

Master's Thesis:
**BUILDING TOGETHER – FUTURE OF THE NORDIC WOODEN
MULTI-STOREY CONSTRUCTION BUSINESS**

University of Helsinki
Faculty of Agriculture and Forestry
Department of Forest Sciences

For the examination of
Master of Science in Forest Economics and Marketing

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Tiivistelmä – Abstrakt – Abstract Tämä laadullinen tutkimus keskittyy monikerroksisen puurakentamisen tulevaisuuteen ja lähestyy sitä hyödyntäen Delfoi metodia. Käyttäen dissensus lähestymistapaa ja koostuen kahdesta kierroksesta, tutkimus tarjoaa eksploraatiivisen katsannon aiheeseen. Tutkimuksen tavoitteena on löytää tekijöitä, joilla on erityistä painoarvoa monikerroksisen puurakentamisen tulevaisuuden arvoketjussa. Tulokset esittävät, että erityisen merkityksellisiä tekijöitä ovat teknologiset kehitysasteleet, tietoisuuden lisääntymisen monikerroksiseen puurakentamiseen liittyen, sekä yhteistyöhön perustuvan toiminnan yleistyminen. Tutkimuksessa havaittiin myös niin sanottuun kestävään kehitykseen liittyvien konseptien olevan alan asiantuntijoiden näkökulmasta erittäin houkuttelevia tekijöitä, mutta niiden yleistymistä ei pidetä erityisen todennäköisenä. Työ tarjoaa tuleville tutkimuksille uusia näkökulmia ja osoittaa että niin sanotun Service Dominant Logicin piiriin kuuluvien teemojen yhdistäminen tämän tutkimuksen tuloksiin saattaa tarjota kiinnostavia havaintoja liittyen metsäalan strategisen orientaation kehittämiseen	
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Foreword

The author would like to thank the Academy of Finland and their FORESCOF -research project for the funding that enabled this study (decision number 278363).

Abstract

This qualitative study focuses on the future of wooden multi-storey construction through the use of the Delphi Method. The study uses a dissensus approach, with two rounds, and gives explorative results of the subject. The aim of the study is to find crucial factors, which the industry experts see as shaping the value chain of WMC in the future. The study proposes, that the main factors that are crucial in the shaping of the future value chain of WMC are related to knowledge transfer, technological aspects and co-operative ways of creating value. The study also suggests that at least in the WMC part of the forest industries, there is a shift in strategic orientation taking place towards the so called Service Dominant Logic. The study also finds that though seen as desirable development for WMC, the growth of importance of sustainability is not seen as a likely future view. This study suggests that further research should be directed at uncovering ways in which potential benefits can be grasped as well as to finding new ways to facilitate co-operation in the value chain.

Keywords: *Delphi Method, forecasting, Wooden Multi-storey Construction, Sustainability, Service Dominant Logic*

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1. Introduction

This study focuses on the wooden multi-storey construction business, and its future. Starting from where previous literature has left off, the aim for the study is to find views regarding future of the business through a two round Delphi study. This qualitative study is an exploration into the topic, and uses expert insights as its main source of data. The study begins by presenting the context, that is broken down into modules that correspond to the simplified model of the wooden multi-storey construction's value chain, as presented in image 1.1. After the literature review the study continues by a look into the relevant background literature, from which the following chapter forms the research questions. Methods and data are presented before moving to the results of the Delphi study. The final parts of the study present the conclusions based on the results and discuss implications and future pathways for research.

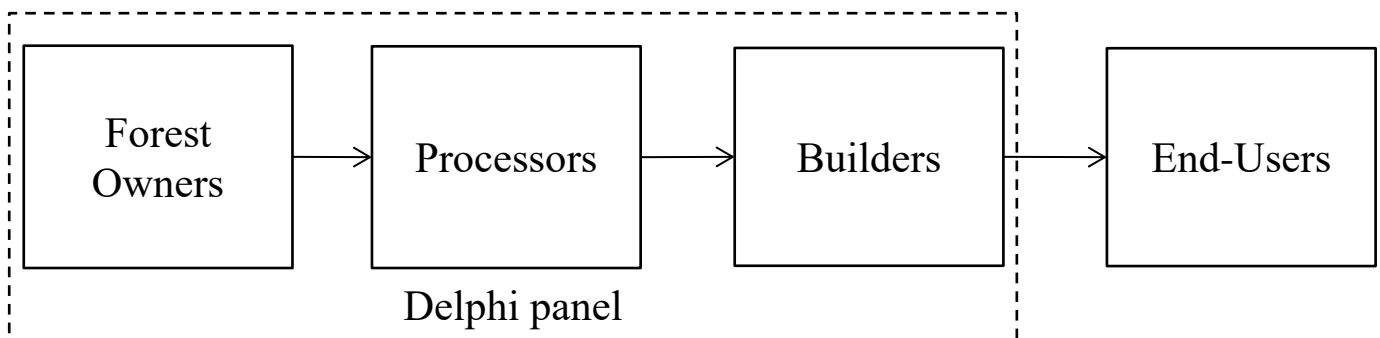


IMAGE 1.1. The simplified model of the WMC value chain used in this study.

2. Context

The following section of the study presents the context for the study. This part is broken down based on the simplified model of the WMC value chain, as presented in Image 1.1.

2.1. Current state of forest resources and private ownership

Almost all the boreal forests in the Scandinavian peninsula have been influenced by human societies. The forests are mainly owned by private entities and families, the challenges of the

future will be the lack of management. Private ownership of forests (private individuals, families) dominates in the Nordic countries. Two-thirds of forests in Finland are in private ownership, and one-third is owned by the State or municipalities (Metsämaan omistus, 2014). In Sweden, 50 % of the forests belong to private individuals and the other 50 % belongs to industrial and state-owned companies. In Norway, 80% of the forests are in individual private ownership. (Parviainen, 2015)

A study by Stupak et al. (2007) also compiles information on the current state of the forests and analyses the potential of forest fuels for energy purposes in Denmark, Finland, Norway, Sweden, Estonia and Latvia. In these countries the forest area is 61 mill. ha, corresponding to 52% of the land areas, which is high in a European perspective where 38% of the land area is forest (EU-27). Although some forest areas are protected, 75-92% of the area can still be used for wood production. A changing climate with larger standing volumes may affect the future growth positively and increase the potential harvest levels. Estimates from Finland, Sweden and Norway show an average growth increase of over 30 % by the end of the century and substantially higher for specific regions. Wood is extensively used for energy purposes and the forests hold a large potential for increasing the production of renewable energy. 57-67% of the total land area in SWE and FIN are productive forest area. 71% of productive land area of the Nordics and Baltics are in these two. 88% in FIN and SWE of growing stock is available, but in Sweden more of the increment is harvested, with fellings covering 77% of the increment whereas the same figure in Finland is 56%. (Rytter et al., 2015)

Previous studies have found many different types of typologies within private sector forest owners, with each having differing reasons and objectives for owning forest lands (Hujala, Kurttila, & Karppinen, 2013). Each typology has different needs in terms of forest services and education, which makes this part of the value chain fragmented. The trend in forest ownership is moving from the typical owner who lives close to the forest and is for example a farmer who farms nearby, to owners who do not live close to their forestlands and have little or no involvement in the

forest management on the lands (Follo et al., 2016). Thus, there have been concerns regarding the disconnection between the owners and their forest lands, as well as the owners' low interest in silvicultural decision making (Hänninen, Karppinen, & Leppänen, 2011). Recent studies have focused on ways to reach this type of owners, and to enhance interest for silvicultural aspects of forest ownership as well as other possible benefits (Hamunen et al., 2015). Other noteworthy changes in forest ownership is for example the rise of the so called 'new forest owners', who are more often than before women. Seminal studies in the subject have demonstrated that the new, often female owners differ from male owners in some aspects, for example Finnish female forest owners react more strongly to changes in stumpage prices (Follo et al., 2016).

2.2. Current state of wood processing

Second stage in the value chain presented by this study in image 1.1. is the processing of the wooden raw materials. The so called wood products industry operates at this stage. News from this part of business have been positive, in retrospect with the national economical situations at large. For example, the sawmill business has seen new investments as well as other business arrangements. In Finland, Keitele Group opened a new sawmill in Alajärvi during 2013 as well as began building another new mill in Kemijärvi during 2014. Major investments into the Vilppula sawmill undertaken by Metsä Group have heightened the efficiency of that plant, and in the beginning of 2014 the sawmills in Raunio and Pihlava formed the new Westas Group. Birch plywood production in the Vammala sawmill will continue under new management and the name Sastamalan Vaneri. (METLA, 2014) However, this does not eradicate the fact that the market prices for sawn wood have been in turmoil, with prices dipping from 2008 to 2009, as well as in 2011. The real prices for sawn wood have declined by close to 20% over the 10 year period between 2001 to 2011 (Hänninen and Sevola, 2011, according to (Sjølie et al., 2015).

Swedish sawmilling industry has been changing during the passed decades. Both production and exports have grown, as a result of specific strategic decisions made by the industry.

These include transforming market channels, changes in the value addition strategies and service value adding strategies. Sawmilling does face challenges at the moment, for example difficulties in technology and knowledge transfer, small scale of saw milling operations, and lack of product diversification on some mills. The industry is expected to grow in the future, but special emphasis needs to be put on the mentioned threats. (Tamrakar, 2014)

Sawnwood consumption per capita is tightly linked to the activities of the construction industry, as well as income and prices. Changes in any of these have direct effects on the amount of sawnwood consumed in Europe (Hurmekoski, Hetemäki, & Linden, 2015). Patterns of consumption have not been found to significantly converge between European regions, meaning that there are differences in the development of consumption of sawnwood between regions, something which is not observed in other forest products (Buongiorno, 2009). In Finland the consumption of sawnwood products doubled between 1995 and 2000. After the peak year of 2007, the markets plummeted and have since returned to similar levels as in 1995 (Hurmekoski et al., 2015). Similarly to the construction market, which is discussed below, sawnwood market is very path dependent and has not seen new consumption methods aspiring from outside the traditional building sector. (Mahapatra & Gustavsson, 2008)

2.3. Current state of wood construction

There are significant differences within Europe when it comes to the popularity of building from wood. As a whole, wood construction accounts for 8-10% of dwellings if defined as timber frame construction, however in the northern part of Europe this number is 45% of housing construction (Unece/Fao, 2013). This number includes all types of dwellings built. Single family houses built from wood are fairly common in countries like Finland and Sweden, however this study is mainly interested in modern ways of building from wood, and thus focuses on Wooden Multi-story Construction, or WMC. The popularity of WMC can be measured by its share of the total apartments completed. In Finland, WMC building has been growing in popularity. In 2010,

1% of the apartments completed could be described as WMC buildings, whereas in 2015 the number had grown to 10% (Tolppanen, 2015). In absolute terms, in 2014 there were 753 apartments and 39 buildings with a wooden frame in Finland, on top of which 700 apartments were built which corresponded to a 4% market share. For 2015, there were 1500 apartments in the pipeline, which was the equivalent of a 10% market share (Hurmekoski, Jonsson, & Nord, 2015). There are many reasons behind this increase, but in some studies this is mainly credited to a change in the Finnish building regulation in 2011, which allowed WMC of up to eight stories, where the previous number was limited to houses with just three (Hurmekoski, 2015a). This change in regulation is already seen as having an effect, with WMC concepts challenging more conventional ways of building in areas such as the Nordics, the Alpine region and throughout the British Isles (Hurmekoski, Jonsson, et al., 2015).

Even though the outlook for construction in general is not very positive in Finland, there are still possibilities for wooden construction to increase its share in construction. For example, even as completely new construction projects are not started as much as in the peak years, wooden solutions have good opportunities in renovational building. These opportunities are expected to balance most of the drop in demand for sawn goods caused by the slowing down of new construction projects especially in the single family house segment. Current growing interest for modern WMC solutions such as cross-laminated timber are expected to both grow the popularity of WMC in general as well as keep the demand for sawn wood relatively steady (METLA, 2014). Studies involving industry experts have also reported strong belief in the increased use of wood in the construction of high-rise building, and thus growing popularity for sawn wood goods in other parts of the Nordics, for example in Norway (Sjølie et al., 2015).

On a larger scale the current prospects for WMC lay in the concerns regarding environmental issues in construction. Though still relatively unknown in Europe, WMC seems to be a promising development as the need for improving productivity is growing in the construction

industry, and as the environmental and climate policies tighten (Hurmekoski et al., 2015). Improving material efficiency, which in WMC can be achieved through industrial prefabrication, is one of the key issues in construction that affect global warming through reduced greenhouse emissions (Ruuska & Häkkinen, 2014). Further, a plethora of research has already established that wood construction has a lowering effect on CO2 emissions as well as other toxicity measures of construction when compared to other popular alternatives such as steel and concrete (Herczeg et al., 2014; Petersen & Solberg, 2005; Sathre & O'Connor, 2010). The potential of more environmental ways of building are well addressed in the EU27 countries, of which 22 have set some sort of national actions plans to push green building (Herczeg et al., 2014). Though not explicitly included as the only choice of material in green building, wood based solutions have a special role in some of the countries as a way to reach more sustainable societies (Finnish Ministry for Employment and the Economy, 2010; Wang, Toppinen, & Juslin, 2014).

Despite the positive developments in regulation as well as the overall interest and positive aspects of WMC, industry experts do not seem to be overly positive about the future, especially in retrospect with the goals set for WMC. The Europe-wide goal for wood construction has been set at 30% market share by 2030. Hurmekoski (2015a) studied expert views about this vision. 74% of the respondents to this study saw the goals as unrealistic, with the most significant progress being limited to few niche sub-sectors and regions. The same study also notes that the main potential for wood construction comes from industrial prefabrication, often linked with large-scale building projects.

Construction sector - as well as the wood products industry in general - have been seen as examples of businesses where the physical product is not limited to meeting a basic level of customer needs, such as living in a house. Rather, these businesses have potential to offer larger service provisions for example to offer possibilities for self-expression. In other words, a house is more than a place to live, it can be an expression of the habitants' lifestyles. Grasping this potential

is up to many factors, one of them being the strategic orientation of the business model occupied by the companies (Mattila et al., 2016), however linkages between material choices and consumer's lifestyles are a complex mix of consumer background, values, and behaviours (Toppinen, Wan, & Lahinen, 2013).

Construction sector has seen a rise in such concepts as green building (Wang et al., 2014). Studying the UK building sector, Wang et al. (2014) found that the rise in green building has had an effect on the nature of wood building. The researchers note that wood construction in the UK has gone from low tech and low value wood products, to more value added and high tech solutions such as hybrid building solutions, which combine for example steel and wood structures, and to the use of composites that contain for example wood and plastic. This change has happened as green building has gained more ground in the construction sector.

In general, previous studies have found many positive aspects associated with using wood in construction. The environmental quality, which can be seen as consisting of both general impacts to the environment as well as direct effects on personal health impacts of the material (Toivonen, 2007), of the material and the end-solutions is seen positive by both the sellers of construction material as well as the consumers (Toivonen, 2011; 2012). Wood has also been found to be an attractive material in studies focused on the quality dimensions of the material (Toivonen & Hansen, 2003).

With all the positive aspects, both in environmental terms as well as economical ones, it is rational to ask what exactly is hindering the diffusion of WMC in the market. Like most societal issues, the answer to this question is complex and impossible to answer completely in brief outlook. However, some reasons will be discussed in the following chapter.

3. Background Literature

In this part of the study, the main background literature, which together with the context forms the setting for the research questions are presented. This part explores both strategic orientation in the overall forest industries, as well as the conceptual background formed from developments in the construction business. The research questions which are presented in the next section of the study are grounded in these two aspects, and aim to bring forward insights that have meaning in both.

3.1. Developments in the strategic orientation towards value networks

Forest industries have gone through numerous shifts in strategic orientation starting from the mid-1900's. This study presents the main shifts, mainly between forestry orientation, production orientation, market orientation and customer orientation. This chapter ends with an exploration of the service dominant – or S-D – logic, which is seen as an emerging form of strategic orientation within the industry (Mattila et al., 2016; Toppinen et al., 2013). These concepts present broad outlines of the strategic orientations that forest industries have gone through. It should also be noted that even though there have been changes in the orientations and the shifts are often presented chronologically, all of the presented concepts do still exist within the forest industries (Toppinen et al., 2013).

Until the late 1950's, forest industries were focused on raw material availability. The companies were able to sell most of the goods made, and the focus was on getting the most out of forests. Thus, the strategic orientation of the time has been dubbed forestry orientation, signalling the main focal point in the value chain being in managing and maximizing the available raw material. (Toppinen et al., 2013)

The next step from forestry orientation, after a sufficient level of available raw materials had been reached due to technical advancements, was the shift in focus to turning the raw

material into lumber, panels, pulp, paper, and other forest products (Cohen & Kozak, 2002). The magnitude of production was the focus of research and development, instead of the amount of raw material. Production orientation aims to achieve maximum product availability and secure low prices, whilst downplaying the needs of the customers to a secondary matter. Increasing production levels is the main goal for production orientation. This orientation when applied to the wood products companies lead to the production of largely standardized products, the pursuit for cost leadership, and price competition. (Toppinen et al., 2013). Hansen and Juslin (2011) see production orientation suitable for situations in which customers have simple demands, competition is limited and the customer demand is high. Tangible assets are the main source of competitive advantage for production oriented companies, with an emphasis on raw materials and physical processes, such as distribution (Korhonen & Niemelä, 2003).

