030 than it is now and ecological and efficiency in construction are one of the key drivers for industrial wood construction. In the ideal vision in the year 2030 developed by the expert panel workshop, Finland will export know-how, projects, value-added products and services in 2030. Importance between these entities can be seen in figure 15 (the most promising type of entities in WMC exports). One conclusion was that we need to know the customer and their needs better in order to increase the competitiveness and improve the product selling skills in the industrial wood construction field.

Flexibility and the speed of the construction were seen as one of the competitiveness factors and exploiting the AI technology have brought about new opportunities. The most promising types of applications in export of entities were seen to be schools, kindergartens, service buildings and multi-story buildings. Overall the creation of connections between other fields with the industrial wood construction sector was seen as important. Importance between these entities can be seen in figure 13.

Year 2020

After painting the 2030 ideal future vision, the panel focused on the current state of affairs regarding 2020 and what kinds of political measures or other activities were needed to achieve the ideal future vision in Finland. Co-operation and networks of WMC operators were highlighted by all the teams in all the stages. Thus, getting along with the investors, planners, construction companies and industry in one common platform was strongly connected to the co-operation and network and future growth of the export of WMC in Finland.

Many different methods were mentioned regarding how to achieve the 2030 ideal vision of the Finnish wood construction sector and its export. Domestic market activation was presented in many of the grids. One of the methods to activate the domestic market was to harmonize the land zoning plan on the municipal level. Also, the wood construction policy-programs were highlighted as developing standards and regulations. Some of the teams mentioned that developing and harmonizing standards with the Nordics not only locally in Finland would be beneficial.

Communication is closely linked to networking and co-operation; this field needs openness and the knowledge/information between actors should be shared more often. The use of opportunities in the field of digitalisation were seen as promising. The cultural know-how, knowledge in the concepts of planning and better understanding of the customer were identified as immediate targets of development and the importance of common marketing forces Finland state sector cannot be forgotten.

Current challenges in the industrial wood construction sector are; shortage of skilled labour, different wood construction standards in Finland and abroad, Finnish actors competing with each other, preventing the real co-operation. Finland should aim for

international growth. The integration of international students and the use of their potential in the trade business were seen as one of the opportunities to explore; what we should develop as soon as possible in Finland. Ministries, both the Ministry of Education and the Ministry of Environment, should invest more resources into wood construction. We have to increase the attractiveness of the field and create innovative ideas for new export products, such as exporting wood construction standards.

Year 2025

By the year 2025, the panel concluded that information should be open in the form of digital platform or using AI technology. Finland should expand co-operation, not only co-operation with Finnish actors but with the Nordics and Baltics. Stepwise development and related actions, which need to be achieved between 2025 and 2030, in order to reach the ideal vision by the year 2030, include: increasing the domestic market volume and supporting the development of commodity products to value-added solutions and concepts.

International students are actively involved in the industrial wood construction sector and Finnish actors in this field have increased their expertise in concept planning.

Conclusion of the workshop data

To summarize the findings from the expert panel workshop: networks and co-operation in Finland and between the Nordic and Central European countries is one of the key issues to achieve more effective ways to build by wood and obtain a broader scope of knowledge. The industrial wood construction sector in Finland has to be more open and create a digital platform to share the knowledge between cross functional sectors. It should aim not to compete against each other, but rather to improve international growth together, allowing for more effective planning for wooden construction building and to help avoid mistakes for construction by using shared knowledge.

In a political aspect, ministries have to communicate effectively with one another, and we have to improve our education because we lack expertise in the wood construction sector. The lack of resources in marketing was seen as a challenge. The idea of a

common marketing program was introduced in the discussions. The increase of the added value of the products was seen important.

The panel data from questionnaires

The most promising export countries for Finland in industrial wood construction products/projects/know-how are presented in figure 11. The size of the words represents the importance between the identified interesting export markets, where larger sized words are more important and smaller sized words are relatively less important.

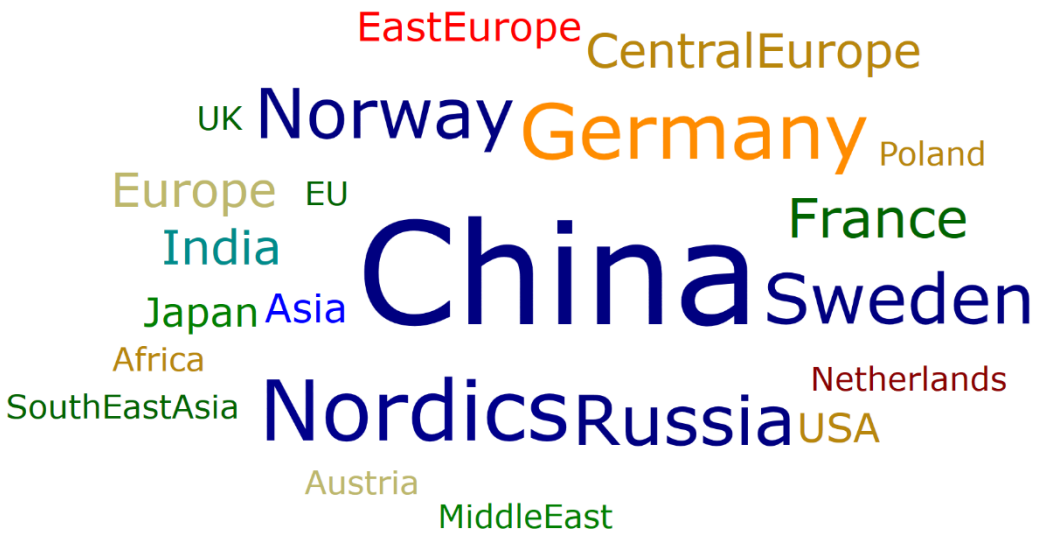

Figure 14: The most promising future export markets for industrial wood construction products/projects/know-how from Finland (Atlas.io).

From figure 14, it can be deduced that the most promising future export market for industrial wood construction products/project/know-how for Finland is China, followed by the Nordics, Germany, Russia and France. This conclusion is formed through an assessment by the expert panel during the workshop, and in their answers to the pre-and post-event-questionnaires. Almost all the respondents mentioned China. The Nordics was also mentioned many times, or Sweden and Norway. Other promising export countries were identified to be Russia, Germany, France and generally Central Europe.

Many expert panellists highlighted in the post-event-questionnaire, that a positive factor for exporting to China is the size of the market and the environmental awareness, which is rising in China. The middle class is becoming wealthier, urbanization is increasing, and the construction volumes are high: these are all factors that benefit the potential export market for Finland. On the other hand, there is uncertainty of the economic growth in China.

