

The Re-emergence of wood as a key construction material

**A study on consumer perceptions and attitudes
in Finland**

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Abstract <p>Wood use is re-emerging in modern construction. Wooden high-rise residential buildings accounted for a 6% market share in 2015. Surveys conducted in the EU show, that perceptions and attitudes vary, with fire resistance and durability listed as top concerns, and inherent environmental and health properties listed as key benefits.</p> <p>The objective was to gain an understanding of the profile of end users interested in this topic as to gain a sense of direction with regards to certain key issues relating to perceptions and attitudes towards wood use in different scenarios.</p> <p>A survey was implemented using a deductive approach based on theoretical framework gathered from secondary data. A semi-structured questionnaire was implemented with 121 participants, 119 of them valid responses.</p> <p>Most of the respondents view wood as a suitable construction material positively in different scenarios. However, wood was considered least suitable for high-rise residential buildings. Factors such as age and external influence (news or research reports) correlated with willingness to live in wooden low-rise residences and views on wood's suitability as a construction material in different scenarios. They did not correlate with people's willingness to live in wood constructed high-rise residential buildings.</p> <p>Health, durability and cozy and comfortable living space were ranked among the most important attributes relating to choice of construction material, whereas easy maintenance, good acoustics and modernity were chosen as the least important. Attributes chosen by the respondents as important hold great practical value. Attitudes towards high-rise wooden buildings are diverse and it shows the uncertainty of demand for high-rise <u>wooden residential buildings even in Finland</u>.</p>		
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Contents

1	Introduction	3
2	Background	4
2.1	Economic Push-Pull Factors	5
2.2	Wood Use in Construction and the Environment	7
2.3	Attitudes and perceptions regarding wood use	12
3	Theoretical Framework	16
4	Methodology.....	19
4.1	Research design and strategy	20
4.2	Designing and implementing the questionnaire	21
4.3	Data analysis	23
5	Results	23
5.1	Attitudes.....	26
5.2	Perceptions	35
5.3	Communications and information influence.....	39
5.4	Assessing relationships.....	40
6	Discussion	42
6.1	Scenarios	42
6.2	Attributes	43
6.3	Factors.....	44
6.4	Additional insight	45
6.5	Validity and limitations	45
7	Conclusion.....	48
7.1	Business perspective	48
7.2	Suggestions for further research.....	50
7.3	Future implications	51
	References.....	52
	Appendices	58
	Figures	70
	Figure 5.3. Education background of the respondents	70
	Figure 5.4. The current living situation of the respondents	71
	Figure 5.20 Comparing wood to other common construction materials in environmental-friendliness.....	72
	Figure 5.21. Comparing wood to other construction materials in beauty	73
	Figure 5.22. Comparing wood to other common construction materials in health	73

Figure 5.23. Comparing wood to other common construction materials in durability	74
Figure 5.24. Comparing wood to other common construction materials in modernity	75
Figure 5.25. Comparing wood to other common construction materials in the context of secure investment	76
Figure 5.26. Comparing wood to other common construction materials in the context of being natural.....	77
Figure 5.27. Comparing wood to other common construction materials in the context of cozy and comfortable living space.....	78
Figure 5.28. Comparing wood to other common construction materials in fire resistance	79
Figure 5.29. Comparing wood to other common construction materials in the context of easy maintenance	80
Figure 5.30. Comparing wood to other common construction materials in the context of providing good acoustics	81
Figure 5.31. Comparing wood to other common construction materials in the context of supporting sustainability	82

Tables	83
Table 5.1. The suitability of wood as a construction material in low-rise recreational properties.	83
Table 5.2. The suitability of wood as a construction material in low-rise residential buildings (1-3 storeys).....	83
Table 5.3. The suitability of wood as a construction material in high-rise residential buildings (4-8 storeys).....	84
Table 5.4. Qualities of wood as a construction material; Environmental friendliness in construction compared to other materials (i.e. concrete).	84
Table 5.5. Qualities of wood as a construction material; Wood constructed residential buildings have good acoustics and sound insulation.	85
Table 5.6. Qualities of wood as a construction material; Wood constructed residential buildings have good indoor air quality.....	85
Table 5.7. Qualities of wood as a construction material; A wood building is a healthier living environment than others (e.g. concrete buildings).....	86
Table 5.8. Qualities of wood as a construction material; The use of wood causes less negative impact on the environment than using brick, concrete or steel.	86
Table 5.9. Qualities of wood as a construction material; People who live in wooden buildings feel close to nature.....	87
Table 5.10. The more environmentally friendly a construction, the more expensive it becomes.....	87