Next development of strategic orientation in the forest industry stems from a higher focus on the marketing concept. Though decades old as a concept, forest products industry was relatively slow in the uptake of a philosophy based on marketing. This new market orientation was more suited in a situation, where the firm had to refocus from commoditized products in order to expand the business (Cohen & Kozak, 2002). In general market orientation has been seen as especially fitting for companies which aim to offer less commoditized products to the market (Narver & Slater, 1990), which was a situation in which the forest products industries were after the gains from production orientation had been covered as well as due to technological advances and changes in the markets (Cohen & Kozak, 2002). Since this orientation did not assume that all produced output can automatically be sold in the markets, market orientation is more focused on producing goods that can be sold on competitive markets, and thus tends to lead to production of less commoditized products than the previous orientations.

The internationalization of the competition as well as overall effect of globalization in the marketplace have changed the strategic orientation of many companies operating in the forest

industries into one that is more based on the internationalization of the business (Toppinen et al., 2013). Both technological advancements as well as changes in the global competition have changed the marketplace and pushed for more international operations (Macdonald, 1997). Since the 1990's the forest industries have become more internationalized, though the level of internationalization can be debated (Siitonen, 2003). The level of global operations, especially relocation of production overseas has been seen as rising within the forest products sector (Toppinen et al., 2012). Many opportunities for the forest industries have been seen to exist in the emerging markets (Ernst & Young, 2013), but the level of internationalization varies greatly between companies (Toppinen et al., 2013).

One final orientation to be brought forward is based on stakeholder involvement. Though market orientation does take into consideration some stakeholders, this orientation alone has not been seen as sufficient to cover all stakeholders involved in business, or has been seen as emphasising one stakeholder group over others. To tackle this issue, and to create a more situational view, the stakeholder orientation was presented (Ferrell et al, 2010). For example, matters related to sustainability have been growing within the forest industries (Li et al., 2011), which calls for more active involvement of the stakeholder into everyday business – something which demands a stakeholder rather than market orientation.

The future strategic orientation of the forest industries is, the so-called next step in strategic orientation is debatable. As the most relevant areas of development for the forest industries, a list of three factors has been presented: (1) adjustments strategies related to the changes in geographic focus of the industry demand and differences in the competitiveness of production and consumption between regions, (2) addressing the role occupied by forest industries in the greening economies as well as in sustainable development on a global scale, and (3) taking part in the growing service orientation in business-to-business markets (Toppinen et al., 2013). One possible and emerging concept to tackle the said points is the service-dominant logic – or S-D.

Toppinen et al. (2013) synthesize the work done by Vargo and Lusch (2004) and Grönroos (2008) by describing the definition of service within the S-D logic as “the application of competences for the benefit of customers; customers are operant resources, rather than operand resources, and they can contribute as value co-creators to the service process”.

Especially focused on discontinuous innovation that stems from changes in value creation, S-D logic highlights that value creation can change as organizations embed operant resources into objects, integrate resources, or reconfigure their value networks. Discontinuous innovation also tends to change the way a customer pays for, buys or uses the service. For the S-D logic to make its way into the forest industries would require the users and consumers to be more actively involved in the development process of the products or services (Toppinen et al., 2013). The lack of active customer participation as well as the lack of value network involvement, and the aim for incremental rather than radical improvements have been seen as reasons why sustainability related innovations in the built environment fail commercially (Sivunen, Pulkka, Heinonen, Kajander, & Junnila, 2013), thus it is easy to see that a logic like S-D offers interesting possibilities as a future strategic orientation for the forest industries, especially the parts of the industry involved in construction. The use of value networks has been considered as difficult within the forest industry and has not been commonplace as of yet. However, network-based business models have been brought up as a way to create competitive advantage. The lack of cooperative mind-set has even been seen as a hindrance to the renewal of the forestry sector in Finland. By increasing the level of networking, more successful and customer oriented business models can be gained (Mattila, 2015; Mattila et al., 2016), something which is integral in the S-D logic as well.

3.2. Conceptual background in the construction business

The construction industry can be characterized as very path dependent (Mahapatra & Gustavsson, 2008). In other words, the construction industry is very much bound to the established ways of working. Cultural issues have been seen as key reason for the slow uptake for new practices within the said industry. Also, from the developers' perspective the key decisive factors in the choice for construction methods are namely costs of construction and the related risk (Hurmekoski, 2015a), both of which are difficult to predict for novel solutions.

The issues for the slow uptake are not only caused by the construction industry, but by the wood construction industry itself also. WMC projects have not always been successful, for example the problems with some project in Finland during the 1990's have left negative associations regarding wooden buildings (Ilola, 2014 according to Hurmekoski, 2015). Especially in the Finnish WMC sector, the structure of the sector and its fragmentation is seen as a hindering factor. When the sector mainly consists of small and medium sized enterprises, further referred to as SME's, tripling the production capacity might be too big of a risk to take. From the perspective of large companies, the Nordic markets can be too small to attract investments into new WMC projects. The decision-making processes of these large organizations are also time consuming, with single pilot projects taking up to half a decade of assessment and preparation. (Hurmekoski, 2015a).

In order to grasp the potential of WMC, and wood construction in general, several measures have been discussed. Of these measures, one in particular is at the heart of this study. Numerous studies highlight the importance of co-operation in various forms such as alliances (Hurmekoski, Jonsson, et al., 2015), joint ventures (Parvinen et al., 2009) and forming new business networks between element suppliers and developers (Hurmekoski, 2015a). From tackling issues with low level of experience (Hurmekoski, 2015a), to lowering the involved risks (Hurmekoski, Jonsson, et al., 2015) and to creating competitive advantages (Toppinen, Lahntinen, Leskinen, & Osterman, 2011) co-operation within the WMC value chain or within the general wood

products industry has been seen as having several possible positive influences. Further studies into the construction industry in general have noted that new business models are necessary in the construction segments in which new technologies require strong push mechanisms (Brege, Stehn, & Nord, 2014). Good relationships in the construction value chain help facilitate knowledge flows (Blayse & Manley, 2004) and better relationships between organizations as well as individuals between organizations, rather than the typical short term interactions which prevail in the construction industry, are seen as supportive to innovation (Dubois & Gadde, 2001). Stronger inter-organizational co-operation has also been seen as a way to innovation in other studies as well, with a special emphasis on continuing co-operations, ie. in business relationships that span further than just one-off projects (Miozzo & Dewick, 2002). In fact, more value added products, which can be achieved through innovation when well exploited (Roper, Du, & Love, 2008), have been called for in the WMC sector, and new business models, which in turn change the roles of operators in the value chain (Hurmekoski, 2015a). The same study highlights alliance models as a way to reach more repetition and learning by doing within the WMC industry.

There is already a significant interest in co-operative efforts within the industry, as well as positive experiences. The alliances between large WMC companies and construction companies has already pushed the credibility of WMC, as well as improved cost competitiveness and provided technical advances in Europe (Hurmekoski et al., 2015). For example, in Växjö, Sweden, the wood construction industry, the public sector and the academia have actively worked together since the 1990's. This co-operation has managed to create new profitable building practices (Hurmekoski et al., 2015).

Construction industry's poor performance and issues with productivity, in comparison with other industries has been credited to the fragmented and adversarial nature of the sector itself, and there has been a call for new practices and tools that could be used to co-ordinate, integrate and

stimulate further co-operation in order to fix these issues (Li, et al., 2001; Ospina-Alvarado, Castro-Lacouture, & Roberts, 2016).

4. Research Questions

This study focuses on the future of the WMC value chain, especially towards the year 2030. Special emphasis is on topics, which have been identified as possible future challenges or opportunities, such as sustainability, raw materials, end-use markets and configuration of the value chain. Through the Delphi method, which in this case contained one interview round and one survey round, further discussed in the following chapter, the goal was to recognize key issues that have either positive or negative aspects, and that are seen as plausible by industry experts. The goal for this study is to obtain deeper insights into the future views that the industry experts have regarding the future of WMC.

The main research question is:

R1: Which factors are crucial in shaping the future of the Wooden Multi- Storey value chain?

In order to reach an answer for R1, two sub questions were formed:

R1.1: Which factors do industry experts within the WMC value chain see likely by 2030?

R1.2: Which factors do industry experts within the WMC value chain see desirable by 2030?

5. Methods and Data

To achieve the aims set for this study, the Delphi method was seen to be the most useable. This method is very popular in foresight studies (Toppinen et al., 2015), and can be described as a way to obtain future oriented expertise, as well as opinions and arguments of a focal

group (van de Linde & van der Duin, 2011). Several definitions of Delphi study exist, as well as multiple variations, however as a generalization Delphi could be described as a survey pointed at a group of experts that consists of two or more rounds as well as feedback in between the rounds (Yousuf, 2007). Some authors also recognize anonymity of the respondents as a characterising factor in a Delphi study, which allows argumentation beyond the roles of the members of the panel (Linstone & Turoff, 2002). Key benefits of Delphi are that it is both easy to use and practical (Hatcher & Colton, 2007).

There are several variations of the Delphi method. One category are the consensus-based approaches. Previous studies have found that forecasting approaches that highlight an iterative process with learning and that are geared towards finding a common ground help the process of decision making (Auvinen, Ruutu, Tuominen, Ahlqvist, & Oksanen, 2014). However, since this study is meant to map the possible avenues for the future of wood construction business, reaching a consensus was not seen as a suitable method. Rather, searching for differing views and visions regarding the future between the actors involved in the wood construction industry was crucial for this study, thus a non-consensus Delphi was chosen as a preferable method (Hurmekoski, Jonsson, et al., 2015). Much like in Toppinen et al. (2015), main aim for this study was to bring forward differences in respondents views regarding the future as well as find key reasons and issues behind these issues.

The panel members in this study were treated as anonymous, and they replied to two rounds first of which was a semi-structured interview followed by the second round, which was an online survey, and the panelists received feedback in between rounds. Similar to the method presented by Hurmekoski et al. (2016), the survey was iterated between the rounds in order to focus on the most relevant issues. In order to continue with the discussion of recent studies regarding the forest industries (e.g. Toppinen et al., 2015 and Hurmekoski, 2015) the time frame extended to 2030. Another reason for the somewhat long time perspective of the study is also the slow rate of

commercialization within the construction industry (Hurmekoski, et al., 2015). The first round interviews were structured around themes, with open ended questions aiding in the process. The online survey consisted of statements with accompanying scales through which the respondents were able to assess the likelihood and desirability of a presented scenario. The survey also included some Likert scale statements, as well as open ended questions. A further description of the process as well as a description of the outcomes of each step are presented below in image 5.1.

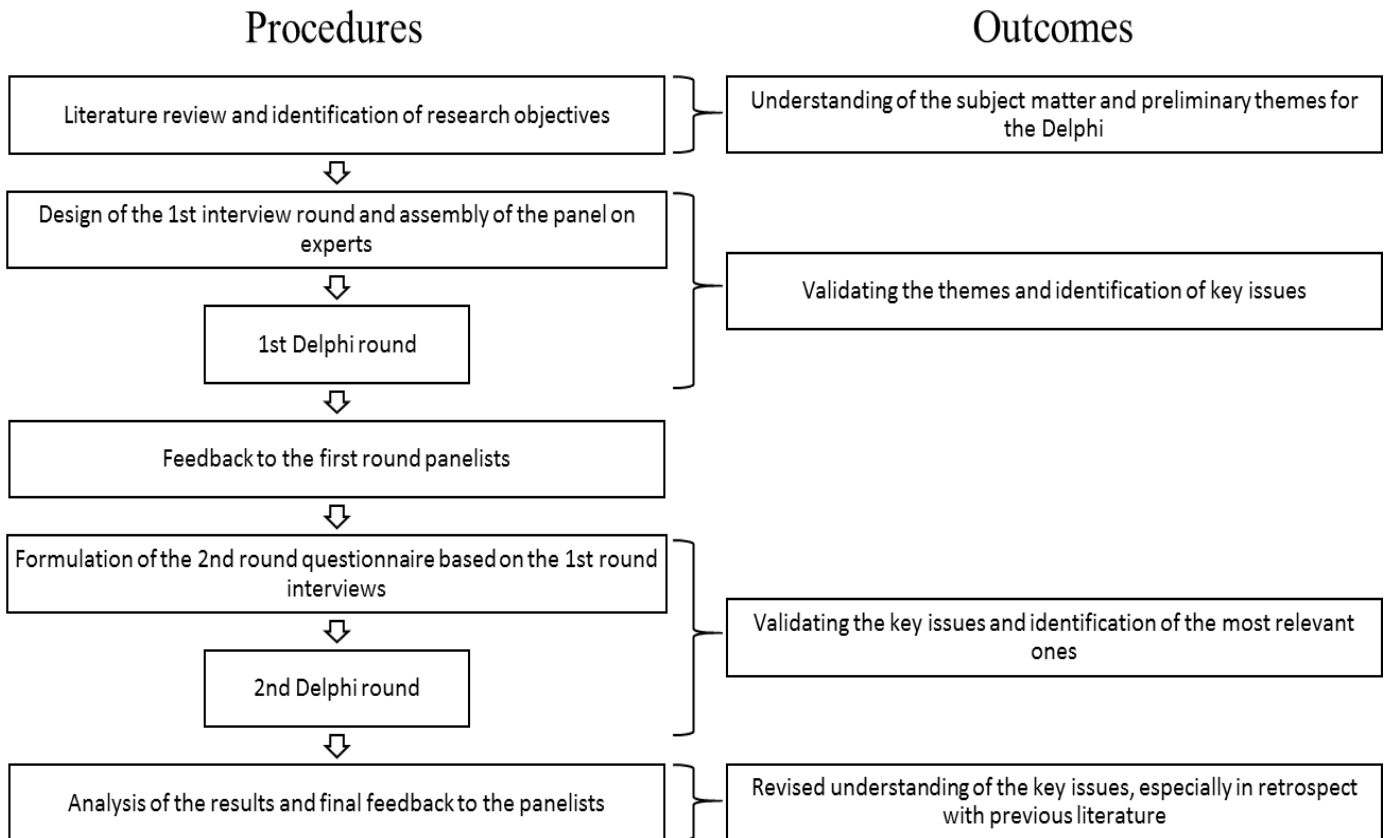


IMAGE 5.1. The structure of the study process and outcomes of each phase.

Overall, 18 respondents participated in the first round, and 17 to the second round. One respondent only replied to the second round. This study focuses on a simplified view of the value chain, with a focus on local characteristics. Mainly this means that the value chain is broken into the forestry, raw material buyers and processors, and finally builders. This study has excluded consultants such as architects. Though important in the process of building, previous studies have noted that in general the choice of material in the North European construction industry is up to the commissioners, developers, or main contractors rather than architects.(Roos, Woxblom, & McCluskey, 2010). If the study was conducted for example in the central parts of the Europe, including the before mentioned parties would have been a necessity. Another aspect of the sample that should be discussed is its emphasis on industry members. Though some experts and academics were included in the respondents, the main goal for the panel was to gain access to industry stakeholders. This is due to previous research, which highlights that the measures that experts

highlight as the most effective when it comes to the market position of wood tend to be seen as unattractive by the industry stakeholders (Hurmekoski, 2015a). As discussed earlier, co-operation is an important factor if wood construction is to reach the goals set for it, thus finding ways to build this in a manner that industry stakeholders see worthwhile was one of the key goals of this study. This line of reasoning lead to the current panel, with many professionals who are actively involved in the industry. Hurmekoski (2015a) also notes that scope of respondents in studies such as this needs to be focused on the distinct market regions, such as in this case the Nordic countries. This study focuses mainly on Finland and some added respondents from Sweden. A further description of the respondents is offered in table 5.1.

TABLE 5.1. Respondents of the study

Country	Gender	Years of Experience	Profession	Type of Organization	Participated in Rounds:
Finland	Male	14	Senior Vice President	Processor	1 and 2
Finland	Female	22	Director of CSR	Processor	1 and 2
Finland	Male	31	Managing Director	Forestry Expert	1 and 2
Finland	Female	1	Executive	Builder	1 and 2
Finland	Male	16	Owner	Forest Owner	1 and 2
Finland	Male	15	Research Manager	Forestry Expert	1 and 2
Finland	Male	3	Field manager	Forestry Expert	1 and 2
Finland	Male	26	Production Director	Builder	1 and 2
Finland	Male	5	Senior Vice President	Processor	1 and 2
Finland	Male	22	Sales Executive	Processor	1 and 2
Finland	Female	16	Planning Executive	Builder	1 and 2
Finland	Male	23	Managing Director	Wood Processor's Association	1
Sweden	Male	21	Senior Advisor	Forestry Expert	1 and 2
Sweden	Male	15	Managing Director	Processor	1 and 2

Sweden	Male	11	Managing Director	Processor	2
Sweden	Male	11	President	Processor	1
Sweden	Male	17	Vice President Market Development	Forestry	1 and 2
Sweden	Male	12	Academic Expert	Building Expert	1 and 2
Sweden	Male	8	Sales manager	Processor	1 and 2

Like most scientific methods, the Delphi method also has its limitations. One of them is the necessity for real commitment from the panel members to the lengthy process. Also, finding the right respondents with proper expertise of the subject matter for the panel can prove to be difficult, which was also an issue in this study. In the end, most of the respondents had over 10 years of experience from either the forest industries or the construction industry. There are no strict guidelines for the sample size of a Delphi Method based study, however in general panels should be representative in terms of locations and sexes. In this study the panel was leaning more towards Finland, with 12 respondents from Finland and 7 from Sweden. Similarly, the panel had an emphasis on males, with male to female ration being 16 to 3. The emphasis was on finding respondents with expertise rather than creating a balanced panel between regions or genders, which should lead to better effect on the validity and the reliability of the answers.