> *"China is a huge market from which a tiny small block can be significant. Furthermore, the green politics control."*
>
> [Panel, Official, Public sector 1]

> *"There is powerful urbanization in China."*
>
> [Panel, Wood Construction/Product Company 1]

Otherwise, in the Nordics, the construction culture is similar to neighbouring countries, geographic location is convenient for trade, and the use of wood is increasing in the construction sector across these countries. There is economic expansion in the construction sector in Norway, and environmental awareness is high in Sweden.

> *"Scandinavia is close by and there is similar construction culture."*
>
> [Panel, Organisation 1]

> *"Markets are close by, similar culture and co-operation with local operators. Green and aware consumers."*
>
> [Panel, Research 1]

Overall, the wood construction culture and environmental awareness are increasing in Europe. There is well-known wood construction culture in Germany and political actions support wood construction there. The interest to Central European markets came forth. Moreover, the need for more apartments in Eastern Europe were mentioned. The UK was also seen as a potentially important export market because of its close proximity and the rising environmental awareness, however the influences of Brexit are uncertain.

"Growing wood construction culture and environmental awareness in Europe (for instance Germany and France)"

[Panel, Wood Construction/Product Company 2]

The need of apartments in an ecological way, speed is an advantage due to the shortage of labour – East Europe and Developing countries globally."

[Panel, Wood Construction/Product Company 3]

The countries/areas like India, Russia and Africa were also mentioned due to expected economic growth and urbanisations. Aspects like digitalization were mentioned to be important in the future market selection process. Construction standards differ between countries and this was seen as a challenge in the country selection process.

The most promising future export products are know-how, services, projects and materials in 2030 based on the panel data. The data collected by the pre-event questionnaire is used to show these entities in order of importance (figure 15).

Figure 15: The most promising type of entities in WMC exports (Atlas.io).

The discussion about how and by which means to reach the ideal vision for exports in Finland by the year 2030 varies. One of the common factors is that the degree of processing should be increased within the Finnish wood construction and wood

construction material manufacturing sectors. Discussion about the regulations in different countries and know-how in the construction sector was mentioned by the panel during the workshop. There was also conversation about the availability of skilled workers in the industrial wood construction field. Some of the participants in the panel did not believe in the growth of exports of the WMC, but rather in exports of related wood materials:

> *" Know-how and materials. Construction is local."*
>
> [Panel, Producer of Wood Modules]

> *" It is not sustaining to achieve the export of construction projects, because the quality of construction is so low in Finland."*
>
> [Panel, 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."*
>
> [Panel, Wood Construction/Product Company 2]

> *" Finnish wood construction architecture is respected in the world. Industrialized prefabricated solutions are needed in the construction sector."*
>
> [Panel, Journalist 1]

In the pre- and post-event-questionnaires by the expert panel, there were questions about the export potential of school and kindergarten construction and also about WMC. Some other ideas also came up like catastrophe buildings, luxury multi-story buildings and service buildings, environmental buildings. Figure 13 shows the significance between applications in WMC exports.

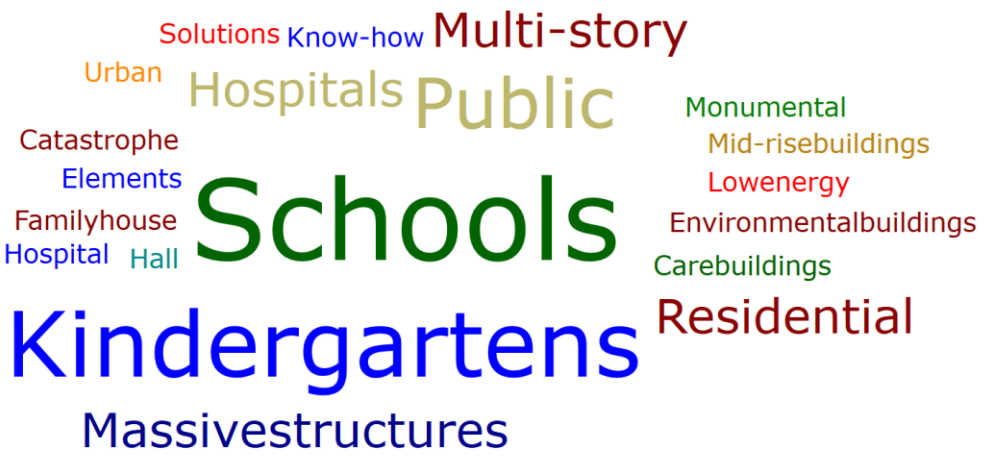

Figure 16: The most promising type of applications in WMC exports from Finland (Atlas.io).

Schools and kindergartens were mentioned many times by the expert panel. The panel also identified that potential for co-operation between different sectors. For example, the Finnish education system is already known worldwide so cooperation between the wood construction material sector and education system may be mutually beneficial. Residential multi-story construction was also mentioned in one of the most promising type of applications after schools, kindergartens, hospitals and other public buildings. One of the demographic factors, like ageing, was seen to establish a positive influence on wood construction:

> *"Care buildings, the population is ageing in all of the developed countries."*
>
> [Panel, Promoting Organisation 2]

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

It was noted that the value of the increase of the wood products/project exports was difficult to identify. The answers about the expected increase in the value of wood products exports varies between 30% and 500%. Also, the estimated increase in the export value of wood construction (projects) varies from 30% to 500%.

> *" 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. "*

[Panel, Research 1]

Overall, post-event-questionnaire respondents saw that exports of the industrial wood construction sector will increase in ten years' time.

4.3 Summary of expert views on future exports and potential export markets of Finnish industrial wood construction sector

Based on the panel data and expert interviews, Finnish experts have varying views of the development of industrial wood construction sector exports in their ideal vision about the sector in the year 2030 however the general perspective of the industrial wood sector is positive and it has promising growth prospect.

In the ideal vision for the year 2030, the Finnish industrial wood construction sector is more flexible and specialized than it is now. Furthermore, customer insight is taken into account and the speed of construction is advanced and buildings are durable in Finland. Finnish actors in the industrial wood construction sector have good networks and co-operation between the various forest-related industries, but also with such as cross-cutting fields. Finland will have created an open system; maybe the digital platform, which is open to all for sharing industrial wood construction expertise. The attractiveness of the field will be raised, and Ministries will be more involved in enhancing wood construction sector development an export. Standards and regulations will be more developed than they are now in Finland and we will have developed effective co-operation networks with the Nordics and perhaps also with the Baltics. The Finnish domestic market will also be wider, and we will have gained more experience and knowledge.

All of the interviewed experts and expert panellists believed that exports of industrial wood construction will increase within ten years' time. The opinions on export entities/suitable products for export varies amongst the experts. Some of the experts believe more in exports of materials than in exports of know-how or construction projects and vice versa. The main export potential was seen in the following applications: schools, kindergartens, public buildings, hospitals and multi-story

buildings. The importance of these entities and applications were seen clearly in figures 15 and 16.