1 Introduction

The objective of this thesis was to gain an understanding over the perceptions and attitudes of end users regarding wood use in construction with respect to factors, such as age and external influence and attributes such as; health, environment, durability, secure investment and fire resistance. These factors and attributes are researched in the context of scenarios, depicted as building types ranging from low-rise recreational to high-rise residential. Specifically, this study aims to answer the following questions;

- What are the perceptions and attitudes of potential consumers regarding wood use in construction?
 - What is the most likely age group to consider living in wooden high-rise residential constructions?
- Is there a difference in perceptions and attitudes towards low-rise to high-rise wooden constructions?
 - Are people, who feel they have been positively influenced by news or research reports over the past 10 years, more likely to perceive wood as a suitable construction material for high-rise residential buildings?

Understanding how end users perceive the use of wood in construction provides an insight into the future of wood as a primary construction material. Respondents to the questionnaire used in this study are all resident in Finland.

According the Finnish Ministry of Employment and the Economy, there are 2.85 million registered residences. From the approximate 30 000 new residences built each year over the past two decades, less than half are detached houses (e.g. single-family and two-family homes). In addition, there are half a million summer cottages in Finland, with approximately 7 000 new holiday houses being built each year. Nearly 99% of these are wooden constructions (The status of wood construction in Finland, 2014).

Approximately 43% of all residences in Finland are in multi-storey buildings. This forms a market, which according to the Ministry has been dominated by concrete for the past 50 years. In 2014, the market share for wooden multi-storey buildings, which The ministry of Employment and the Economy (2014) had defined as buildings with more than two storeys, was only 5% (The status of wood construction in Finland, 2014) and in 2015 it had grown to 6% (Market opportunities in industrial wood construction in Finland, 2016).

Although the focus is narrowed to people resident in Finland in this study, perceptions on wood use have been studied widely around the world. Wood has great potential due to its inherent environmental properties and attributes such as providing a healthy living environment, based on people's perceptions.

2 Background

Wood has a long history in housing and construction. It has been used in construction for centuries around the world. Some of its inherent features offer significant value to society in comparison to alternative materials. Recently, there has been a renewed interest in the use of wood for a range of building types. (Sevchenko, 2015). This has also been the case in Finland where this study has been conducted.

One key focus of interest has been improving social, economic and environmental indicators of sustainability. The construction industry has seemed to have given this attention, at least to some extent. (Castells, Ortiz and Sonneman 2009, 28-39)

Due to urban settlements being accountable for a large portion of resource consumption (Urban Development, 2016), the construction industry has emerged as an important sector for finding ways to reduce consumption and contribute to achieving levels of sustainability. The construction industry is accountable for roughly a third of the total waste in the landfill waste stream and for 44% of all extracted materials from the earth's biological or mineral resources (Akhtar, Hewage, Hossaini, Resa and Sadiq 2015, 1217-1241). Buildings account for 40% of total primary energy consumption and are the cause of roughly a third of all greenhouse gas emissions (GHGs) globally (Takano 2015, 1). According to some scientists, human activities that release

Carbon Dioxide (CO₂) and other greenhouse gases into the atmosphere are the most significant contributing factor to global warming (NASA 2016).

All of the actions in the construction process such as extraction and processing, manufacturing, transporting, and the final end use of a product, have an environmental impact. Construction processes create greenhouse gas emissions (GHGs), which are a major contributor to the global warming crisis (IPCC, 2007).

End products of construction, such as housing, utilize significant amounts of energy through three inter-related stages; 1. Construction, 2. Occupation and 3. End of life deconstruction (or in some cases, demolition) (Monahan and Powell 2011, 179-188).

CO₂ emissions have increased with the use of fossil fuels and cement manufacture in construction processes. These two factors are argued to be responsible for a 75% rise in atmospheric CO₂ since the pre-industrial era of the 18th century (Monahan and Powell 2011, 179-188).