The Delphi Method has also been criticized for the inabilities of experts to review their viewpoint during the round, or because individuals choose to change their opinion only because the majority disagrees with them (Modrak & Bosun, 2014), however these critiques are pointed to the consensus-based approaches, which are not used in this study. Another point of critique is the tendency to run the Delphi method in a ‘quick and dirty’ manner, which leads to unreliable results, as well as the formulation of questionnaires that are not clear to the respondents (Modrak & Bosun, 2014). These risks were eliminated as far as possible by careful planning, and iterating the questionnaire based on feedback gathered from scholars with experience from using

the Delphi method in the past. This consulting process also helped to eliminate possible issues arising from the skills of the investigator, which can have a negative effect on the quality of the study (Keeney, Hasson, & McKenna, 2006).

6. Results

The results of the study are presented in this chapter. The results are presented for each round separately

6.1. Round 1

The first round of the Delphi study consisted of semi-structured interviews done either in person or over the phone. Main findings from these are presented in the following chapters.

6.1.1. Theme 1: Overall state of the Forest Industries

The respondents were asked to discuss the overall state of the forest industries in the beginning of the interviews. This section was guided by two questions, first of which was a question about the current state of the forest industries in their operating area and the second was about the main changes in the overall forest industries that the respondents are expecting to take place by 2030.

Almost all of the respondents saw the overall state of the forest industries as positive, or moderately positive. Some of the respondents responded by specifying that the current state in paper, graphic paper or newsprint is not positive, but saw the current state of other segments as positive or improving. Two respondents raised concerns about the profitability and state of sawmilling, but almost all of the respondents were positive about the state of WMC. Respondents also identified new opportunities arising from more advanced forest based products such as biochemical applications as well as pulp, and several respondents identified the current strengths to arise from the renewable raw material that is used in the forest industries as well as other

environmental aspects. One respondent described her feelings about the current state as well as the future as follows:

“I see that wood will have a renaissance in a larger scale, simply because a more environmental way of thinking will increase.” Sustainability executive at a processor, 22 years of experience, Finland

Similarly to the current state, also the visions regarding to the future were overall positive. The raw material was seen as a strategic asset, that has future potential in more advanced products that add more value. Recent investments were seen as a source for future demand for wood as a raw material, especially for pulp wood. Positive developments in the economy overall were expected to drive construction. However, some respondents identified needs to change the ways in which companies operate in order to grasp the potential. One responded mentioned a need for more co-ordination within the industry in the future to drive positive changes, and another respondent noted that especially sawmills need to move downwards in the value chain. Overall wood was seen as a strength as mentioned in the quote below:

“For a brief moment we were on top of the world with the electronics industry but now we’re back in wood, and somehow I believe that in it we are the world leaders – both in education and in terms of companies – and through it we can solve many problems”
Executive at a builder company, 26 years of experience, Finland

6.1.2. Theme 2: End-use markets

When asked about the end use markets, especially possibilities and threats related to them, the responses were much more varied than in terms of the overall forest industries. In general, the theme seemed harder to define to the respondents, with answers mainly circulating around technological and societal matters rather than the actual end users.

There were two themes that stood out. These two were the most common subjects that the respondents talked about when asked about market opportunities. First of them was the positive

ecological aspects of wood construction. Increasing environmental awareness was seen as a possibility for wood construction. For the most part it was seen as a opportunity that is still in its infancy, and was expected to grow in the future. One respondent noted that while important, environmental aspects are not as strong of a driver for housing decisions as the health benefits that living in a wooden building offer, and another respondent identified both of these as strengths.

Second important theme that six interviewees discussed was the need for further co-operation. Currently the industry was seen as too fragmented to serve the markets in a competitive way, or it was seen as consisting of too small players to grasp future opportunities. The need for co-operation was also seen as a necessity to challenge the concrete building industry, which is often seen as the archenemy of WMC. The quote below further illustrates this matter:

“...we need the be able to operate together, and not each player alone, because otherwise it [wood construction] will always stay small – it will never become something that truly challenges the concrete industry.” **Executive at a processor, 5 years of experience, Finland**

More advanced ways of working as well as modern products were seen as possibilities for WMC. Most notably, two respondents discussed the possibilities that technologies such as CLT offer as a way to expand the role of wood in building beyond the single family housing that it is most commonly associated in the Nordics. The possibilities of industrial prefabrication were also mentioned, offering time efficient ways to build as well as less waste. Some respondents also discussed the need to work together rather than against the more established large scale building materials such as steel or concrete. This was expressed by pointing that wood needs to be used where it is most competitive. One respondent called this phenomenon as hybrid building. There seemed to be clear distinction between those who saw wood as a substitute for concrete and those who would rather see it as a complementary material.

“I would like to see different types of hybrid solutions – much rather than either or choices between materials” **Executive at a processor, 14 years of experience, Finland**

“I do see that there can be optimal [hybrid] building solutions in some types of buildings – but these must be approached with an eye on the costs.” Executive at a processor, 5 years of experience, Finland

Most customer-oriented views were related to the positive aspects that people tend to have about living in a wooden building. One respondent pointed out that living in a wooden multi-story building is not such a far-fetched idea for the consumers, since many people have lived in wooden houses before. One respondent saw that the demand for urban wooden housing already exists in Sweden, but the amount of units is still too low. An issue linked to this that some respondents mentioned was the strict regulation that inhibits multi-storey building. However, as the regulation has been changed to facilitate WMC, and the respondents saw this as a future opportunity.

“Usually the customers knowledge [regarding large-scale wood construction] is quite low. It is the regulation – that pushes the demand” Executive at a processor, 11 years of experience, Sweden

6.1.3. Theme 3: Sustainable development

In the interviews, sustainability was discussed from a broad perspective, and for example defining the contents of the term were not discussed before hand. The goal was to not only find commonalities and differences regarding perspectives on sustainability, but also to shed light on which topics the interviewees discuss when generally asked about sustainability. For the most part, the discussion only regarded the environmental aspects of sustainability, even though one interviewee did discuss social aspects. However, this respondent talked about employee safety as a topic that used to have a lot of meaning in the wood using industry in general, but had since lost its importance.

“There are many different perspectives [within sustainability]. For example, ten years ago when customers were buying cardboard, they used to ask a lot about safety of the workers.”

Executive at a processor, 14 years of experience, Finland

Both WMC’s effect on biodiversity and WMC’s effect on climate change were discussed, but for the most part, the respondents saw potential in the aspects related to climate change and overall ‘greenness’ of WMC. One respondent stated that for those consumers who are most concerned about climate change, wood building in general is a positive matter, whereas those concerned about biodiversity might not view the industry positively. Overall, the climate change and related regulation and general interest were seen as drivers for the popularity of WMC.

“Global megatrends are favourable [for WMC]. That supports the industry.”

Executive at a processor, 5 years of experience, Finland

All respondents viewed sustainability as an area that was either already important, or at least growing in importance. Further elaborating on that importance was where many respondents had differing views. When asked about how the environmental consciousness of the consumers affect the industry, some saw it as having an effect, whereas others saw institutions such as governments and NGO’s as the drivers for the demand for more environmentally friendly products. One respondent saw that due to the nature of the construction industry overall, the end users and their views tend to have very little meaning in the process. However, several respondents did see consumer demand for green building as growing, and possibly having more importance in the future.

“It just may be that the demands of consumers – will direct our actions more in the future. – This is important to the younger people” Sustainability executive at a processor, 22 years of experience, Finland

Most sceptical about sustainability were the respondents that were identified as builders. One builder saw certificates related to whole buildings merely as a tool to “keep property

owners calm”, another one stated that they build green only because that is what they personally want to do, and the third one saw that environmental aspects are merely an undercurrent and that quality and aesthetics matter most. The decision regarding what type of projects are undertaken is dependent on the end user and their willingness to pay for certain aspects of a building, at least from the perspective of the builder.

“It starts from the consumer, what the consumer is willing to pay for is what we will do” Executive at a builder company, 26 years of experience, Finland

“ I wish to believe that consciousness is growing through positive things. – Being ecological in combination with comfort (of living) will create pleasure.” Executive at a builder focused on sustainable housing, 1 year of experience, Finland

The most potential in sustainability was seen as stemming from the ecological nature of the raw material. Very few respondents saw that this potential was already grasped, on the contrary some pointed explicitly that it is not used. For example, two respondents blamed the industry for not using certificates as a sales tool. One respondent saw that sustainability is a competitive advantage of WMC, which will be meaningful once the building solutions are as technically and in terms of the competitiveness at the same level as other possible materials.

“It (sustainability) is a thing that will get us passed (other materials) if we can get to the same level in competitiveness and technical knowhow.” Executive at a processor, 5 years of experience, Finland

Overall, sustainability and such concepts as green building are viewed as growing in importance in the future as well as offering potential for success for WMC. The main issues are with the commercialisation of sustainability, meaning that some respondents saw that the industry itself is not capable of building successful products that utilize the positive environmental aspects to their advantage. Some respondents saw that the positive affects that WMC has on the issues discussed under the sustainability umbrella are taken for granted within the industry itself. Others

saw that the end users do not understand sustainability or that is only a small part of the decisions that go into the process of choosing housing. One Swedish respondent saw that there are too few positive examples that could build consumer understanding. Finally, some respondents are sceptic whether or not consumers actually are willing to pay for sustainability. The quote below demonstrates the most sceptic of views:

“It (choice of material) is only a discussion about price” Sales manager for a processor, 9 years of experience, Sweden

In sum, it could be stated that the growing interest for sustainability was seen as a major opportunity for the wood industry. The main differences between respondents views was regarding where and through which actions this potential will turn from interest into profitable business. This clearly summarised by the following quote:

“There is a difference between interest and when it (the importance of sustainability) actual happens. - The direction is towards more green building, and it is the future.” Field manager at a forestry expert organization, 3 years of experience, Finland

6.1.4. Theme 4: Raw material markets

In order to find out more about the perceptions that the interviewees have regarding the current state as well as the future of the raw materials, the interviews focused on overall use of wood as well as a few issues identified from the previous literature. The respondents were asked about their views regarding the use of wood as a raw material now and in the future, as well as about the views on the prices, availability and the quality of the raw material.

The respondents were confident that the use of wood as a raw material for building would increase in the future. The popularity will be based on the existing products, such as single-family housing, which the respondents see as growing as the overall economic situation develops, but also on more modern solutions. Most commonly mentioned of these modern solutions were multi-story buildings, but some respondents also identified infrastructural building such as wooden

bridges to be a growing segment. Two respondents mentioned that solutions such as CLT will open new possibilities for wood, as load bearing structures, as elements or as a way to substitute concrete. Hybrid building was also mentioned in this discussion as a new opportunity for wood in construction.

When asked about the price development of the raw material, respondents did signal some concerns. Two respondents, both of whom actively work with forest owners, saw that the prices for forestry related tasks such as forest management will be growing, which will affect the price of wood. In fact, price related issues were the most commonly discussed discerning aspect of the raw material, with several respondents reporting this as an issue that will impact the industry more in the future. Predictability regarding the price development of wooden raw materials was also mentioned as an issue that practitioners face now and in the future. However, the interviewees were very familiar with this issue already from the past as the following quote illustrates:

“We will always be running after the price, there will never be a moment when this wouldn’t be the case.” Executive at a forest procurement R&D organization, 31 years of experience, Finland

In terms of availability of raw material, the interviewees were relatively uniform in their views. Most respondents saw no issues with availability in the future, even though some respondents were somewhat concerned with the recent large-scale investments in the Finnish markets into more advanced biomaterials and pulp factories. Swedish interviewees were more prone to mention the already high utilization rate of the raw material in Sweden, whereas Finnish respondents saw that there is for the most part still available resources for more demand.

“The availability of wood for large scale operations worries me as there are big pulp projects going on. I’m not sure if there will be enough wood or not.” Sustainability executive at a processor, 22 years of experience, Finland

The respondents were very uniform in terms of their perceptions regarding the future of the quality of the raw material used in the WMC sector. As previous studies (e.g. Hurmekoski, 2015a) have raised concerns regarding the effects of growing WMC industry to the quality of the wooden raw materials rather than its volume, the interviewees were specifically asked if they see future issues arising around the availability of sufficient quality raw materials. All but two interviewees saw that no such issues exist, mainly due to modern technologies such as CLT, which enable manufacturing of large-scale wooden elements from lesser quality material. One respondent noted that CLT also has limitations in terms of quality and that not everything goes for it. Another respondent noted that quality is a complex matter, and that in some segments of the wood construction industry it might be an issue but for the most part technology can be used to tackle the issue. One respondent identified the builders working with whole logs as maybe being affected by the changing quality, but she did not see this as an issue for her own building style which was more based on CLT. Finally, two respondents mentioned that the current way wood is sold is not focused on quality, but rather dimensions, and thus does not provide incentives to track the quality.

“The raw material can be primed during processing. Finger-joints, glulam, CLT, laminated veneer... These are all products that have been primed. For sure, it will be possible to make high value added products from lesser quality wood.” **Executive at a forest procurement R&D organization, 31 years of experience, Finland**

6.1.5. Theme 5: Structure and co-operation of the value chain

The perceptions regarding current co-operation schemes as well as the future direction of such schemes, was the topic that could be described as the most complex as well as the most difficult to answer. The initial structure of this topic was iterated during the first round, as the first version proved difficult to grasp to some interviewees

In general, the most experienced in co-operative efforts were the respondents who worked at larger companies. For example, the executive at the largest builder interviewed worked

together with a large forestry company on a recent project. Similarly, one respondent who worked at a large processor was familiar with working with builders, planners and architects. Respondents from smaller processors were also used to working with architects, but the further upstream the respondents were from the end users, the less they seemed to co-operate. Respondents that represented large firms saw that developing the WMC industry is a task for the big operators, as the quote below illustrates.

“If large industrial actors - such as [respondent’s employer] are not involved in creating these [construction] systems and taking these to the markets – then it is a question of who else would do it? I am afraid that the reply is no one really.” **Executive at a processor, 5 years of experience, Finland**

In general, the respondents did see co-operation as an important factor in the future, however their views differed largely on how and with whom it should be undertaken. Smaller, and more local operators were more prone to discuss networked models, in which they co-operate with other small operators. For the respondents that worked at larger organizations, the concept of hybrid-building solutions seemed interesting, as well for the respondents that represented smaller builders. However, the co-operation between the wood construction sector and for example concrete solution providers was also challenged by some respondents due to for example different optimum dimensions and because of the on-going ‘wood vs. concrete’ rhetoric. One respondent summarised the situation as follows.

“I don’t think the co-operation [with concrete] will happen – there is just too much competition” **Executive at a processor, 11 years of experience, Sweden**

“The way construction has been developed by concrete builders for the passed 50 years is not optimal for wood construction. We should get the optimal of our material out” **Executive at a processor, 5 years of experience, Finland**

When explicitly asked about the future co-operation in the value chain, the replies were again rather scattered. Networked structures, co-operation with competitors, the necessity of standards, issues with the complexity and time consuming nature of construction projects, large operators taking control of a bigger part of the value chain, hybrid building, online marketplaces, and even competing ecosystems within the WMC were all mentioned, with little commonalities between the respondents views. In general, respondents were quite opinionated about this issue.

“It could be [that in the future] we will see competitors as partners. One manufactures the walls and the other manufactures the flooring.” Executive at a processor, 22 years of experience, Finland

“Everyone needs to take care of their own competitiveness, if you start playing all fields it is very challenging. – I believe in a networked way of thinking in which different actors co-operate by leveraging their own strengths.” Executive at a processor, 14 years of experience, Finland

“There will be many types of [organization] concepts. I believe that we will have both big and small [companies in the future].” Research manager at a forestry expert organization, 15 years of experience, Finland

“It is more and more important to find strategic alliances” Executive at a processor, 11 years of experience, Sweden

Differing timespans on which operators in the value chain plan their actions as well as the resources that different organizations have to develop building solutions based on wood were cited as key issues in co-operation on several accounts. Some respondents were sceptical, even critical towards the capabilities and interests of sawmills to develop their products to better serve the WMC sector. This voice was raised both from upwards as well as downward from sawmills in the value chain. Sawmills were seen as either too small or too focused on current operations to be able to put efforts into development of modern building solutions. At the same time, respondents

saw that sawmills are missing opportunities offered by modern technologies.

“I see it is a waste of money and time that the sawmills just produce bulk to the construction companies. They should deliver ready-made, half-fabricated products. - The co-operation in my mind should be like that of the production companies, they just press a button and an order at the sawmill is made.” Academic Expert of wood industry related economics and business, 12 years of experience, Sweden

“It is quite hard to co-operate with the sawmills. They are quite stiff. – They need enough volume to be able to sell the by-products as well.” Sales executive at a processor, 22 years of experience, Finland

Respondents also identified an issue with the timespan being the length of a single project.

“[Building] processes can be very long, even unbearably so.” Research manager at a forestry expert organization, 15 years of experience, Finland

The development of more sophisticated building solutions was seen as a capital demanding process for which only a few of the biggest operators have the necessary resources. Builders, especially the ones that build with a range of different materials were not interested in developing the solutions, and would rather only be interested in bringing them to the markets. This is further illustrated by the quote below:

“We will not do this validation [of wood based building solutions], that needs to be undertaken by the wood industry itself.” Executive at a builder company, 26 years of experience, Finland

What should be noted is that the builders were interested in offering their expertise, and already did utilize it in co-operation with the solution providers when bringing the validated products into market. This can be seen as an example of one claim that came up in many interviews;

there is a lack of positive examples and experience from WMC for it to be a building technology that is considered as a credible alternative to the more established large scale building technologies.

“There are no major issues we could not tackle, we just happen to be at a very early stage.” *Executive at a processor, 5 years of experience, Finland*

6.2. Round 2

The first round of interviews was followed by a second part that was conducted to the panel as an online survey. The survey consisted of statements, as well as open questions. Most of the statements were assessed through two Likert scales, one regarding the likelihood of the statement holding true and the second regarding how desirable the view presented in the statement was to the respondents business. The survey was distributed to all first round interviewees as well as one extra member who was interested in participating in the study but replied after first round was already conducted and the survey generated.