Based on the panellist experts' opinions, the future exports markets for industrial wood construction are China, the Nordics, Germany, Russia and Central Europe. The potential attractiveness between these countries is clarified in figure 14. Based on literature analysis, potentially interesting future export markets would include Central Europe, China, the UK, the Nordics, India, Nigeria, Australia and Japan. Figure 10 clarifies the literature analysis for assessing the potential new markets for industrial wood construction by key drivers.

Actions to achieve these expert views are required immediately. Concrete actions, which were mentioned by panel experts, included improving education surrounding forest products, creating a common marketing program for the field, and improving the co-operation with other Nordic countries.

4.4 Industrial wood construction sector in Estonia and Sweden: analysis of expert views

These results are based on the expert interviews from Estonia and Sweden. The chapter describes the pathway to the current position of industrial wood construction market position in Estonia and Sweden. Secondly, the chapter goes through the competitive and limiting factors in these countries' perspective regarding the domestic market and the exports. Thirdly, the expert views of identifying the most promising export countries for the future are explored.

Estonia

The value of exports in prefabricated houses has grown in recent years in Estonia. The main export countries are Norway, Sweden, Germany and Finland. However, there is hardly any significant domestic market in the WMC sector in Estonia since the Estonian market for housing is quite limited. The export business in prefabricated houses in Estonia has a 25-year history.

> *"Most of the Estonian actors still afraid wood and Estonians use concrete in construction sector […]. I think in the future about 10-15*

years forward it will change. The mind is ready but maybe, cost efficiency is still better in concrete. […] Therefore, I think that the efficiency of the factories, which produce of wood is getting higher and higher [...]. Price is not ready yet and the Estonian market is so small."

[Estonia, Construction Company, Developer 1]

"It started from log buildings and then they started to export them. They saw that market would also like to have industrial wood construction. The companies changed their production and came to the market. We have also log producer companies, which started to produce wood elements. "

[Estonia, Director 2]

The competitive factors in Estonia in terms of export are good references and knowledge and the open mind set and co-operation with government, universities, and others. The industrial wood construction market has development in Estonia due to;

"Partnership with Sweden and Finland. Most of all it is helping us to. European market overall. Engineers have done great work. The universities, the part of this national teams to develop all these technologies of WMC. "

[Estonia, Construction Company, Developer 1]

"I sincerely think that Estonia is quite competitive, because of our competence, our reference is already, what we have done in the last decade or little bit more, maybe a little bit price, but I think the price advantage is disappearing."

[Estonia, Policy Officer]

Estonian experts have noticed that the lack of skills in the wood construction sector is one of the limiting factors. Also, Estonia is not anymore so competitive when comes to pricing of wood construction products. Other limiting factors include lack of experience and regulations.

"I think it is a good partnership with our customers and they have made such a good product with us that it is easy to produce. Easy to assemble and cost-efficient and fast on the site. This is the main key in the structures. So, they have put lot of engineer power to develop the new series. "

[Estonia, Construction Company, Developer 1]

"First it was price, now it is references and the knowledge."

[Estonia, Director 2]

"Then limiting factor is maybe experience in terms of procurement can be where we sometimes limit the growth in the wooden, timber building sector that still I believe, not only in Estonia, but in Nordic countries wood in many cases is still more expensive than concrete or even steel, wood becomes more competitive when in terms of in the procurement process the let say the value of the building was placed higher than the cost, so in Estonia still a lot of building procurements are based on lowest cost or lowest price and this very often becomes."

[Estonia, Policy Officer]

Many current and future export countries were discussed in the Estonian Interviews:

"We are producing them but 97 % we sell to Sweden, Finland and Norway […] Export countries; 1. Sweden 2. Finland 3. Norway 4. Germany. In the future, Germany is the growing markets."

[Estonia, Construction Company, Developer 1]

"New markets; UK for sure for us […] and Germany. […] Environmental issues are gaining attention in Europe. […] We don't have interest in Asian market at the moment. I believe that Asian market within the twenty years, they will sure make their own factories and start to produce they do not import from here. I think that one thing is the

transportation cost. It is not that difficult, if you have knowledge and right people to produce them. "

[Estonia, Construction Company, Developer 1]

In Sweden, the release of the legislation in 1994 opened for the building of wooden multi-story buildings. The Swedish government has also had promotional projects, but they have not been particularly successful in local actions. Progress has been positive in the WMC sector during the last three years and the industry has invested more resources into it and in its production capacity. In export business, we have to take into account the exchange rate of the Swedish crown.

"The UK and Scotland could be future markets, also Central Europe including Germany, Austria but there is also more land to build in East European countries like Poland, Czech Republic and Slovakia […]."

[Sweden, University, Research 1]

Swedish and Estonian markets differ from each other quite clearly. There is a significant domestic WMC market in Sweden, while Estonia produces mainly for exporting of prefabricated houses. Table 4 summarizes key issues, which were identified in the interviews

Table 5: Current status and influencing key factors in WMC sector in Estonia and Sweden

	Estonia	Sweden
Current position in WMC sector	✓ No significant local market ✓ Production to export ✓ Export growth 23 percent in 2018 ✓ Main export countries: - Norway, Sweden, Germany, Finland	✓ Local actions have been more successful (PPP) than government promotional activities regarding wood construction market in Sweden ✓ Last two/three years really positive progress ✓ New Swedish actors to WMC markets
Competitive factors	➢ References and knowledge ➢ Open mindset ➢ Co-operation with government and universities	➢ Positive crown exchange course ➢ Industry has increased the volumes
Limiting factors	➢ Lack of designers ➢ Losing price competitiveness	➢ Lack of skills in the construction industry (to build with wood) ➢ Architect traditions ➢ The use of wood for other needs (energy, hygiene products, textiles) ➢ A conservative industry
Future export countries	✓ the UK, Germany, Ireland	✓ Central Europe (Germany, Austria), East Europe

4.5 Comparison of expert views on development of exports and potential export markets for industrial wood construction sectors in Finland, Sweden and Estonia

Based on the expert interviews from Sweden and Estonia and the data from Finland, it is noticed that the current conditions of industrial wood construction differ between these countries. There is variation in the domestic market conditions and the export status.

There is a significant domestic market in WMC in Sweden. Sweden has successfully managed to grow their domestic WMC markets in the last twenty years because the local actions have been successful. The Finnish domestic market for WMC has grown in recent years but activation has started later than in Sweden. The first modern WMC

building was completed in Estonia this year, 2019, so it can be stated that they do not have an active domestic market at all.

Estonia has been more active and profitable than Sweden and Finland in the industrial wood construction exports. Estonia successfully increased the value of exports in prefabricated houses in the last ten years due to good references, knowledge and co-operation between actors. Estonian experts also mentioned the lack of designers like Swedish and Finnish experts. Swedish experts pointed out the lack of skills in the construction industry and the conservative nature of the industry. The Swedish growth of WMC business has been very powerful: Sweden imports more prefabricated houses than it exports. They have also become an importer of construction wood. Swedish experts saw that Swedish markets for WMC would grow and new actors would come to the Swedish market, so there were no changes in the exports in the future.