2.1 Economic Push-Pull Factors

There are economic benefits in wood construction that can be seen in the construction industry and wood and forest based industries in various ways. This includes the potential to generate employment in wood products and the bioenergy industry (Gustavsson, Hemström and Mahapatra 2012, 62-85), as well as industries involving building and maintaining heavy machinery, such as tractors and trucks used for harvest activities, forest management and logistics.

The building sector can account for up to 40% of a country's Gross Domestic Product (GDP), and involve 5 – 10 % of a country's total employment (Takano 2015, 1). Høibø, Hansen and Nybakk (2015, 1617-1627) refer to a global demand for housing estimated at a 5 million units per year increase, which points to the significant role that this sector plays in an overall economy.

Gustavsson, Hemström and Mahapatra (2012, 62-85) state that construction can often be viewed as a slow change sector where technological advances happen over decades, not years or months. Their report refers to a summary of barriers collected by the Building Research Establishment in 2004, which counter the shift from tradi-

tional concrete or brick construction to a re-emerging wood construction system within the EU (Building Research Establishment 2004, 4). According to Gustavsson, Hemström and Mahapatra (2012, 62-85) one set of these barriers are the characteristics of the construction industry (also referred to as liabilities). These are as follows;

- *The nature of the activities in a project do not facilitate replication or continuous interaction amongst the actors*
- *The structure of the industry is considered fragmented which is dominated by only a few companies which rely on a large amount of small local sub-contractors*
- *Uncertain demand for wood construction*
- *difficulty to quickly evaluate innovations because of the long age of the buildings*
- *the type of contractual agreements*

Investments made on infrastructure, production lines and knowledge and skills, what Gustavsson, Hemström and Mahapatra (2012, 62-85) describe as “sunk investments”, are seen as obstacles to change in the construction industry. However, whilst it is a sound argument, it does not affect new and upcoming construction companies in the same way.

Gustavsson, Hemström and Mahapatra (2012, 62-85) argue that the path dependency of an established construction system could also resist new innovations in the construction industry. Path dependency is defined as an established innovation system, which has become stable overtime. It follows a specific developmental path due to a growing network of actors, which are supported by institutional, economic and social factors. In this case, concrete or brick-based construction systems are examples of established innovation systems as they have developed over more than a century, thus creating path dependency. (Gustavsson, Hemström and Mahapatra (2012, 62-85).

As a slow to change sector, traditional building methods may well hinder new and upcoming techniques in construction. Gustavsson, Hemström and Mahapatra (2012, 62-85) argue that in order to break this path dependency and help the re-emergence of wood as a key construction material, market intervention is needed, and they de-

scribed the emergence of wood as a radical, incremental and a really new innovation.

In 1999, the UK market share of wood frame houses was 2% in England, 4% in Wales, while in Scotland the market share remained at roughly 40%. By 2008 the market share had risen to 17% in England and 76% in Scotland. A clear majority of these houses were 1 -3 storeys high, but the market for multi-storey wooden buildings is expected to rise alongside an increase in multifamily buildings, especially in England where roughly 80% of all residential units were single-family houses in 2007 (Gustavsson, Hemström and Mahapatra (2012, 62-85).

Finland, as with other countries such as like Norway, has a long tradition of using wood as a construction material, particularly in low-rise buildings of 2-3 storeys maximum (Bysheim and Nyrud, 2010). In Norway, wooden buildings of 800 years old are still in use (Høibø, Hansen, and Nybakk. 2015, 1617-1627). In Finland, several centuries old wooden buildings also still stand, such as the Petäjävesi Old Church which is listed in the UNESCO World Heritage List (UNESCO 1990). Current statistics on wooden low-rise buildings in Finland show that despite the long history and tradition of building wooden low-rise residences in Finland cement has remained the dominant construction material in high-rise residential buildings in Finland for decades (*Status and possibilities of wood construction in Finland*. 2014).

2.2 Wood Use in Construction and the Environment

The share of forest and other types of wooded land constitute roughly 42% of the “total land area” in the EU geographically. This shows high potential for the building sector to shift its vision more towards wood products, assuming that forest management practices are sufficiently developed to ensure maximum long term benefits in a sustainable manner.