Though similarities between the themes used in round 1 and 2 exist, the emphasis was given to the themes and topics that were seen as more thought provoking or controversial in the first phase. For example, where the first round focused more on the raw material market, the second round consisted more of statements regarding the raw material in general, as the first round showed that the respondents were more vocal and interested in the raw material itself rather than the markets for it. Similarly, the statements regarding the current state of the industry were kept to a minimum, as the key focus of the study is in the future of WMC rather than on its current state.

6.2.1. The future of the forest industries

The second round of the study had five statements related to the future of the general forest industries. The evaluations regarding these statements are presented in table 6.1.

TABLE 6.1. Evaluations of statements regarding the future of forest industries

Statement number	Statement		Likelihood (%)	Desirability (%)
1	<i>By 2030, the overall product offering of the wood product industries is significantly more diverse than today.</i>	Low	6	6
		Medium	12	6
		High	82	88
2	<i>By 2030, wood product industries will offer significantly more value added products than today</i>	Low	0	0
		Medium	29	12
		High	71	88
3	<i>Wood product industries are going through a paradigm shift, and will operate in a completely new way by 2030.</i>	Low	6	0
		Medium	35	24
		High	59	76
6	<i>In 2030, wood construction industry will still struggle with competitiveness and lack of value added products.</i>	Low	41	59
		Medium	24	29
		High	35	12
7	<i>By 2030, large-scale wooden construction, such as wooden multi-storey building projects, has become the most important segment within wood construction.</i>	Low	12	0
		Medium	29	29
		High	59	71

Based on the replies obtained through the online platform regarding the overall state of the forest industries, it is clear that the respondents saw both likely (82% respondents saw it as either likely or very likely) and desirable (88% saw it as desirable or very desirable) that the future product offering of the wood products industry is significantly more diverse than it is today. Similarly, the industry was seen as both likely (71% likely or very likely) to as well as desirable (88% as desirable or very desirable) to offer more value added products than today, though the opinions were more scattered in this than in the overall diversity of the offering. However, no respondent saw this as unlikely nor undesirable.

Two comments addressing the first question were submitted through the system. First one, sent by an executive at a Swedish forestry organization noted that there is a need to diversify the portfolio away from commodities, and into more value added products. Similarly, the second comment posted by a manager at a Finnish forestry organization noted that further processing will increase the value added, and that the portfolio of the industry will diversify in the future. Whether this diversification in the latter comment will be toward the more processed products remained somewhat vague in this comment.

In one interview the respondent explicitly stated that he sees the industry as going through a paradigm shift, and similarly other experts talked about an on-going change that they saw taking place in their business environment. In comparison with the first two statements, this statement was less agreed upon, with less than 60% seeing it as being likely or very likely, and 76% seeing it as desirable or very desirable. It seems this issue, was difficult to grasp as relatively high percentage of respondents opted for the middle ground choice with 35% placing at the middle of the likeliness scale and 24% placing it in the similar spot on the desirability scale.

Competitiveness of the wood construction industry is an issue that has been discussed very much within the industry, which also became evident in the first round of interviews. To reveal the views regarding this matter, statement 6 of round 2 directly addressed this issue. Like could be

expected, this statement was seen as undesirable by more than half of the respondents (59%), which was the highest percentage reached by any statement. One respondent who had graded the desirability as high, wrote a comment suggesting that his option might have been an accident or a misunderstanding as the respondent wrote that “*this change has been hoped for the past 100 years*”. The more interesting result is that the likeliness given to this statement holding true is very scattered. There are respondents who see it likely that there are still issues with competitiveness and a lack of value added product still in 2030 (35%), those who were neutral in their view (24%) and those who did not see it likely (41%). In comparison with some other statements, there seems to be a lot of uncertainty around this issue, which is further illustrated in image 6.1.

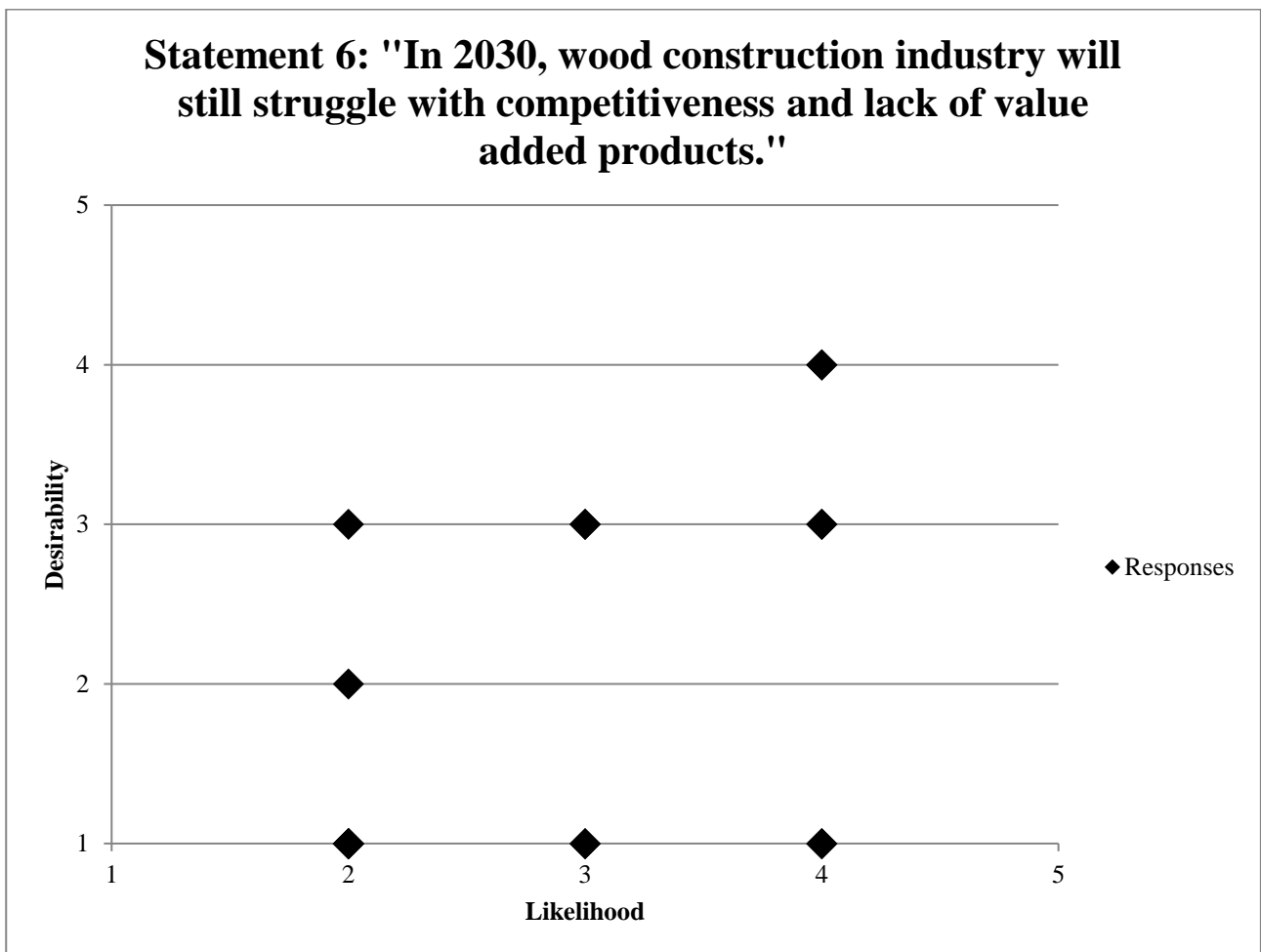


IMAGE 6.1. Desirability and likelihood evaluations of statement 6. Due to overlapping responses, there are less value points on the scatter plot than actual responses (n=17).

A topic that was only modestly covered in the first round was the role of large scale building in the wood construction sector in the future. In some interviews the large amounts and big market shares of wooden buildings in single-family housing was discussed, but there was no cohesion regarding the role of multi-storey building in retrospect with all of wood construction for example. Statement 7 was generated to discuss this topic. The respondents of this study saw it likely (59% responding the likeliness being high or very high) that large scale construction will be the most important part of wood construction by 2030 and an even larger portion of the respondents (71%) saw this as desirable, with no respondent seeing it as undesirable.

The first round of interviews raised an interesting point regarding the preferential treatment of wood in construction which is being pursued in some cases, especially in the public sector. As many respondents saw possibilities in hybrid building rather than building solely out of wood, the preferential treatment of wooden buildings could become problematic or hinder the co-operation between different actors. Thus, an open-ended question that asked the respondents “*should wood material be given preferential treatment in public construction in your country?*” was added to the end of the questionnaire. 12 respondents replied to the question, out of which 10 saw that preferential treatment should be in place, whereas 2 responded that there needs to be equal opportunities or that wood does not need subsidies. The reasons why wood should be given preferential treatment circled around environmental aspects, the importance of using domestic raw materials, economic development and the need to gain more experience from building with wood.

“Yes. We have excellent raw material and it should be used more. We also need more experience of wood in public construction. Environmental issues is one reason to support wood in public construction.” Executive at a builder focused on sustainable housing, 1 year of experience, Finland

6.2.2. End use markets

One of the main points of interest in round 2 of the study was the views of the respondents regarding the future of the end use markets. Based on the interviews 11 statements were generated to be evaluated based on their likeliness and desirability were generated, and an additional two end use market related statements that were assessed in a different manner were generated. The results are presented in table 6.2.

TABLE 6.2. Evaluations of statements related to end use markets

Statement number	Statement		Likelihood (%)	Desirability (%)
4	<i>Future opportunities for wood construction mainly exist outside of Western Europe</i>	Low	47	41
		Medium	35	41
		High	18	18
5	<i>By 2030, we will sell and buy more wood construction products & services through open online platforms, such as web shops or professional digital networks.</i>	Low	0	0
		Medium	12	29
		High	88	71
8	<i>By 2030, there will be many experienced professionals both buying wooden building solutions as well as selling them.</i>	Low	12	6
		Medium	6	18
		High	82	76
9	<i>By 2030, strong business networks within the industry will help us build competitive products more effectively and faster.</i>	Low	6	0
		Medium	18	18
		High	76	82
10	<i>By 2030, prefabrication will be the main operating logic, with less on site building.</i>	Low	0	6
		Medium	0	6
		High	100	88
11	<i>By 2030, the housing regulation has</i>	Low	6	6

	<i>become more suited for large-scale wooden buildings.</i>	Medium	35	0
		High	59	94
12	<i>By 2030, wooden interiors have become a trend preferred by consumers.</i>	Low	0	0
		Medium	59	18
		High	41	82
14	<i>By 2030, most building renovation in the urban space will involve wooden building solutions.</i>	Low	0	0
		Medium	29	18
		High	71	82
18	<i>The future of wood building is in hybrid buildings, using jointly other materials such as concrete and steel where it brings the most benefits.</i>	Low	0	0
		Medium	12	24
		High	88	76
17	<i>By 2030, wood has become a competitive material for building on its own right.</i>	Low	0	0
		Medium	35	18
		High	65	82
42	<i>By 2030, consumers will see wood construction as a modern way of building.</i>	Low	0	0
		Medium	12	6
		High	88	94

One topic discussed in the first round was the location of the future markets for wood construction. This was addressed in statement 11. The notions were scattered, but the biggest group (47%) of the respondents did not see that the future opportunities to mainly occur outside of Western Europe. 47% of the respondents saw this possibility to be low in desirability, which could be explained by the fact that most of the respondents operate in this area. One respondent from Finland who gave this statement a 2 (low) in likeliness and a 1 (very low) in desirability commented that he is “hoping that even as the population growth will mainly happen outside of Europe, the

opportunities will not move from the area completely” and that *“renovational building with wood is – profitable even here”*.

Online platforms were discussed in the first round in multiple ways. From information flows to trading, this topic remained vague in the first round. Thus, in the second round it is presented as a way to reach customers as well as in the form of information flows, latter of the two aspects will be discussed in the chapter 6.2.5. *Configuration of the Value Chain*. When faced with a statement regarding open online platforms such as web-shops as a future means of selling products and services in statement number 5, the respondents saw this claim as very likely (88% of respondents replied with high or very high likeliness) and desirable (71% of respondents saw this claim as high or very high in terms of desirability). No respondent gave this claim any of the grades in either of the two categories that would respond to low values. A Finnish respondent commented that this is the general direction in all sales.

To discuss the effect of regulation on the future of wood construction, a statement *the future of wood construction is dependent on the changing regulation* was presented in the survey. 76% of the respondents saw that the future of wood construction is dependent on the changing regulation.

One of the statements in this part of the survey scored some of the highest grades for both desirability and likelihood. Statement 10, *“by 2030, prefabrication will be the main operating logic, with less on site building”*, was considered to be likely or very likely by all of the respondents and 88% of the responses evaluated the statement to be either desirable or very desirable. The results are presented below in image 6.2.. Due to the scale used, and the sample size, many responses are over lapping and thus not all 17 responses are visible individually.

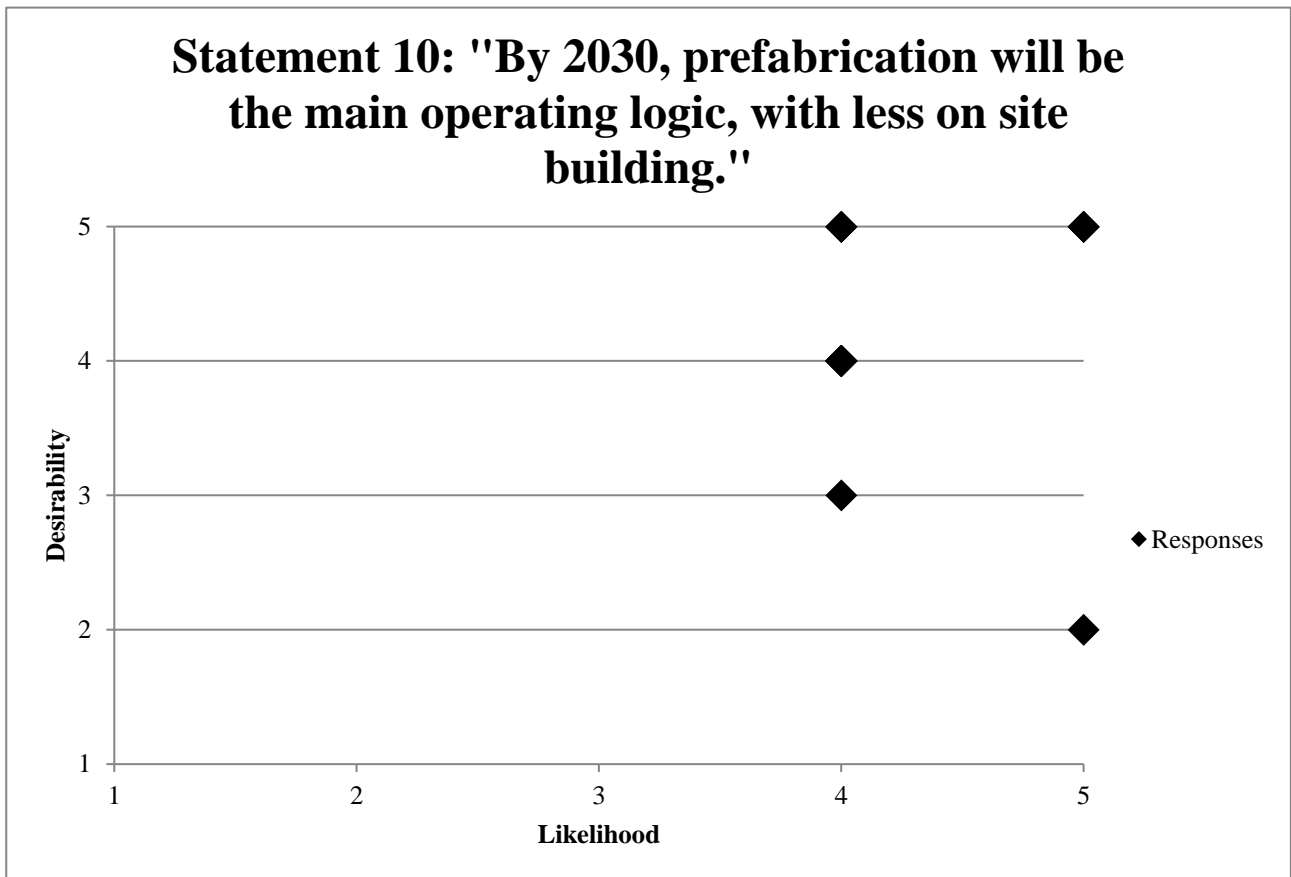


IMAGE 6.2. Desirability and likelihood evaluations of statement 10. Due to overlapping responses, there are less value points on the scatter plot than actual responses (n=17).

Similarly to statement 10, also statement 42 was among the statements that were considered to be both likely and desirable by industry experts. When evaluating the statement “*by 2030, consumers will see wood construction as a modern way of building*” was seen as desirable or very desirable by 94% of respondents, whilst 88% saw it as likely or very likely. The findings are presented below in image 6.3.