In all the countries researched, industries related to the wood construction sector have increased their volumes. Many Swedish companies have invested in wood construction. Also, some of the Finnish companies have invested in the development of WMC but on the other hand also in the VAP's, which are commonly used in construction. Estonian companies are also raising their industrial capacities.

Finnish experts saw the Nordics, Germany, Russia, France, and China as the most promising countries for exporting industrial wood construction by 2030. Swedish experts mentioned Central Europe, the UK, Scotland and Ireland. Estonian experts saw the market potential in Central Europe and East Europe. The differences between the expert views of potential future export countries can be from the current market situation in these countries. Finland exports a lot of wood products to China whereas Estonia does not. Estonian exports have increased in the past years to Central Europe, which Estonian experts mentioned as one of the future markets. We cannot make wide suppositions from Swedish views because the data was limited from researchers' views.

5 CONCLUSION AND DISCUSSION

The aim of this study was to assess future export markets for the Finnish industrial wood construction sector. This was done by analysing secondary materials, previous studies, and creating a future vision of the Finnish industrial wood construction sector; particularly its exports by the year 2030. This analysis was based on qualitative individual expert interviews and by performing a backcasting analysis using separate expert panel data. All the data was collected in 2019 and treated by taking into account the limitations, which were mentioned in the variability and reliability section of this study. International market selection model (IMS) was employed in the study as a theoretical framework to identify characteristics of potentially attractive export markets for the future of the industrial wood construction sector in Finland.

The results emphasised that concrete collaborative actions are needed as soon as possible in knowledge sharing and the industrial wood construction marketing. Based on the International market selection model (IMS), which is employed in this study and combining all the information from the workshop, interviews, literature and questionnaires have proven that the most promising future markets would be Central Europe, the UK and the Nordics by 2030. Otherwise the Finnish expert views of most promising export entities by 2030 varies between products, know-how and projects. During the research process it was realised that future markets need to take a closer look especially from the companies' perspective.

The study compares the current status of the forest industry exports and future assessments between Finland, Sweden and Estonia by analysing secondary materials, previous studies and expert views. This combining of the different data and the current situation is important to get a wider understanding; the field of industrial wood export is still a relatively new research subject.

Firstly, assessing the current position of industrial wood construction sector exports and imports in Finland, Sweden and Estonia is helpful for understanding the future prospects of the industrial wood construction sector and its exports from Finland.

The analysis of historical development concluded that Finnish exports of prefabricated buildings are slowing down, but the export of wood products has risen from 2014.

Sweden imported more prefabricated wooden houses and manufactured wood than it exported in 2017, the main reason being the growing domestic market for industrial wood construction. On the other hand, Estonia has almost constantly increased their export value of prefabricated wooden houses since 2007. These countries have different situations in terms of domestic and international industrial wood construction sector, therefore the outcomes from this research and the novelty value is significant.

The domestic market conditions differ between Finland, Sweden and Estonia. In Sweden the market share for WMC has grown over the last twenty years but the WMC has not yet experienced a similar breakthrough in Finland. Studies by Steinhardt and Manley (2016) and Toppinen et al., (2018) have reflected the same issues. On the other hand, Estonia has been successful in the export market of industrial wood construction but there is no local market for WMC. Estonian experts identified that the price is one of the key factors that there is no local market for WMC in Estonia. Attitudes towards the use of wood in multi-story construction is another factor to consider.

Finnish experts believe that exports of industrial wood construction will increase in ten years' time in Finland. Also, they believed in positive development in industrial wood construction in domestic markets. Previous data of wood construction activity in Finland supports the conclusion that industrial wood construction is a growing industry. According to Rakennustutkimus RTS report, the number of wooden multi-story houses is expected to double in Finland between 2018- 2020 (Rakennustutkimus RTS Oy, 2018).

Thirdly, based on the panel data and expert interviews, Finnish experts have varying views of the industrial wood construction export in their ideal vision for 2030. This study proved that the experts' views were clearly divided. Many of them believed that Finland should export more know-how and projects by 2030. Others believed that Finland should concentrate on the export of value-added materials. However, all the experts agreed that Finland should activate the domestic market and harmonize the regulations, which have a positive influence on our competence and know-how.

In the ideal vision of the year 2030, the industrial wood construction sector will have improved networks and co-operation within the forest industry but also together with other construction business that is in focus in this study. Ideally, the knowledge sharing

within industrial wood construction actors in Finland will happen in a common digital platform, which is open for all. It will have more advanced standards and regulations in Finland and together with other Nordics regarding WMC. The wood construction industry will be more attractive for the younger generation and Finland's' domestic market will be wider and Finland will have gained more experience and knowledge in the field of industrial wood construction. Previous research by Haapio, (2013) in the wood construction sector has identified some of the same issues such as lack of experience.

The lack of relevant education was seen as one of the most important external factors in the wood construction sector has also been raised up in previous research (Hurmekoski, 2016; Hurmekoski et al., 2018; Toppinen et al., 2019). It was widely realised among the Finnish, Estonian and Swedish experts that we need more wood construction experts, such as in the field of design.

Fourthly, based on the expert panel data from Finland, the most interesting future exports markets for industrial wood construction are China, the Nordics, Germany, Russia and Central Europe. China was seen as an attractive market due to the size of the market, rising environmental awareness, wealthier middle class and increasing urbanization. However, China and other emerging countries have to be treated with caution, because they were not highlighted in the Estonian, Swedish or literature-based data. Secondly, the construction culture is similar in the Nordics and location is nearby and the use of wood is increasing there. Overall, the culture of industrial wood construction and environmental awareness are increasing in Europe, especially the countries where there are longstanding traditions in wood construction, like countries in Central Europe. Previous studies by Jonsson (2009), Hurmekoski (2016) and Toppinen et al., (2018) have identified that improving the regulations have clear positive impact to the industrial wood construction activity.

Expert views of future export markets differed in the results of previous research which analysed the level of acceptance of wood (regulations and positive attitudes) and demographic changes (market volume growth, urbanization and ageing population) based on previous research and secondary data (Jonsson, 2009; Riala and Ilola, 2014; Wang et al., 2014; Hurmekoski et al., 2015; Kuzman and Sandberg, 2016; Rebane and Reihan, 2016; Antikainen et al., 2017; Lindgren and Emmitt, 2017; Toppinen et al.,

2018; Markström et al., 2019). Based on the literature analysis the future markets are Central Europe, China, the UK, the Nordics, India, Nigeria, Australia and Japan (Qinfen, 2006; Mahapatra et al., 2012; Verkasalo and Karvinen, 2012; Hetemäki et al., 2013; Hansen et al., 2013; Cao et al., 2015; Hetemäki and Hurmekoski, 2016; Kuzman and Sandberg, 2016; Abergel et al., 2017; Gaston and Pahkasalo, 2018; Chang et al., 2018).

The interviewed Swedish experts saw market potential and competitiveness as most interesting in Central Europe and Eastern Europe, but one needs to consider the fact that the data from Sweden is limited to few researchers' opinions in this study. The interviewed Estonian experts saw future market potential as most interesting in the UK, Germany and Ireland by 2030. They did not see China as an attractive potential market, as was the case in the results from Finland. Their argument was that the Chinese will copy the methods and build their own factories in China. Also, Estonian experts pointed out the challenge of transporting goods to far destinations. In, Hurmekoski's (2016) study, the Nordics were identified as having the highest market potential of European countries for wood construction. Therefore, the results of this study support Hurmekoski's outcome.

Fifthly, based on my personal experiences in the study process the interest towards industrial wood construction and its opportunities are high in Finland, Sweden and Estonia. This study approached the wood construction markets from a different angle than earlier research. Many previous studies have focused on the market activation in domestic markets. This future- and export-oriented study raised up new questions in the domestic wood construction sector, including the difference between building systems. The variation in the growth of export volumes in the field of industrial wood construction tells that there is potential for growth in the industry based on the expert views.

The identified potential attractiveness for the future export countries varied significantly in Finnish, Estonian and Swedish experts' views but also in the previous literature. More detailed market analysis and closer look at the competitiveness factors in industrial wood construction sector in the identified potentially attractive export countries should be done.

This research is based on qualitative data; therefore, the results cannot be generalized to the broader group. However, this research interviewed four interviewees from Finland and the panel included 35 experts from different sides of the Finnish industrial wood construction and previous researches have considered. Nevertheless, it is always possible that all new perspectives have not been recorded. The future research should take a closer look into this reason of the previously mentioned reliability issues.

As a final note

The Finnish Government Program "Inclusive and competent Finland" 3.6. (Finnish Government, 2019) describes that "Added value creation will be boosted in wood product processing. Wood construction and exports will be promoted." and "We will advance wood construction expertise and continuing education in the construction sector and promote research, product development and exports related to wood construction." However, Finland has a small market and development of industrial wood construction needs also industrial wood construction exports.

Finland can learn many things from Sweden about the domestic WMC activation and from Estonia about the export business.

Local actors should be more active in the field of wood construction and the governmental policies towards the use of wood for construction purposes should be more attractive. Moreover, the market activation locally creates more competence and knowledge in the field of wood construction.

Increasing the level of co-operation between the actors such as universities and companies has been important in Estonia. Estonia is currently losing the price competitiveness but their good references and know-how in the field of prefabricated wooden houses has led them to be the market leader in exports in Europe.

Although, the experts' views of export ideas varied, it is commonly noted that Finland should concentrate on creating more expertise in the wood construction field in Finland and be more open and communicate better to achieve the desired results. At the same time, Finland should try to identify future markets and to not rely only on the current wood industry markets, but also rely on their market potential.

As I mentioned earlier, the promising future export markets need a closer look, especially in the most promising future export markets like the Nordics, Central Europe and China. Now, it is difficult to estimate the increase in the value of exports because we do not know the exact current data. However, currently the municipalities and cities appear the most interesting actor in the WMC in Finland. Also, the expert panel suggest that there is growing demand of WMC in municipalities such as in the construction of schools and hospitals.

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Appendix A: Questionnaire for pre-interviews for Finnish wood construction experts

1. What kind of challenges have you faced in the industrial wood construction markets in Finland?

2. Which matters bring 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 be change in the next ten years?

5. What came up to your mind of 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 that Finland would be exporter of WMC in 2025/2030?

8. Where is the growth opportunities for Finnish industrial wood construction in 2025 or 2030?

9. Who are the buyers of WMC in export markets now and in the future (2030)?

10. Which actors or networks are needed to export of WMC?

11. What kind of is export of WMC in 2030 from Finland?

Appendix B: Pre panel questionnaire

*WMC = Wooden Multistory Construction, meaning 2 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 exports of materials (like CLT), in know-how or construction projects?

(2) Which are the most 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?

Appendix C: Post panel questionnaire

(1) Which are the three most significant export countries for export of industrial wood construction and its value chain in 2030?

(2) Why these countries have the greatest market potential? Analyse this by countries. How much the export value of value-added materials (CLT and LVL etc.) would increase by percent between 2020 and 2030 in the ideal condition?

(3) How much the export value of projects increases by percent between 2020 and 2030 in the ideal condition? Which questions/themes should rise up or be studied related to wood construction exports in the future?

(4) Which questions/themes in your opinion should be brought up in future research on industrial construction of wooden houses and in the favorable development of their exports?

Appendix D: Questionnaire for Estonian wood construction experts

*WMC = Wooden Multi-story Construction, meaning 2 floors or more, with either wood frames or hybrid wood elements and materials

1. Do you have commonly used definition for wooden multi-story building?

2. What is the current situation in the Estonia construction sector? (and the market situation in WMC) - How many wooden multi-story houses has been built?

3. How has the industrial wood construction market developed in the Estonia in the last ten years? Has there been some key changes in market environment (support measures, regulations etc.)?

4. There are many companies involve in wood construction business in Estonia, which reasons have contributed this?

5. Many of them (Estonian wood module/construction companies) have succeed in export business, how do you see, which factors have contributed to this?

6. What are the main export countries for Estonian companies in industrial wood construction business now and in the future? - Do you know, which are the reasons affecting this?

7. Which are the make the Estonian companies competitive in the export markets in those countries?

8. How do you anticipate the development of the industrial wood construction markets especially the WMC area in domestically and international in the next ten years? What are the key competitiveness factors?

9. How has Estonian state or the industry associations had some programs or support measures to try to boost industrial wood construction? For instance: education, research and development, innovations, network, co-operation. How about in the future?

10. What are the limiting factors for the growth in WMC sector?

Appendix E: The background questions of the panel

1. 2030 creating the vision

The team created the vision of desired prospect 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-done solutions (for instance, modules, large panels)
    - Know-how/service of industrial wood construction?

2. Which of these value have increased most between 2020 and 2030? Why this?

3. Which are three remarkable entities for export of industrial wood construction? And, why these?

   - Service buildings (school, kindergartens, hospitals)
   - Multi-story buildings (for residents and companies)
   - One-family houses
   - Culture/sports etc.
   - Other possible like catastrophe objects

4. Which are the five most significant export countries for export of industrial wood construction in 2030? And why these (shortly)

Crystallize the vision to one sentence or motto (write down to "other section"), you can do it at the end, when 2020 and 2025 is done.