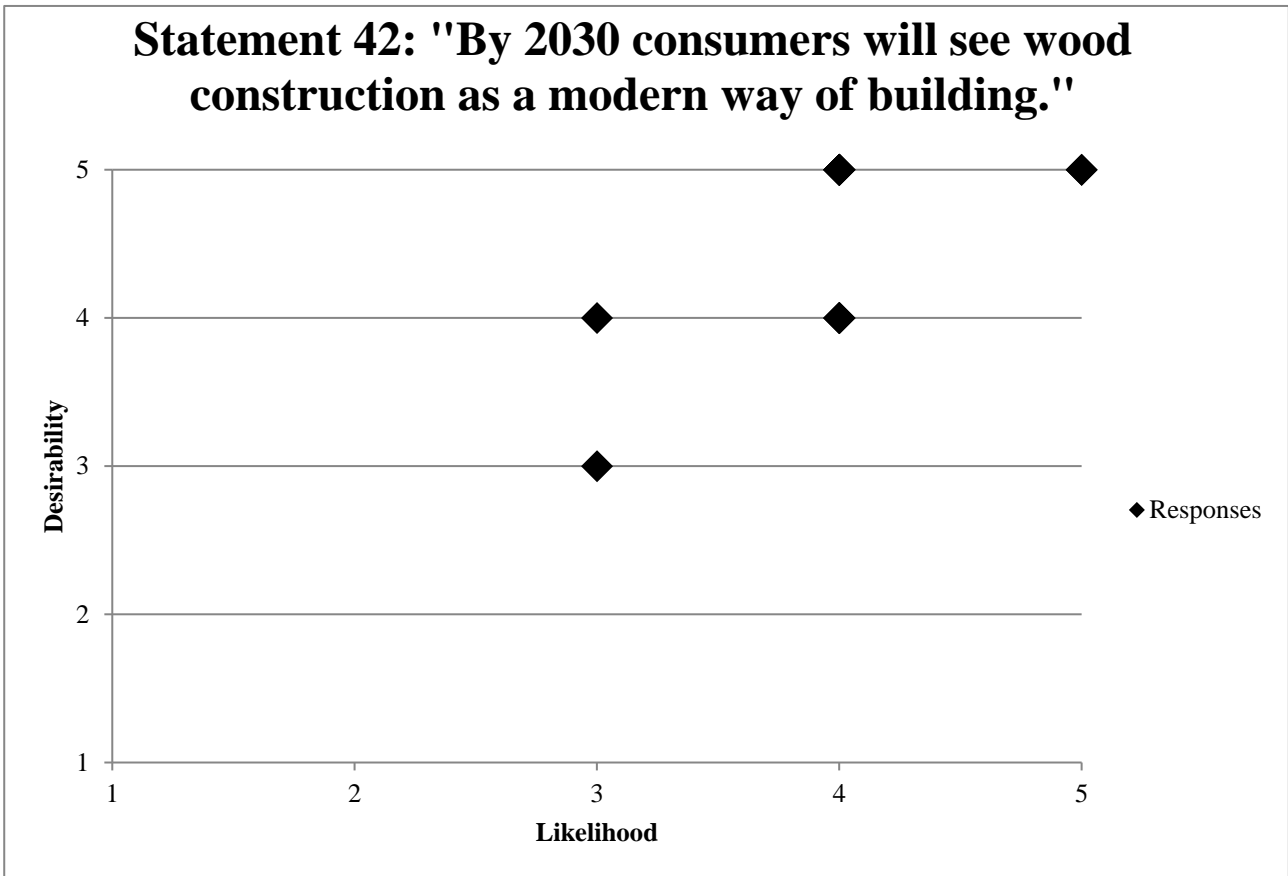


IMAGE 6.3. Desirability and likelihood evaluations of statement 42. Due to overlapping responses, there are less value points on the scatter plot than actual responses (n=17).

The discussion about the main reasons why an end-user would prefer to live in a wooden building was something that came up in the first round of the study. To further highlight this topic, the second round included one specific question that was aimed at understanding more about the two selling points, which came up during the first round. The respondents were asked to reply to the question *Which of the following do you see as the main rationale for living in a wooden building for consumers?* by choosing either *The building is environmentally friendly* or *The building has significant health benefits in comparison with other alternatives*. Based on the round 2 replies, personal health benefits were seen as the main rationale for choosing wood over another possible material in housing. Over half of all the respondents saw this as the stronger argument of the two. The responses were also analysed based on the respondent type. Environmental aspects seemed to be a popular opinion regarding the consumer’s rationale to live in a wooden building amongst the professionals identified as processors, with four out of six respondents identifying it at the main

rationale. Amongst the forestry professionals, and builders the majority vote went for the health benefits argument. As the sample size of this study is typical for a qualitative study, these results can only be described as illustrative and not concluding.

The respondents were also asked to comment on their choice. Amongst those who saw environmental aspects as the main rationale, the respondents made remarks about the rising awareness for sustainability as a reason behind their choice. One respondent also commented that “good interior environments can also be achieved with competing materials” but that similar environmental performance, which the respondent linked to such methods as life-cycle assessments, cannot be reached by competing materials. A comparison of the findings is presented in image 6.4.

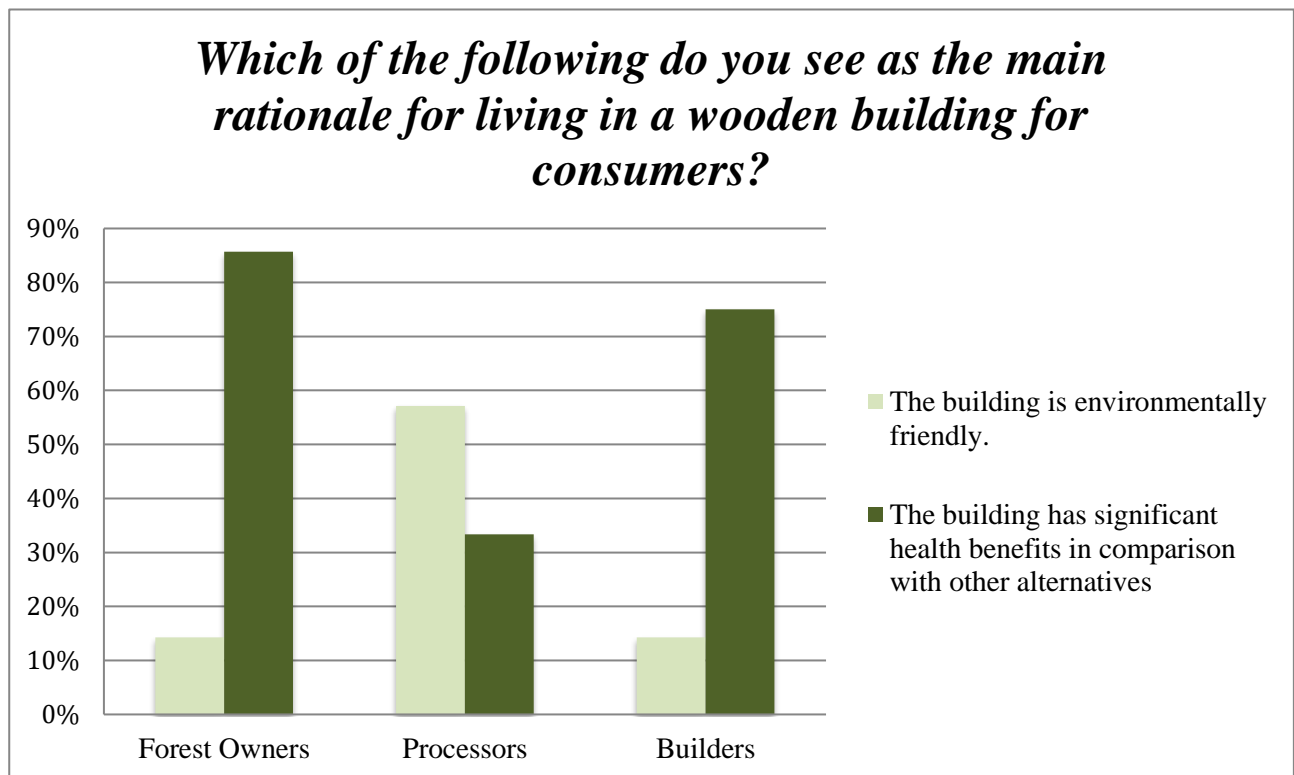


IMAGE 6.4. Comparison of answers between respondent types.

On the comments received for personal health arguments an emphasis was on such wordings as “*in the end, personal benefits matter the most*”, and the direct benefits that wooden buildings offer to the consumers and their families are more important. In general it could be said

that both in the first round as well as the second, it was clear that whilst being an important factor, environmental aspects regarding the material from which housing is built is a minute factor when making such an important personal decision. Personal benefits such as better health, and positive health aspects that also others living in the housing such as family members gain from living in a wooden home are seen as stronger sales arguments. This is not to say that environmental aspects could not also drive the decision towards living in wooden housing, but when industry experts have to choose one over the other, personal health benefits are seen as the stronger choice. One respondent summarized her response as cited below.

“Based on our experience public opinion is environmentally friendly but when customer is deciding his/her own house the prize and healthy living are considered primary causes.” Executive at a builder focused on sustainable housing, 1 year of experience, Finland

6.2.3. Sustainable Development

Sustainable development is a key topic in the wooden construction sector and in the society in general. Thus, special focus was given to this topic also in the second round of the study. Most of the statements used were based on issues raised in the first round, some that were common, but also some that were raised by only a few respondents but opened up possibilities for discussion such as the statement number 22. The evaluations of sustainability related statements are presented below in table 6.3.

TABLE 6.3. Evaluations of sustainability statements

Statement number	Statement		Likelihood (%)	Desirability (%)
19	<i>By 2030, the consumer demand for sustainable living is a significantly stronger driver for wood construction.</i>	Low	0	0
		Medium	24	12
		High	76	88
20	<i>By 2030, counting for life cycle costs of buildings and not just purchase prices will have significantly more effect on the decision making in large-scale building projects.</i>	Low	0	0
		Medium	24	0
		High	76	100
21	<i>By 2030, sustainability has become a megatrend in the housing market.</i>	Low	0	0
		Medium	29	6
		High	71	94
22	<i>Future certification schemes will be difficult to manage for smaller businesses, due to the bureaucracy involved</i>	Low	0	65
		Medium	24	18
		High	76	18
23	<i>The importance of wood as a construction material will be mainly based on its environmental impact.</i>	Low	24	41
		Medium	35	24
		High	41	35

The respondents saw it both likely (with 76% seeing this as either likely or very likely) and desirable (88% desirable or very desirable) that consumers of the future will be more driven by the aim to find sustainable housing by 2030. Paired with the results for statement 21 in which the respondents commented on the statement *By 2030, sustainability has become a megatrend in the housing market*, the outcome of statement 19 seems to point that there is still room

for sustainability to grow as a driver for purchase decisions regarding housing and that this future view is seen as a very desirable by industry professionals.

The respondents were also asked to assess how likely and desirable it would be that by 2030 *counting for life cycle costs of buildings and not just purchase prices will have significantly more effect on the decision making in large-scale building projects*. This topic was discussed in round 1 and seemed to cause distress to some respondents, as they saw that currently it is difficult for wood to compete on purchase price only. The extent of the issue is highlighted by the results reached in round 2; statement 20 reached highest desirability of all statement, with 11 out of the 17 respondents giving it the highest possible grade in desirability. However, in likelihood this statement reached a relatively a low amount of high grades, with 76% choosing grades corresponding to likely or very likely. Though a high percentage, when reviewing it side by side with the likelihood grades reached by other statements, it is on the lower end of the spectrum. Many respondents chose to give this statement the neutral grade. A further illustration of the responses is presented below in image 6.5.

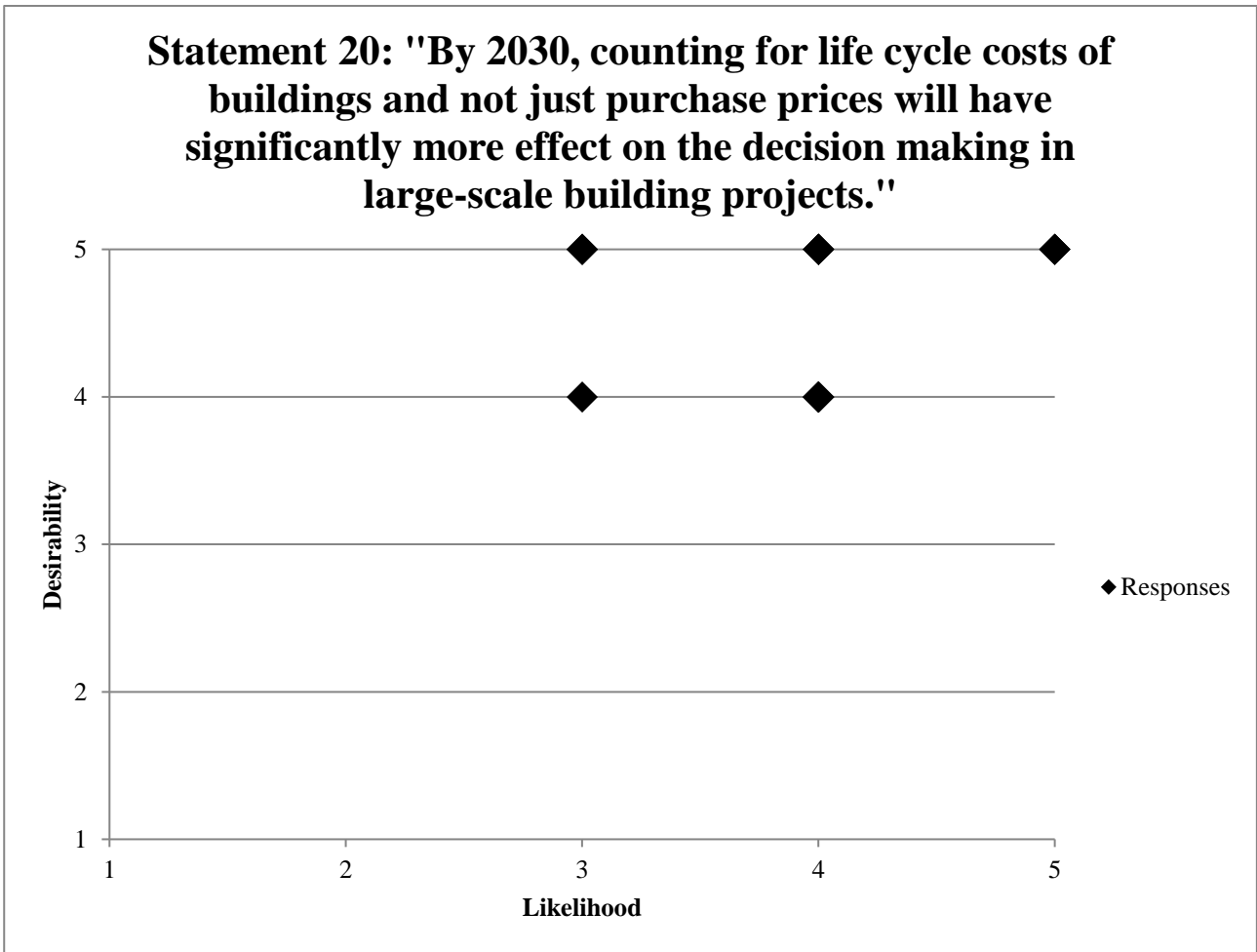


IMAGE 6.5. Desirability and likelihood evaluations of statement 20. Though the responses are still bundling to the top right corner of the graph, the amount of grades of 3 in likelihood was higher than in many other statements. Due to overlapping responses, there are less value points on the scatter plot than actual responses (n=17).

Statement 22 was based on certification, especially on the complexity of future schemes that was raised by a couple of the respondents in round 1. A clear majority (76%) of respondents saw that the bureaucracy involved in certification schemes will be difficult to manage for smaller businesses in the future. In fact, no respondent saw this as an unlikely future. Simultaneously, 65% of the respondents saw this future as either undesirable or very undesirable. Two respondents did see this as a very desirable future, both representing builders in this study.

Statement 23 that asked the respondents to assess the claim that *The importance of wood as a construction material will be mainly based on its environmental impact* reached very scattered responses. As the previously presented question regarding environmentalism vs. personal health suggested, personal health was seen as a stronger driver when these two choices were presented. Thus, it was not surprising to see the responses to statement 23 being so scattered.

6.2.4. Raw Materials

Four statements in round 2 were made regarding the future of the raw material markets. Three of the claims (24,25 and 26) reached quite varied responses, whereas statement 27 was fairly uniform as was expected based on round 1. Results for this raw material section of round 2 are presented in table 6.4.

TABLE 6.4. Evaluations of raw material related statements

Statement number	Statement		Likelihood(%)	Desirability (%)
24	<i>The difference between the relatively steady stumpage prices the high volatility of the markets for sawn wood will be a major challenge by 2030.</i>	Low	18	29
		Medium	41	53
		High	35	12
25	<i>By 2030, new wood based products (for example advanced biomaterials from wood) will create significantly more competition over the raw materials that the wood products industry is dependent on.</i>	Low	12	24
		Medium	47	47
		High	41	29
26	<i>By 2030, the cost of raw materials will be a significantly bigger proportion of overall costs of wood construction.</i>	Low	12	18
		Medium	71	71
		High	18	12

27	<i>By 2030, it will be possible to make more value added products from lower quality raw materials due to technology development.</i>	Low	0	0
		Medium	12	18
		High	88	82

Statement 24 focused on the difference between relatively stable stumpage prices and more volatile markets for sawn wood goods, which was discussed in round 1 especially by respondents that represented processors. The replies were scattered with 41% of the respondents giving it a 3 in likeliness, meaning somewhere between likely and unlikely, and 53% giving the statement a 3 in desirability. The respondents were slightly leaning towards this statement being likely but undesirable, but less so than in some other cases.

Similar to statement 24, statement 25 did not reach clear opinions when reviewing all the respondents together. 47% of respondents gave the statement *By 2030, new wood based products (for example advanced biomaterials from wood) will create significantly more competition over the raw materials that the wood products industry is dependent on* a 3 in both likelihood and desirability. There was a slight tilt towards this statement being likely (41% seeing it as likely) but in terms of desirability the respondents were very scattered, with 24% seeing it as undesirable and 29% seeing it as desirable.

Of the all the statements, number 26 was the one with the least clear opinions. In fact, 71% of the respondents could not grade the statement *“by 2030, the cost of raw materials will be a significantly bigger proportion of overall costs of wood construction”* clearly in terms of desirability of likelihood on the given grading system, but rather opted for giving it the grade neutral grade.

Statement 27 continued on from a perspective raised by previous literature, but to which the respondents had a differing opinion in the interviews. The concern that previous literature, such as Hurmekoski (2015) has raised was that there might be quality, rather than

quantity issues regarding the raw material in wood construction in the future if it becomes significantly more popular. This claim was challenged in the first round of interviews by many respondents claiming that technological developments in the future will enable the actors in the wood construction business to manufacture value added products from lesser quality raw materials. To reveal how common this view is, and how desirable it is, statement 27 was formed as follows: *By 2030, it will be possible to make more value added products from lower quality raw materials due to technology development.* 88% of the respondents saw this as a likely scenario, with 0% of respondents seeing it as unlikely, and 82% of respondents saw it as a desirable scenario, with no respondent seeing it as undesirable.

6.2.5. Configuration of the Value Chain

As the future of the value chain, especially how the actors view the operating logic of it is the key point of interest in this study, many of the statements the respondents were faced with in the second phase of the Delphi process had to do with these aspects. A total of 10 statements, one multiple-choice question and one open ended question was directed to unfold the views of industry experts regarding the future configuration of the value chain. The statements are presented below in table 6.5.

TABLE 6.5. Evaluations of statements related to the configuration of the value chain

Statement number	Statement		Likelihood (%)	Desirability (%)
28	<i>By 2030, concrete builders will be significantly more interested in the opportunities offered by wooden building solutions than today.</i>	Low	12	0
		Medium	35	24
		High	53	76
29	<i>In 2030, the wood construction industry could be described as a network of</i>	Low	0	0
		Medium	65	41

	<i>specialized organizations of different sizes rather than a value chain consisting of only a few large companies.</i>	High	35	59
30	<i>By 2030, builders will be significantly more educated about all available materials and hybrid solutions.</i>	Low	0	0
		Medium	12	6
		High	88	94
31	<i>Small companies will lack the money and knowhow to develop more competitive and advanced wooden building solutions.</i>	Low	18	53
		Medium	59	41
		High	24	6
33	<i>By 2030, organizational cultures will be more prone to co-operation and strategic alliances between different organizations.</i>	Low	0	0
		Medium	29	24
		High	71	76
34	<i>By 2030, a building process from start to finish will be significantly shorter than today.</i>	Low	0	0
		Medium	6	18
		High	94	82
35	<i>By 2030, the flow of information from the construction site to the forests will be significantly faster.</i>	Low	0	0
		Medium	18	18
		High	82	82
38	<i>In the future, my organization will co-create value with different types of players, including customers and suppliers</i>	Low	0	0
		Medium	6	6
		High	94	94
39	<i>By 2030, we will have more standards, open access platforms and public data banks for the wood construction businesses to use.</i>	Low	0	0
		Medium	24	18
		High	76	82
40	<i>In 2030, the best business model is to control a bigger part of value chain than</i>	Low	6	12
		Medium	59	53

	<i>today.</i>	High	35	35
41	<i>By 2030, the amount of companies involved in the wood construction value chain will be much higher than today.</i>	Low	12	6
		Medium	41	35
		High	47	59

The difficult situation between concrete processors and builders versus the aims of those specialized in wood, and the developers of wooden building solutions was eminent in the first round interviews. Thus, statements 28 and 30 dealt directly with this topic. The respondents saw the future in which concrete builders would be more interested in the possibilities that wood offers as a desirable one, but in terms of views regarding the likelihood of this scenario becoming true, the respondents were not as positive. Where 76% of the respondents identified the view to be desirable or very desirable, only 53% saw it as likely or very likely, and 12% saw it as unlikely or very unlikely. Statement 30 had to do with the level of knowledge regarding all available materials that a builder has at their disposal, and read “*by 2030, builders will be significantly more educated about all available materials and hybrid solutions*”. Based on the results, it was clear that the respondents saw it as a likely future with 88% responding either likely or very likely, and 94% identifying it as a desirable or a very desirable future view. Statement 30 was amongst the highest ranking statements in both factors. The responses are illustrated in image 6.6. Neither one of the statements received further comments from the industry experts.

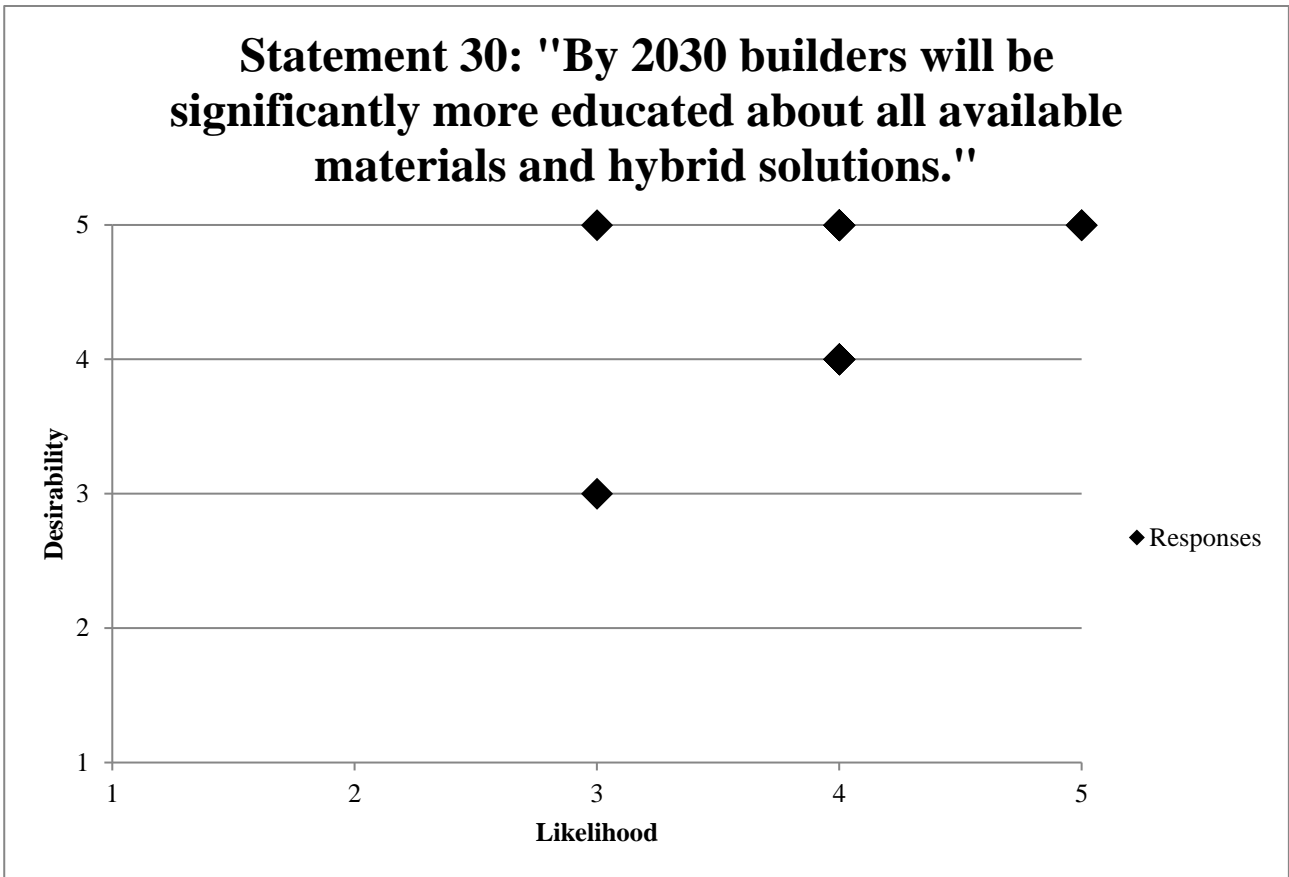


IMAGE 6.6. Desirability and likelihood evaluations of statement 30. Due to overlapping responses, there are less value points on the scatter plot than actual responses (n=17)

Statement 29 was focused on networks, especially on how the industry as a whole operates. Networked value creation system was discussed in the first round of interview in a couple of cases, in which it mainly rose as a possible way to operate in the future. In the second round, this insight was formulated into the statement “*in 2030, the wood construction industry could be described as a network of specialized organizations of different sizes rather than a value chain consisting of only a few large companies*”. No respondent saw this as an unlikely future, however 65% of the respondents were indecisive on this aspect. 65% of respondents saw this future as either desirable or very desirable, with no respondent seeing it as undesirable. Considering that many respondents represented very large organization, the latter grading could be described as surprising.

In some of the interviews of the first round, especially with larger operators, there were concerns regarding the abilities of small companies to develop advanced building solutions from wood. Based on statement 31, this view of the future did not evoke strong opinions regarding its likelihood, and 59% of the respondents gave it a value of 3. However, of all the statements in this study, 31 received second most responses in the undesirable or very undesirable end of the spectrum. This finding is further illustrated in image 6.7.

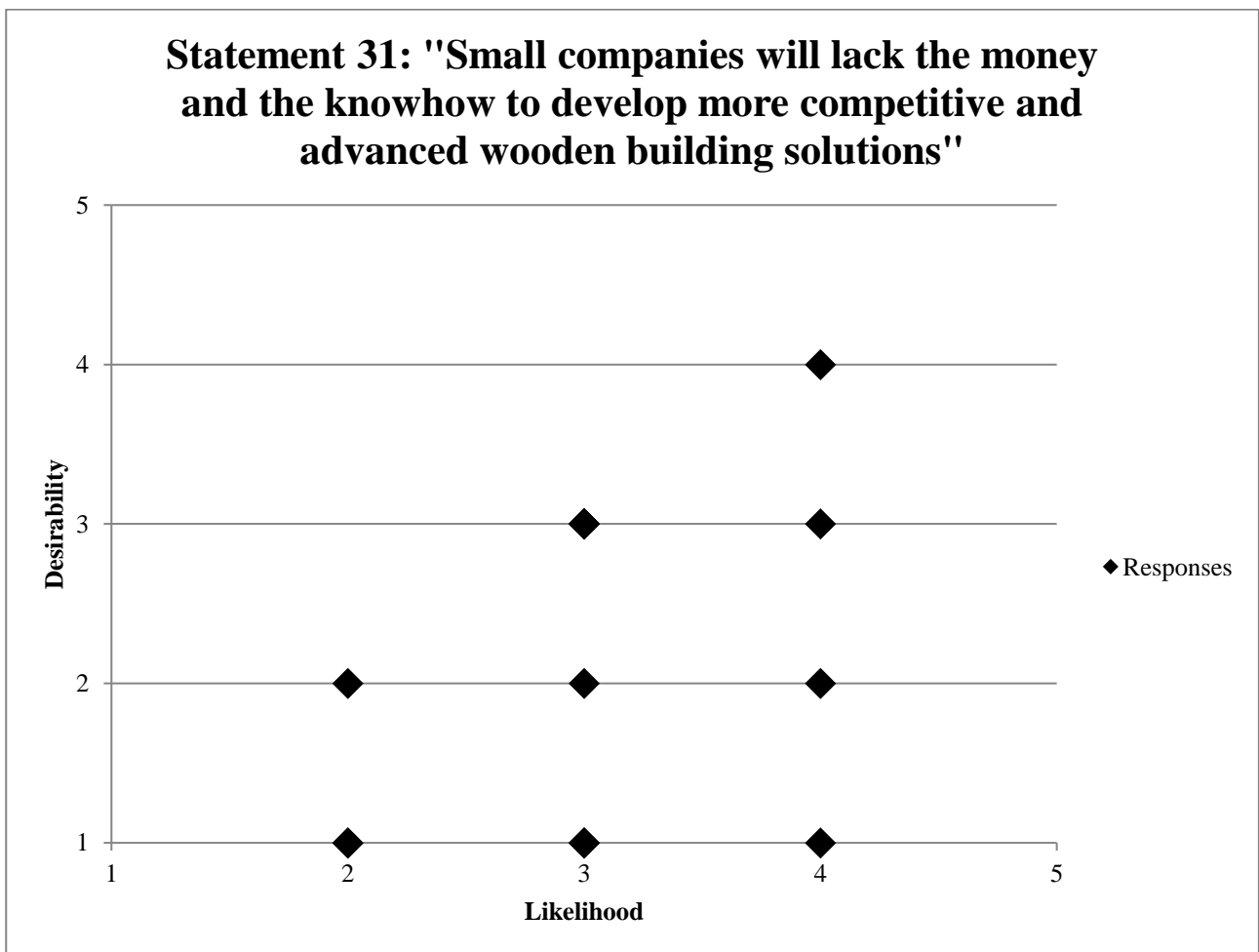


IMAGE 6.7. Desirability and likelihood evaluations of statement 31. Due to overlapping responses, there are less value points on the scatter plot than actual responses (n=17)

Some of the interviews of the first round suggested that industry experts see a change either on-going or happening in the future in the forest industries. For example, one respondent saw that the way things are done is changing as younger generations enter the industry, whereas another

respondent saw that there is a paradigm shift going on in the forest industries. To view how common these views are, especially from a co-operative perspective, statement number 33 read “*by 2030, organizational cultures will be more prone to co-operation and strategic alliances between different organizations*”. 71% of respondents saw this as a likely or very likely future state, and 76% saw it as a desirable one.

One of the key advantages that came up in the first round of interviews regarding WMC, as well as a commonly discussed advantage of the forest-based raw materials in general, is the speed at which wooden building projects can be completed. As a means to discover if all of the industry experts of the study share this view, statement 34 was formed to state “*by 2030, a building process from start to finish will be significantly shorter than today*”. 94% of the respondents shared this view, and 82% saw it as desirable. Round 2 did not yield further explanations to this due to the lack of comments for this question.

Digitalization, especially the flow of information from the site to the forest, was discussed especially by one professional who could be identified as an expert in forest procurement. This insight was also used in the second round as formulated in statement number 35. Based on the results, it seems like this view of the future is welcomed by professionals and is also seen as likely, having scored the either a 4 or a 5 in both parameters from 82% of the respondents. No respondent gave this statement the lowest grades.

Co-creation has emerged as a popular term in new value creation related literature. Often understood as a way to create value with customers (Zwass, 2010), in this study the term was used more broadly in the questionnaire as a term that also includes other stakeholder such as suppliers. The aim was to help the respondents to think of value creation with different, possibly new entities. A future in which value creation is done with more parties than today was seen as very likely based on the responses to statement 38, with 94% of respondents seeing it as likely or very likely. 94% of respondents also saw this view to be desirable or very desirable. The statement also

yielded one comment, where one respondent from a Swedish processor noted that they already use this as their “main working method”. Statement 38 was one of the statements that gained the best evaluations in both of the factors, which can be observed from image 6.8.

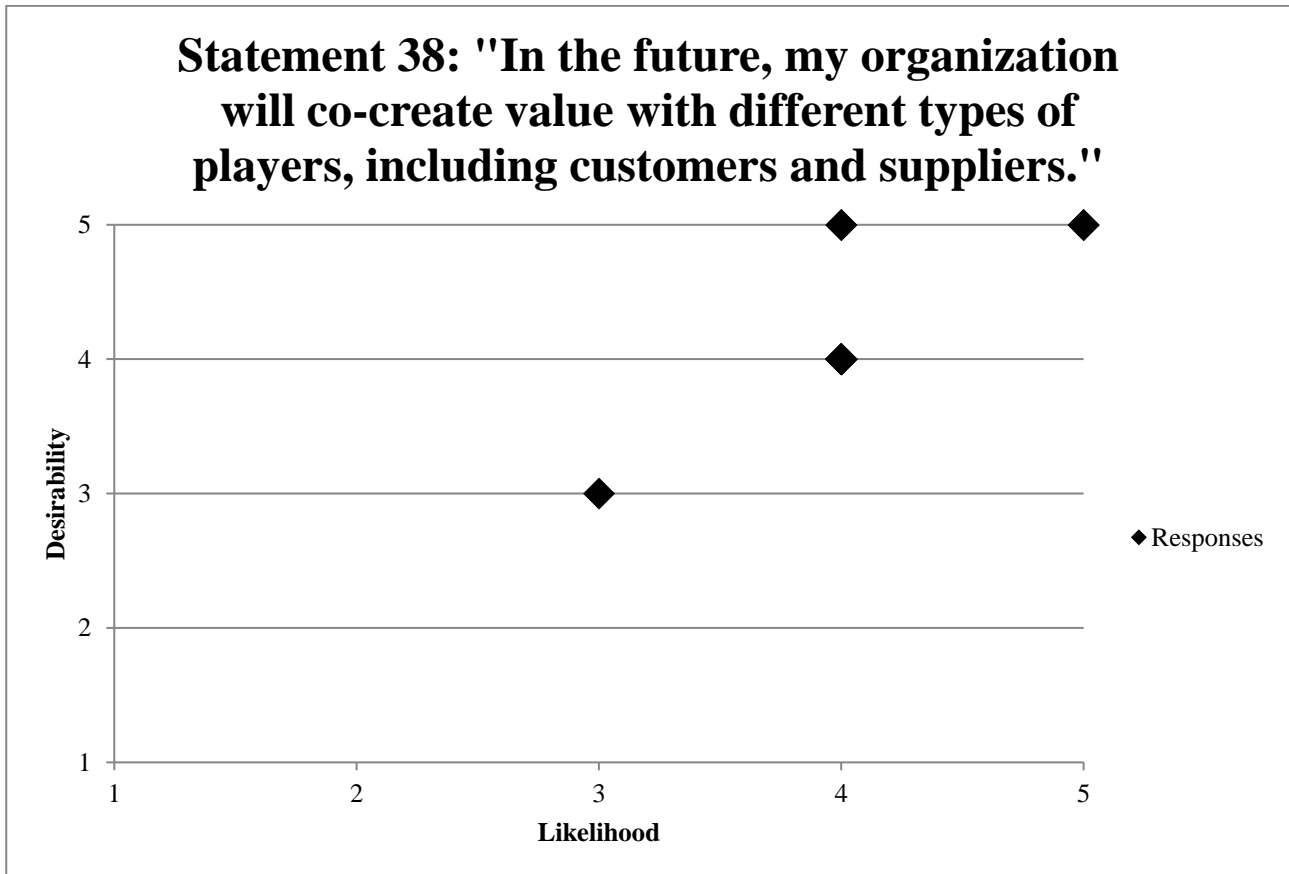


IMAGE 6.8. Desirability and likelihood evaluations of statement 38. There are less value points on the scatter plot than respondents due to overlapping responses.