2. Starting point

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

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

3. Status in 2025 (intermediate stopping point)

The team creates picture of status of export in industrial wood construction in 2025

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

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

2. Which are three remarkable entities for export of industrial wood construction? And why these?

   - Service buildings (school, kindergartens, hospitals)
   - Multi-story buildings (for residents and companies)

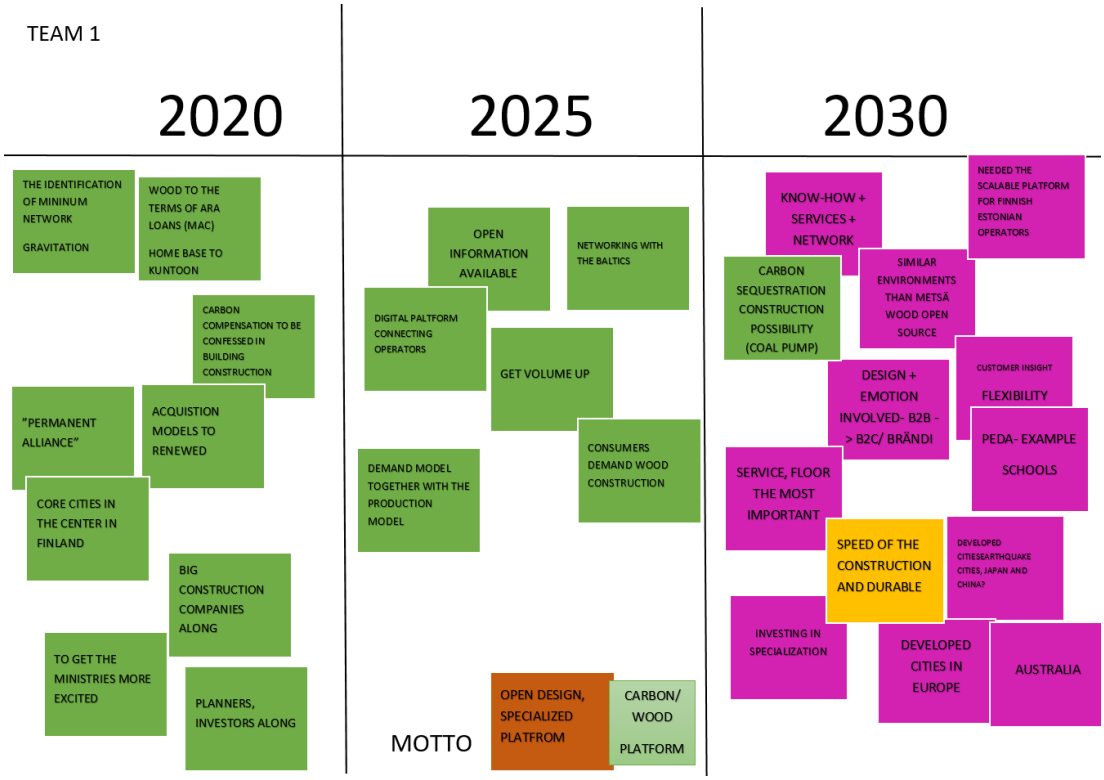
- one-family houses
- culture/sports etc
- other possible like catastrophe objects

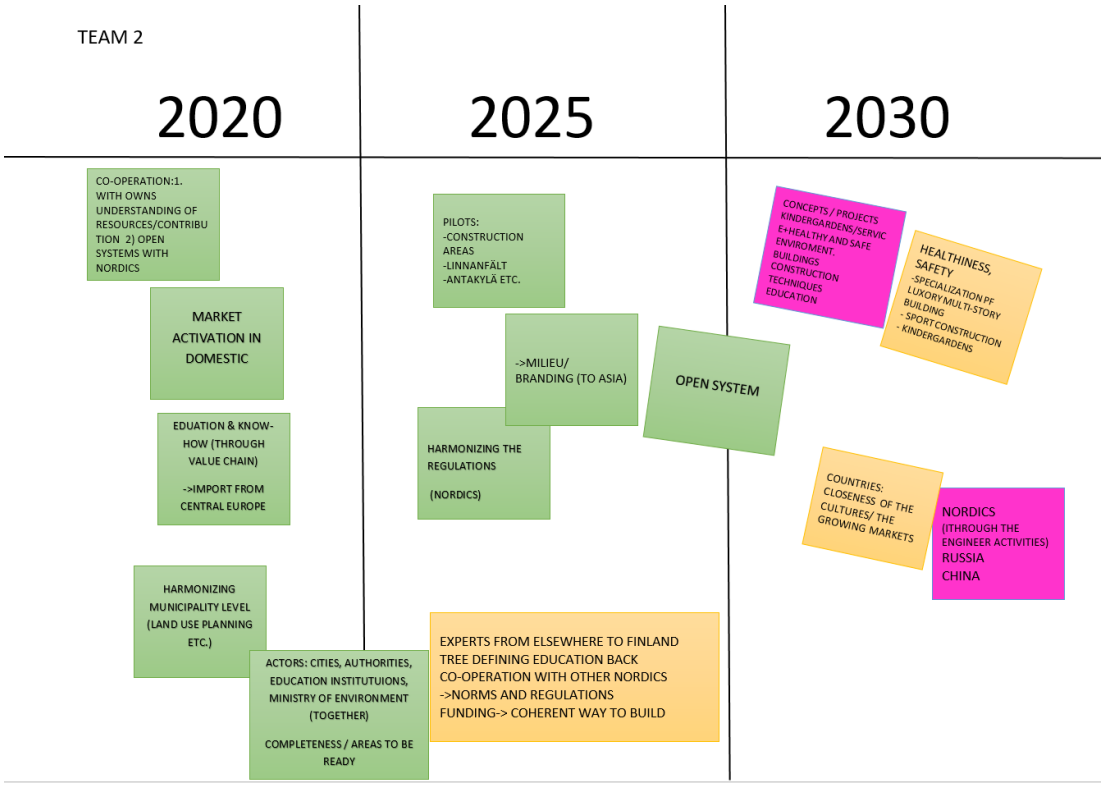
3. Which are the five most significant export countries for export of industrial wood construction in 2030? And why these (shortly)