Statement 39 was formed with the aim of revealing how the respondents see the future of open access platforms and open standards in wooden construction. In many interviews, the issue of standardization was discussed, mainly as something that is needed, but from a business perspective open standards can be less desirable to some parties in the marketplace. Considering the capital needed to develop new construction technologies, opening technical standards could be seen as an invite for competition inside carefully created systems. However, 82% of respondents saw the statement “by 2030, we will have more standards, open access platforms and public data banks for

the wood construction businesses to use” desirable or very desirable. 76% of respondents also saw this statement to be likely or very likely.

Where in statement 29 the aim was to discover how the respondents viewed networked operating logics, statement 40 approached the operating logics through how much control single actors have over the value chain. Though not necessarily contradicting ways to operate, after all big organizations can also be networked to other organizations, the first round of interviews suggested that the industry experts see these as two different, and even opposing business models. The views based on round 2 are scattered, and the respondents are somewhat indecisive on whether or not controlling bigger parts of the value chain is the best way to operate in the future. Over half of the respondents were in the middle of the scale in likelihood, as well as in desirability. 35% saw this as a likely statement, and similarly 35% saw it as desirable.

Statement 41 continued with the discussion on the formation of the value chain, by claiming that “*by 2030, the amount of companies involved in the wood construction value chain will be much higher than today*”. 47% of the respondents saw this view as either likely or very likely, whereas 12% saw it as unlikely or very unlikely. 59% saw it as desirable or very desirable, and 6% as undesirable or very undesirable.

When directly asked about who in the value chain has the most possibilities to develop the more advanced solutions for the future in statement 32, which read “*who do you think has the most possibilities to develop more advanced building solutions based on wood?*”, the respondents were emphasizing the converters and builders role. In this question, the *processors* category, which is used in the most parts of this study, was further broken to sawmills and converters, due to the discussion that the respondents raised in the first round regarding the way sawmills operate. No respondent saw sawmills or forest owners as the part of the value chain that would have the most possibilities to develop the more advanced building solutions, similarly no respondent had identified any other parties. Out of the two most popular choices, the builders were

seen as having more possibilities to undertake the development of more advanced solutions. Interestingly, this was also the most popular choice amongst the builders themselves, even though some respondents in the first round who were identified as builders did not see this as the responsibility of the builders but of the wood industry. All the builders who participated in the first round, replied to the second round and all of them identified builders as the ones who have the most possibilities. The findings of this question are illustrated in image 6.9.

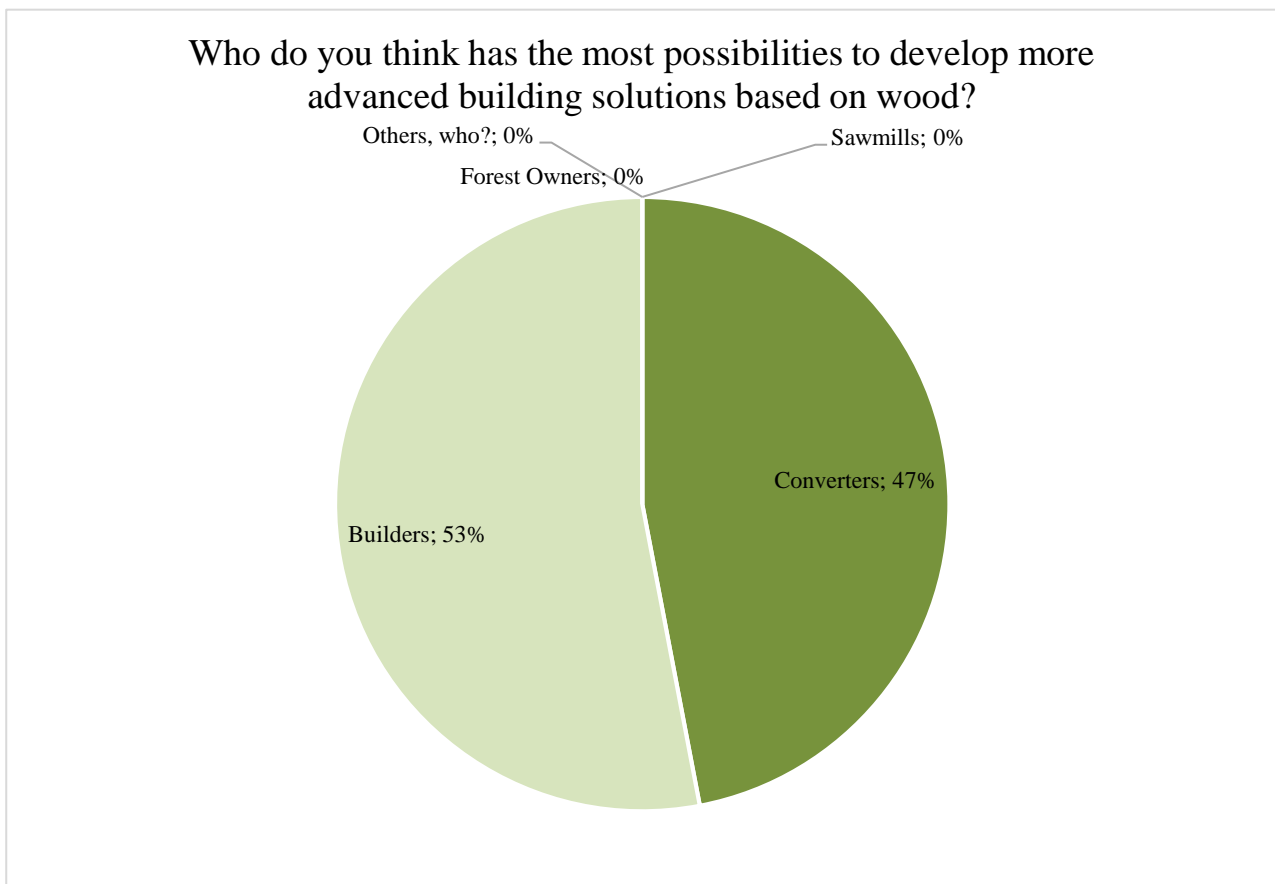


IMAGE 6.9. Evaluation on who in the value chain has the most possibilities to develop advanced building solutions.

The respondents were also asked to assess how they viewed the claim that actors in the wood construction value chain would be too difficult to co-operate in statement number 37. These replies were somewhat scattered, with almost a third (29%) of respondents being indeterminate about their position regarding the matter. There were no respondents who would have chosen the option “I fully disagree”, and only one respondent chose the option “I fully agree”. The

first round did suggest that there is friction and difficulties in the co-operation currently, which was also visible in the results obtained in round two with the higher percentage (41%) of respondents falling into the agreeing group.

There was also one open-ended question at the end part of the survey, which directly asked the respondents about the way they see their co-operative efforts changing from the moment of the survey to 2030. 10 people responded to the question “*How do you see your organization’s co-operative efforts changing from now until 2030?*”, all of whom saw co-operation to increase during the presented timespan. Reasons behind this development were for example globalization, advantages that the organization gains from an open creative environment, changing role as a service provider to the rest of the value chain, and development of more customized solutions through partnerships. One comment raised concerns regarding the difficulty of developing building solutions in general in the construction industry, as the “*tricky thing is to protect innovation since copying is done very fast in building industry*”, but other than this no negative voices were raised regarding the future of co-operative measures. One respondent saw the growing trend of co-operative efforts to be rooted in recent changes in the way they operate, as the following quote highlights:

“We have a closer dialog with our main wooden suppliers today than just one year ago and I think this will get even closer in the future” **Managing director at a processor, 15 years of experience, Sweden**

6.3. Differences between countries

The way that the study was constructed also offered a possibility to compare the results based on the country from which the respondent operates from. Due to the small sample size, these results should be treated with extra caution before deriving any over-arching conclusions. However, they do suggest towards insights worthy of attention and further studying.

The first round responses revealed some differences between topics, that the respondents discussed about when replying to the semi-structured interview. Swedish respondents were discussing for example about the high utilization rate of the wood raw material at the moment. Respondents did not see as much potential for an increase in raw material supply as their Finnish counterparts, as they saw the current utilisation rate of woodlands to be on high. Finnish respondents on the other hand were keen on pointing out that there is plenty of forest, however the recent investments into pulp and energy production facilities that use wood did raise concerns with some respondents. Swedish respondents did not raise similar issues. During the interviews with Swedish respondents, issues with insurance companies were discussed, especially their attitude towards wooden buildings. This topic was unique to Swedish respondents. Similarly, only Swedish respondents discussed raw material imports from countries such as Poland, though this was noted as an issue mainly concerning the southern parts of the country. Finally, a clearly differing topic was the issues that the Finnish respondents raised over the fragmentation of forest ownership, as generational shifts in ownership in Finland break ownership of forestlands into smaller farms. One Swedish respondent noted, that this is not an issue in Sweden, as the local law forbids breaking small farms into even smaller areas when inherited.

In general the responses were highly uniform between the countries. For example, it was common for respondents irrespective of his/her country to see sustainability as a growing and important megatrend. In both countries, the respondents expressed concerns regarding the financial state of sawmills and regarding their commodity-based logic of operations. Similarly, it was common for respondents from either country to see that there is still a need to produce more value-added products in order to stay profitable. Changes in markets and value chains were seen as necessary and as likely shifts in both countries. An interesting similarity between the countries is also the notion that in both countries there seems to be lack of knowledge in the marketplace regarding the WMC in general. Similarly the view that WMC is still in its early stages is an

interesting commonality between the countries. As Sweden has been an early adopter in the development of WMC, and the popularity of wood construction in Sweden is ahead of that in Finland, the notion that players in both countries still struggle with lack of knowledge and seeing WMC as being in it's infancy points that there is still a lot to do before WMC can solidify its presence in the Nordic region. A Venn diagram in image 6.10. further exemplifies differences and similarities between the countries, arisen from the first round interviews.

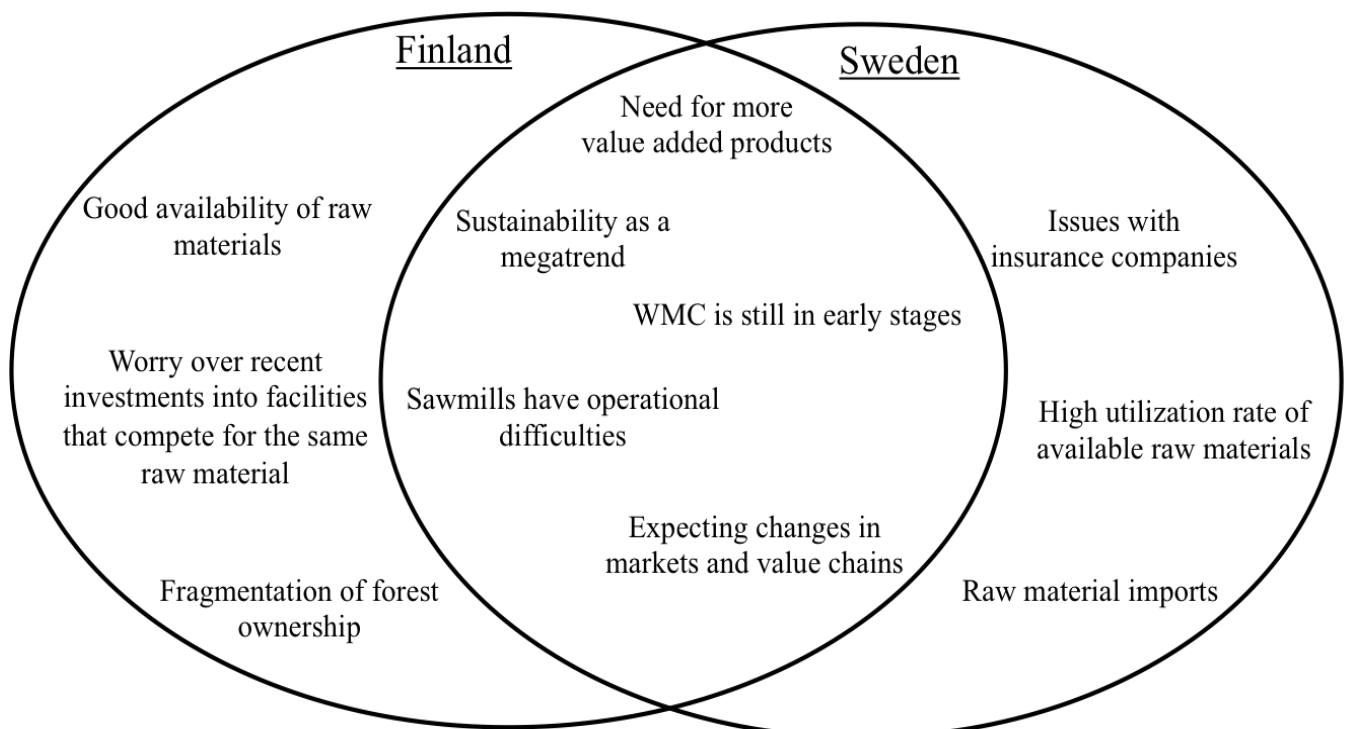


IMAGE 6.10. Examples of similarities and differences between topics discussed during the semi-structured interviews in Round 1.

Round 2 replies were analysed more systematically to uncover the strength of the responses, in which the countries have the most differences and similarities in terms of future views. An overall insight of the responses further supports the findings of the comparisons between the countries from the first round in that the perceptions in both countries are rather similar. In the end, four of the most similar as well as four statements where the differences were the strongest were chosen as worthy of attention.

TABLE 6.6. Statements that had similarities or differences between countries.

Statement	Likelihood Difference	Desirability Difference	Notes
4	High	High	Swedish respondents see this as more likely and desirable.
5	Medium	Low	
6	High	High	Swedish respondents see this as more likely, yet less desirable.
7	Medium	Low	
8	Low	Medium	
25	High	High	Swedish respondents see this as less likely and less desirable.
30	Low	Medium	
31	High	Medium	Swedish respondents see this as less likely.
38	Medium	Low	
39	Medium	Low	
40	Low	Medium	
41	Low	High	Swedish respondents see this as more desirable.

In terms of likelihood, the respondents disagreed the most when assessing statement 4, *future opportunities for wood construction mainly exist outside of Western Europe*, statement 6, *in 2030, wood construction industry will still struggle with competitiveness and lack of value added products*, statement 25, *by 2030, new wood based products (for example advanced biomaterials from wood) will create significantly more competition over the raw materials that the wood products industry is dependent on*, and statement 31, *small companies will lack the money and*

knowhow to develop more competitive and advanced wooden building solutions. Statements 4, 6, and 25 were also the highest ranked statements in terms of the differences between assessments regarding desirability. Statement 4 was assessed as both more likely and more desirable by the Swedish respondents. Statement 6 was assessed more likely, yet less desirable by the respondents from Sweden. Statement 25 was seen less likely and less desirable by the Swedish respondents than their Finnish counterparts. Statement 31 was rated less likely by the Swedish respondents. Statement 41, *by 2030, the amount of companies involved in the wood construction value chain will be much higher than today*, was seen as more desirable by Swedish respondents.

Most similar assessments regarding likelihood were found in statement 8, *by 2030, there will be many experienced professionals both buying wooden building solutions as well as selling them*, statement 30, *by 2030, builders will be significantly more educated about all available materials and hybrid solutions*, statement 40, *in 2030, the best business model is to control a bigger part of value chain than today*, and statement 41, *by 2030, the amount of companies involved in the wood construction value chain will be much higher than today*. Unlike in terms of differences, the most similarities in desirability were not found in the same statements as the most similarities in likelihood. The most similar rating in desirability were found in statement 5, *by 2030, we will sell and buy more wood construction products & services through open online platforms, such as web shops or professional digital networks*, statement 7, *by 2030, large-scale wooden construction, such as wooden multi-storey building projects, has become the most important segment within wood construction*, statement 38, *in the future, my organization will co-create value with different types of players, including customers and suppliers*, and statement 39, *by 2030, we will have more standards, open access platforms and public data banks for the wood construction businesses to use*.

In general the results could be summarized to be similar in the what could be described as big issues, such as the need for more value added products, future megatrends and opportunities,

as well as the view of the future as being more co-operative. The differences discovered especially in the first round pointed to differing structures in the markets, for example the different ownership structures driven by the differing legislations of the countries. Round two did suggest that the Swedish experts see a more global future for their products with the main opportunities existing in locations outside of Western Europe. The notion on the issues with raw material supplies being limited in Sweden also echoed in the survey as the Swedish respondents seemed to be more concerned about the competition over raw materials even though they did not worry over recent investments into competing facilities in the first round.

7. Conclusions

This study set out to find future factors, which the industry experts see as key in the future of the WMC value chain. This quest was further broken down into finding both desirable future views as well as likely ones. The process started with the literature review, which aimed to find themes from the context, ie. from literature focusing on each of the parts of the value chain, as well as from the theories involved in the strategic orientations of the forest industries and from concepts in the construction industry. These themes were synthesized into the semi-structured interviews undertaken in the first round of the Delphi method. Finally, the second round of the Delphi method focused on receiving evaluations for statements that were formed from the findings of the first round. This process generated a large body of information that became more specific with each step of the way.

When reviewing the most likely future factors, a few notions are clearly visible. The industry experts in this study identified likely changes happening in the technological aspects of WMC, which can be grouped into factors. Within the top 10 most likely statements, five were related to technical aspects. Among these were a move to more prefabrication, faster building processes, online platforms and digital professional networks, the ability to produce value added

products from low quality raw materials, and a more diverse product offering. In the light of this notion, it seems like the main factor shaping the WMC value chain is the development of new technologies and ways of producing.

Second factor that seemed likely in the future is based around growing knowledge regarding WMC with three of the top 10 most likely statements being related to this topic. Though especially the first round results noted that the current situation of WMC could be described as being in its early stages, in the second round the experts saw it likely that the consumers will see WMC as a modern way to build, and that the industry professionals in construction will be more educated about wooden building and WMC solutions. There was also a strong trust in the view that the people buying building solutions will be better educated about WMC in the future. As previous literature showed, WMC's market share is not high as of yet, but at the same time the trend is growing. This will hopefully lead to better understanding about the possibilities WMC offers and even more demand, if the projects undertaken are successful.

Third likely factor in the future of WMC is the co-operative measures in the value chain. Out of the top 10 most likely statements, two were related to this. Respondents saw it relatively likely that they will co-create more with a diverse set of stakeholders in the future. Similarly, hybrid building, which calls for co-operation across experts in different building materials was seen as a likely concept in the future. Hybrid building has been discussed in previous literature as a possible future path for WMC, and was also discussed on several occasions in the first round. Similarly, especially S-I related literature has suggested that with the new strategic orientation, the value networks in the forest industries will change and new co-operative ways of delivering value to the end user will emerge. First round of the Delphi method already showed that co-operative actions are underway for the WMC, and to some extent have already become familiar to industry professionals. The second round clearly demonstrated, that this view is likely to grow at least amongst these industry professionals. This was also further supported by the notion that - even

though in this case categorized under technological developments - the experts saw it likely that in the future there are more online platforms through which professionals can be connected.

In terms of desirable factors affecting the future, the evaluations are not clearly for one topic only, but scattered around four main points. Similarly to likelihood, technological aspects were among the top factors that the experts saw desirable. Three out of the top 10 statements in desirability were related to changes in technology. The possibilities to produce value added products from lesser quality raw materials, diversification of product offering, and growing use of prefabrication with less on site building were all found amongst the most desired changes. Similarly in the first round of the Delphi method, the respondents were vocally supportive of these topics.

The experts also saw it desirable that in the future there would be more knowledge regarding WMC. The respondents saw that it is desirable that builders would be more educated regarding available materials as well as hybrid building solutions. Similarly, the vision of a future where consumers see WMC as a modern way to build was seen as desirable. First round of the Delphi study also supported this view, as many respondents hoped to see more knowledge regarding WMC in the marketplace.

Sustainability also proved to be a factor, which the experts saw as desirable. The experts desired for a future in which sustainability has become a megatrend in the housing market and consumer demand for sustainable housing has become a stronger driver for wood construction. First round of interviews also revealed that experts are putting a lot of expectations into the possibilities that sustainability related concepts offer to their business. This was even seen as a possible competitive advantage over other available materials. Similarly, previous studies presented in the background literature had emphasised the possibilities that sustainability related issues offer to the forest industries.

The experts also saw that a desirable future will have changes in the way that the markets function, especially how the purchasing functions and how building is regulated. The

statement regarding the change in regulation in a way that would better suit large-scale wooden building was amongst the most desired ones. The statement, which proposed that in the future, decisions over building materials would be based more around life cycle costs rather than simple purchase price was the most desired view of all. First round of the Delphi method also supported these views, with regulation being discussed actively. Also, the difficulties in competing with purchase price against other materials came up during the interviews. Though life cycle cost based purchasing was not actively discussed in the interviews, it seemed to be a factor that would be very favourable for the future of WMC.

There are several ways to identify a factor as ‘key’ for a value chain. In this study, it is proposed that especially the aspects that are both likely and desirable are important in the future. This follows from the logic that it is rational to grasp the opportunities that offer most reward and seem credible to take place. Amongst the top 10 likely and top 10 desirable statements, there were five items that appeared on both. First of them was the diversification of product offering in statement 1. It was interpreted that this statement could be grouped in both likelihood and desirability as a member in a group of technological factors. Another technological aspect that appeared on both lists was the growing amount of prefabrication, as formulated in statement 10. Knowledge was a third factor that was formulated from the top lists of statements. Two of the shared items also belonged to this grouping. Statement 30, which proposed that the builders will be more educated in the future regarding available materials and hybrid solutions, and statement 42, which proposed that consumers will see wooden construction as a modern way to build in the future, both were amongst the shared items. The last of the five shared items was statement 38, which proposed that the organizations in which the experts worked at will co-create more with different stakeholders in the future, was grouped under co-operation related factors.

To conclude and to answer the main research question, this study proposes that the main factors that will have an effect on the future of the WMC value chain are a mix of

technological changes, growing knowledge for the opportunities that WMC can offer and finally the move from operating in isolation to a more connected and co-operational way of working. In retrospect with previous literature, it seems that WMC is moving to a strategic orientation that at least has similarities with the so called Service Dominant Logic, if not even actually is S-I.

The set up of the study proved to be limited in it's in ability to find likely but undesirable factors, which could be called weaknesses or threats in the future. However one possible value chain shaping issue did emerge from the data. The first round of interviews suggested that there is a vast emphasis and large amount of expectations set on sustainability and possible gains that WMC can achieve from this megatrend. In round two, sustainability related statements appeared as desirable future views, but none of the sustainability statements received strong support in terms of them being likely to become true. This leads to the question, should the operators in WMC take more actions to support the growth of sustainability related issues, if there are high gains from this concept but limited likelihood of it having a significant role in the markets and in the value chain in the future?

8. Discussion

In addition to the main findings, the study also brought forward interesting insights that either challenge or support previous literature. The study also offers possible future paths for research and brings managerial implications to the table. The limitations of the study are also discussed at the end of this chapter.

Overall, the respondents seemed to have a positive outlook on the popularity of WMC in the future. Other studies, which used similar focus groups have found results that point to the same direction, though these studies have been conducted in countries which were not included in this study (eg. Sjølie et al., 2015). Another aspect of previous studies, which this study supports is the notion that WMC has a role in finding more sustainable building solutions in the future (eg.

Ruuska & Häkkinen, 2014; Herczeg et al., 2014; Hurmekoski, 2015a). Finally, the previous notions that linking material choices in building with actual consumer needs is a complex matter (eg. Toppinen, Wan & Lähtinen, 2013). This could be seen as somewhat supported by this study, as it was difficult to link sustainability to the end-user in any other form as personal health benefits. The experts also struggled with explicitly stating how sustainability could be turned into commercial successes. Like in other studies (eg. Toivonen 2011; 2012), the sellers do see the wooden raw material in a positive light in this study.

Some aspects that previous literature has found, but this study does not agree with were also identified. Firstly, the experts in this study did not see future opportunities to exist mainly outside of the Western European markets, unlike some studies have concluded (eg. Ernst & young, 2013). Some studies have seen there to be a lack of co-operative mindset in the forestry sector (eg. Mattila, 2015; Mattila et al., 2016) but at least amongst WMC experts there seems to be a lot of interest and even some actions to co-operate more openly with other actors in the values chain. Only part of the value chain, which was seen as lacking interest or possibilities to participate in co-operative projects were the sawmills. However, some issues with co-operation that previous studies have identified, such as scale and time related difficulties (eg. Hurmekoski, 2015a), were also mentioned by the experts in this study. It seems as if there is a will but limited ways to co-operate at the moment. Finally, previous studies have outlined possible issues arising from not the volume of raw material supplies but their quality (eg. Hurmekoski, 2015). This study found no signs of this type of issues arising, even when explicitly asked from the respondents. Some noted that even if such a situation would form, there are technological ways to work around it.

The managerial implications of this study are focused on ways to co-operate with fellow members of the value chain. The conclusions offer interesting starting points for co-operation. For example, if an industry professional would wish to begin building direct and open communication with other members in the value chain, two factors which can help build trust and

foster mutual interests (Das & Teng, 2001) and thus operate as a starting point for further strategic alliances, this study would suggest starting with projects related to new technologies, knowledge transfer to the public, or finding shared views of the ways in which co-operation could take place. Similarly, finding ways to promote sustainability and its uptake on the markets could be a starting point for co-operative projects. On a more philosophical note, it could be stated that the current actors in the value chain seem to be equally interested in co-operation and have similar views about the future, so a natural step would be to start looking for new and insightful paths together.

For legislators, this study raises an interesting paradox. The industry experts who partook in this study see future possibilities in hybrid building, but at the same time see it necessary for WMC to be given preferential treatment in order to grow. However, this preferential treatment might discourage other material suppliers to take interest in the possibilities of hybrid building, if one material is treated in a different way than others. So the question is, when and where should WMC be supported and how? Can legislative push mechanisms for WMC cause friction in the search for hybrid solutions?

Research implications of this study point to two directions. The findings of this study should be tested on a larger arena, with either geographically broader scope or with a larger sample, preferably both. The small sample size is the main source of weakness for this study, as well as the way in which the study mainly searched for factors that are quite positive. In a way, this study mainly searched for the first and third aspects of a classical SWOT analysis, for the strengths and opportunities of WMC. A future study could aim to find problems, weaknesses and threats that the industry experts see coming for WMC. A future study could also continue on with the Delphi process and aim to find actionable insights through a third round that would discuss which factors and how the WMC sector could grasp in order to build a better future. This path is illustrated in image 8.1. This study does already offer a guiding answer to who could be driving the development of novel solutions, as the experts saw builders and converters as being the ones with the most

possibilities to develop solutions, but a further exploration of possible roles and co-operation structures could also be an interesting direction for the third Delphi round.

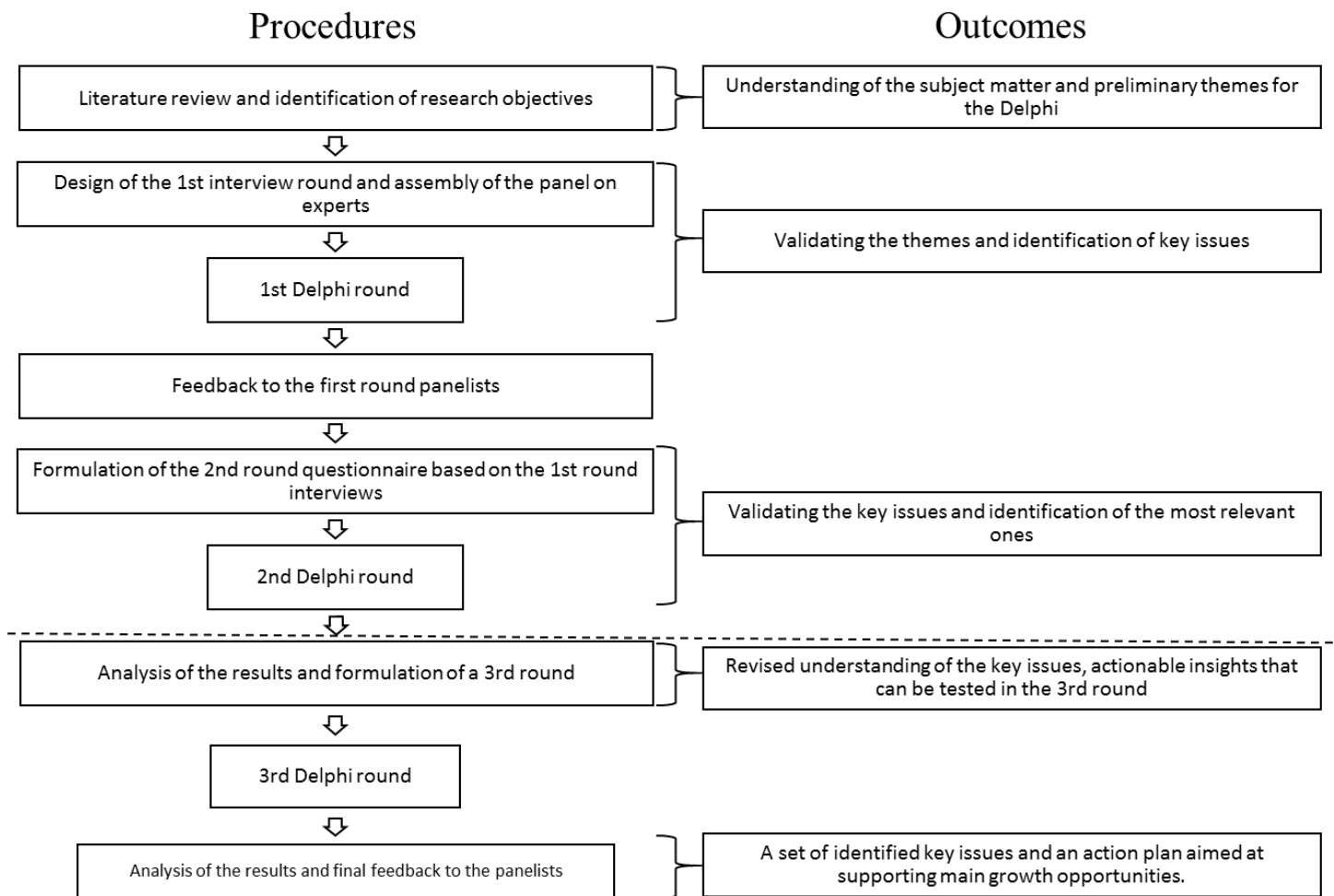


IMAGE 8.1. Illustration of a possible third Delphi round

There are several papers that have studied interfirm relations and co-operation for example in marketing literature (Young & Wilkinson, 1989). Co-operation in construction industry has also been studied before (Liu et al., 2014). Such concepts as shared vision and mutual dreams have also been studied under innovation literature (Feldbrugge, 2015; Holt, Love, & Li, 2000; Li, 2005; Morrison & Mezentseff, 1997). These are just some examples of scientific concepts, which could be combined with the findings of this study in the future.

Finally, this study offers further proof to the suggested next strategic orientation for forest industries. Using a similar setting and method, and combining the results of this study with

other aspects of the Service Dominant Logic could help uncover how prepared the forest industries are to uptake this new orientation and how far it has already made its way into the forest industries.

Appendix

List of statements	
1	By 2030, the overall product offering of the wood product industries is significantly more diverse than today.
2	By 2030, wood product industries will offer significantly more value added products than today.
3	Wood product industries are going through a paradigm shift, and will operate in a completely new way by 2030.
4	Future opportunities for wood construction mainly exist outside of Western Europe
5	By 2030, we will sell and buy more wood construction products & services through open online platforms, such as web shops or professional digital networks.
6	In 2030, wood construction industry will still struggle with competitiveness and lack of value added products.
7	By 2030, large-scale wooden construction, such as wooden multi-storey building projects, has become the most important segment within wood construction.
8	By 2030, there will be many experienced professionals both buying wooden building solutions as well as selling them.
9	By 2030, strong business networks within the industry will help us build competitive products more effectively and faster.
10	By 2030, prefabrication will be the main operating logic, with less on site building.
11	By 2030, the housing regulation has become more suited for large-scale wooden buildings.
12	By 2030, wooden interiors have become a trend preferred by consumers.
14	By 2030, most building renovation in the urban space will involve wooden building solutions.

17	By 2030, wood has become a competitive material for building on its own right.
18	The future of wood building is in hybrid buildings, using jointly other materials.
19	By 2030, the consumer demand for sustainable living is a significantly stronger driver for wood construction.
20	By 2030, counting for life cycle costs of buildings and not just purchase prices will have significantly more effect on the decision making in large-scale building projects.
21	By 2030, sustainability has become a megatrend in the housing market.
22	Future certification schemes will be difficult to manage for smaller businesses, due to the bureaucracy involved
23	The importance of wood as a construction material will be mainly based on its environmental impact.
24	The difference between the relatively steady stumpage prices the high volatility of the markets for sawn wood will be a major challenge by 2030.
25	By 2030, new wood based products (for example advanced biomaterials from wood) will create significantly more competition over the raw materials that the wood products industry is dependent on.
26	By 2030, the cost of raw materials will be a significantly bigger proportion of overall costs of wood construction.
27	By 2030, it will be possible to make more value added products from lower quality raw materials due to technology development.
28	By 2030, concrete builders will be significantly more interested in the opportunities offered by wooden building solutions than today.
29	In 2030, the wood construction industry could be described as a network of specialized organizations of different sizes rather than a value chain consisting of only a few large companies.

30	By 2030, builders will be significantly more educated about all available materials and hybrid solutions.
31	Small companies will lack the money and knowhow to develop more competitive and advanced wooden building solutions.
33	By 2030, organizational cultures will be more prone to co-operation and strategic alliances between different organizations.
34	By 2030, a building process from start to finish will be significantly shorter than today
35	By 2030, the flow of information from the construction site to the forests will be significantly faster.
38	In the future, my organization will co-create value with different types of players, including customers and suppliers.
39	By 2030, we will have more standards, open access platforms and public data banks for the wood construction businesses to use.
40	In 2030, the best business model is to control a bigger part of value chain than today.
41	By 2030, the amount of companies involved in the wood construction value chain will be much higher than today.
42	By 2030, consumers will see wood construction as a modern way of building.

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