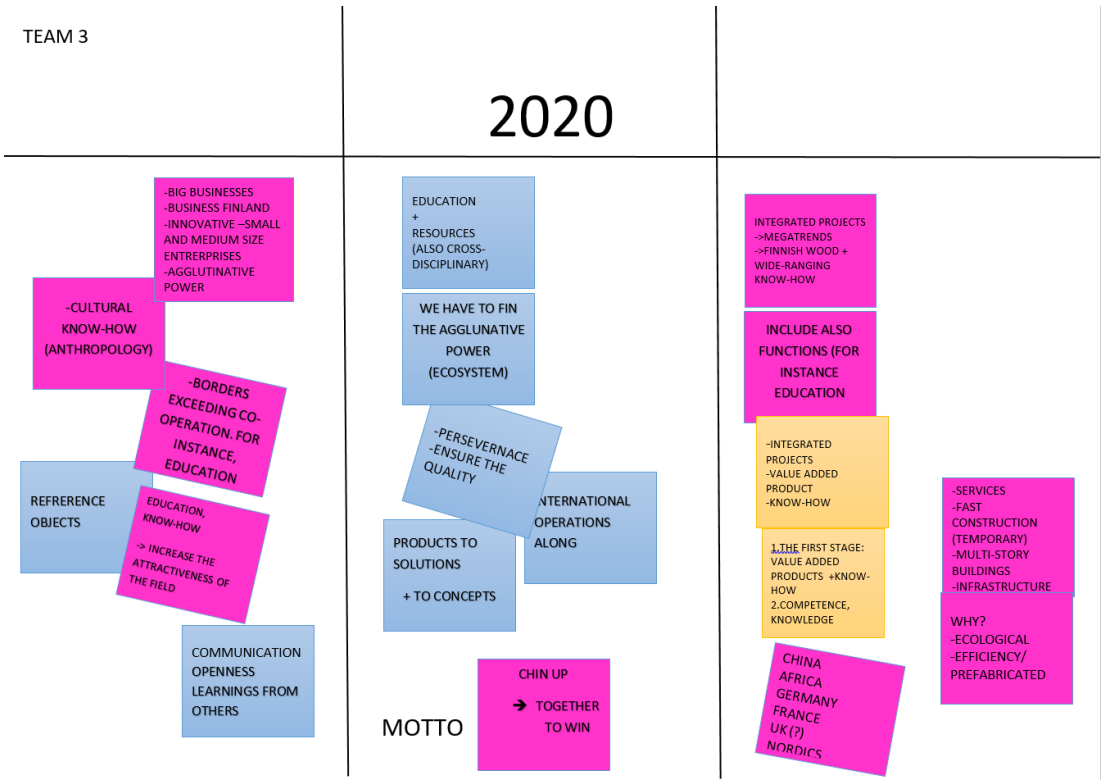
The team creates the picture of needed actions in the intermediate stopping point to reach the ideal prospect in 2030

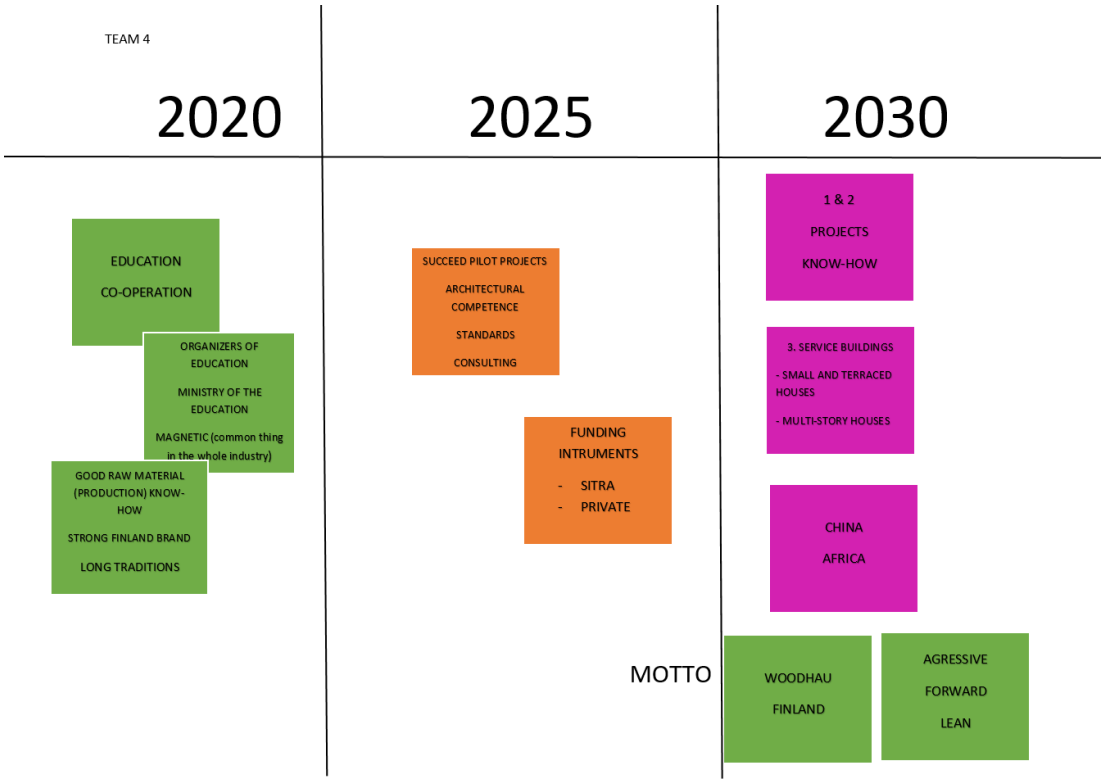
- Which are the most important actions and changes in methods, which is needed to reach the vision 2030?
  - for instance, new co-operation models
  - actions in private and public sectors
- Which are the main actors related to these? Write down the actors near by the actions.
- Which are the competitive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

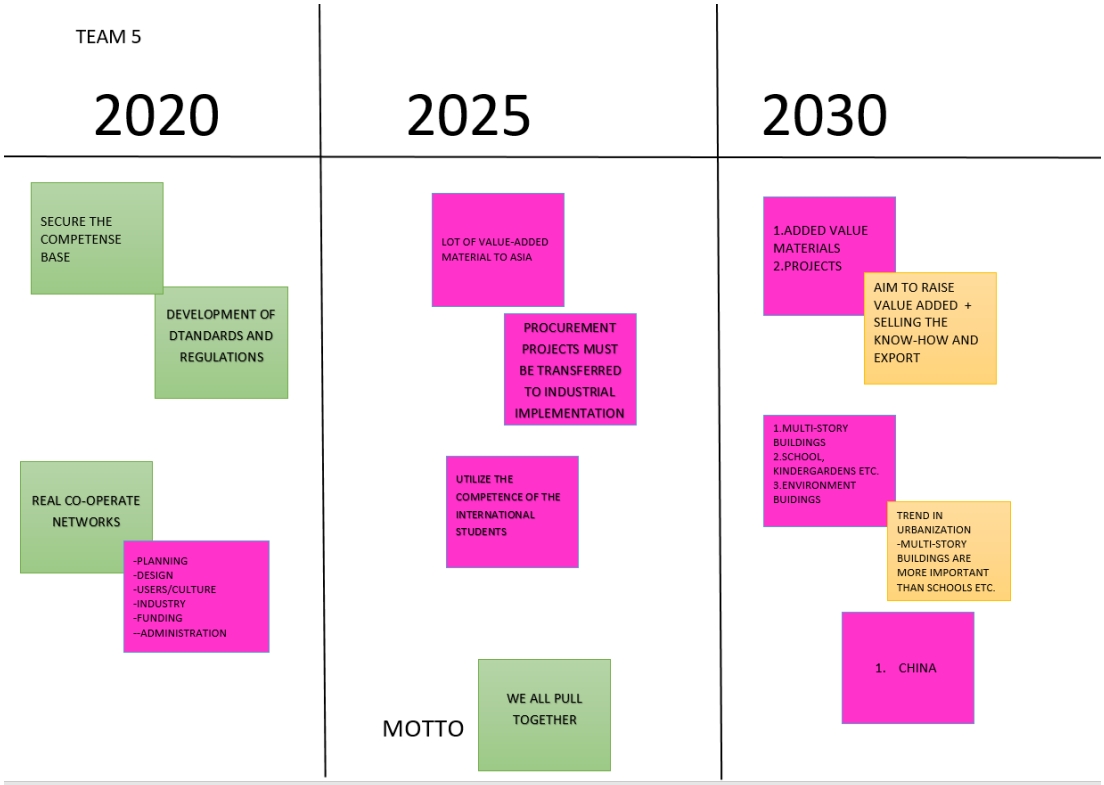
Appendix F: Grids from the expert panel data




TEAM 2
2020
2025
2030
CO-OPERATION:1. WITH OWNS UNDERSTANDING OF RESOURCES/CONTRIBUTION 2) OPEN SYSTEMS WITH NORDICS
MARKET ACTIVATION IN DOMESTIC
EDUATION & KNOW-HOW (THROUGH VALUE CHAIN)
->IMPORT FROM CENTRAL EUROPE
HARMONIZING MUNICIPALITY LEVEL (LAND USE PLANNING ETC.)
ACTORS: CITIES, AUTHORITIES, EDUCATION INSTITUTUIONS, MINISTRY OF ENVIRONMENT (TOGETHER)
COMPLETENESS / AREAS TO BE READY
PILOTS: -CONSTRUCTION AREAS -LINNANFÄLT -ANTAKYLÄ ETC.
->MILIEU/ BRANDING (TO ASIA)
HARMONIZING THE REGULATIONS
(NORDICS)
OPEN SYSTEM
EXPERTS FROM ELSEWHERE TO FINLAND
TREE DEFINING EDUCATION BACK
CO-OPERATION WITH OTHER NORDICS
->NORMS AND REGULATIONS
FUNDING-> COHERENT WAY TO BUILD
CONCEPTS / PROJECTS KINDERGARDENS/SERVICE+HEALTHY AND SAFE ENVIROMENT. BUILDINGS CONSTRUCTION TECHNIQUES EDUCATION
HEALTHINESS, SAFETY -SPECIALIZATION PF LUXORY MULTI-STORY BUILDING - SPORT CONSTRUCTION - KINDERGARDENS
COUNTRIES: CLOSENESS OF THE CULTURES/ THE GROWING MARKETS
NORDICS (ITHROUGH THE ENGINEER ACTIVITIES)
RUSSIA
CHINA


TEAM 3
2020
-BIG BUSINESSES -BUSINESS FINLAND -INNOVATIVE –SMALL AND MEDIUM SIZE ENTRERPRISES -AGGLUTINATIVE POWER
-CULTURAL KNOW-HOW (ANTHROPOLOGY)
-BORDERS EXCEEDING CO-OPERATION. FOR INSTANCE, EDUCATION
REFRERENCE OBJECTS
EDUCATION, KNOW-HOW
-> INCREASE THE ATTRACTIVENESS OF THE FIELD
COMMUNICATION OPENNESS LEARNINGS FROM OTHERS
EDUCATION + RESOURCES (ALSO CROSS-DISCIPLINARY)
WE HAVE TO FIN THE AGGLUNATIVE POWER (ECOSYSTEM)
-PERSEVERNACE -ENSURE THE QUALITY
NTERNATIONAL OPERATIONS ALONG
PRODUCTS TO SOLUTIONS
+ TO CONCEPTS
MOTTO
CHIN UP
➔ TOGETHER TO WIN
INTEGRATED PROJECTS ->MEGATRENDS ->FINNISH WOOD + WIDE-RANGING KNOW-HOW
INCLUDE ALSO FUNCTIONS (FOR INSTANCE EDUCATION
-INTEGRATED PROJECTS -VALUE ADDED PRODUCT -KNOW-HOW
1.THE FIRST STAGE: VALUE ADDED PRODUCTS +KNOW-HOW 2.COMPETENCE, KNOWLEDGE
CHINA AFRICA GERMANY FRANCE UK (?) NORDICS
-SERVICES -FAST CONSTRUCTION (TEMPORARY) -MULTI-STORY BUILDINGS -INFRASTRUCTURE
WHY? -ECOLOGICAL -EFFICIENCY/ PREFABRICATED


TEAM 4
2020
2025
2030
EDUCATION
CO-OPERATION
ORGANIZERS OF EDUCATION
MINISTRY OF THE EDUCATION
MAGNETIC (common thing in the whole industry)
GOOD RAW MATERIAL (PRODUCTION) KNOW-HOW
STRONG FINLAND BRAND
LONG TRADITIONS
SUCCEED PILOT PROJECTS
ARCHITECTURAL COMPETENCE
STANDARDS
CONSULTING
FUNDING INTRUMENTS
- SITRA
- PRIVATE
1 & 2
PROJECTS
KNOW-HOW
3. SERVICE BUILDINGS
- SMALL AND TERRACED HOUSES
- MULTI-STORY HOUSES
CHINA
AFRICA
MOTTO
WOODHAU
FINLAND
AGRESSIVE
FORWARD
LEAN


TEAM 5
2020
2025
2030
SECURE THE COMPETENSE BASE
DEVELOPMENT OF DTANDARDS AND REGULATIONS
REAL CO-OPERATE NETWORKS
-PLANNING
-DESIGN
-USERS/CULTURE
-INDUSTRY
-FUNDING
--ADMINISTRATION
LOT OF VALUE-ADDED MATERIAL TO ASIA
PROCUREMENT PROJECTS MUST BE TRANSFERRED TO INDUSTRIAL IMPLEMENTATION
UTILIZE THE COMPETENCE OF THE INTERNATIONAL STUDENTS
MOTTO
WE ALL PULL TOGETHER
1.ADDED VALUE MATERIALS
2.PROJECTS
AIM TO RAISE VALUE ADDED + SELLING THE KNOW-HOW AND EXPORT
1.MULTI-STORY BUILDINGS
2.SCHOOL, KINDERGARDENS ETC.
3.ENVIRONMENT BUIDINGS
TREND IN URBANIZATION
-MULTI-STORY BUILDINGS ARE MORE IMPORTANT THAN SCHOOLS ETC.
1. CHINA

Appendix G: Average exchange rates of Swedish crown

[1] 2017 – 9,4689

[2] 2016 – 9,4689

[3] 2015 – 9,3535

[4] 2014 – 9,0985