Numerous studies have assessed environmental benefits at each stage of the life cycle of a wood product. For the purpose of this study, the environmental benefits of wood building will be limited to the consideration of CO₂ mitigation.

In a process called carbon sequestration or carbon storage, trees and forests absorb an estimated 50% of carbon equivalent to their mass from the atmosphere, only re-

leasing carbon back into the atmosphere during decay (releasing both CO₂ and methane, CH₄, in roughly the same portions) This includes wood products being made for construction purposes. (Ximenes and Grant 2013, 891-908.)

Wood substitution for other construction materials has been found to affect carbon balance in four significant ways; 1. The need for fossil energy is relatively low for manufacturing wood products compared to other construction materials, 2. Industrial process carbon emissions are avoided, which would ordinarily result from i.e. cement manufacture, 3. The biomass from wood construction by-products can be used as bio-fuels replacing their share of fossil fuel alternatives, and finally 4. The physical storage of carbon in wood products and forests. (Eriksson, Gustavsson, Hänninen, Kallio, Lyhykäinen, Pingoud, Pohjola, Sathre, Solberg, Svanaes and Valsta 2012, 131-144). Biomass is formed from the residue of wood products and forestry. It is not wood per say, hence using the biomass resulting from wood construction by-products is not the same as the earlier mentioned 'burning wood products as fuel for energy' thus releasing stored carbon. (Wilson 2006.)

Carbon remains in storage all the way to the end of the wood product's life cycle when it begins to decay and release stored GHGs back into the atmosphere (Ximenes and Grant 2013, 891-908). Thus wood is composed of roughly 50% carbon by dry weight that is CO₂ absorbed from the atmosphere (Sathre and O'Connor 2010, 15). Both trees and wood products continue to store carbon until they are decomposed chemically or biologically or combusted as fuel (Wilson 2006). Therefore the attribute of long-term carbon storage also applies to wood constructed buildings (Crews, Ding, Thomas 2013, 647).

The same environmental benefit, however, cannot be obtained from alternative materials such as concrete, brick or steel. Wilson (2006) argues that the positive benefits of carbon storage in forests and the use of wood in construction can be easily offset by the usage of fossil fuels in the process of construction (stage 1 in a building life-cycle). For example, to prepare wood as a building material may involve the use of coal, natural gas or oil to generate electricity for power saws, diesel to power vehicles for transport, and fuel to operate machinery in the deconstruction phase (stage 3 in a building life-cycle) (Wilson 2006). However, the amount of fossil energy

required for manufacturing wood products for construction still remains relatively low compared to alternative construction materials, such as concrete (Eriksson, Gustavsson, Hänninen, Kallio, Lyhykäinen, Pingoud, Pohjola, Sathre, Solberg, Svanaes and Valsta 2012, 131-144).

Wilson (2006) uses an example where houses with similar features were built and measured with a Global Warming Potential Index (GWPI) model. This model measured the release of GHGs in two separate scenarios; Scenario 1. Cold-climate house by frame type (Steel vs. Wood) and Scenario 2. Warm-climate house by frame type (concrete vs. Wood).

Release of greenhouse gases (GHG) and the Global Warming Potential Index (GWPI) for materials, transportation, product manufacturing and construction of both CORRIM house designs

	Cold-climate house by framing type				GWPI contribution
	Steel	Wood	Steel-Wood		wood design
GHG	kg	kg	kg	%	%
CO ₂ fossil	45,477	35,743	9,734		96.56
CO ₂ biomass	526	1,547	-1,021		"
N ₂ O	0.227	0.211	0.016		0.17
CH ₄	54.5	52.7	1.8		3.27
GWPI	46,797	37,017	9,780	26.4	
	Warm-climate house by framing type				GWPI contribution
	Concrete	Wood	Concrete-Wood		wood design
GHG	kg	kg	kg	%	%
CO ₂ fossil	27,150	20,570	6,580		96.29
CO ₂ biomass	1,291	1,388	-97		"
N ₂ O	0.188	0.172	0.016		0.24
CH ₄	33.63	32.22	1.41		3.47
GWPI	27,979	21,362	6,617	31.0	

Table 1.1. Shows the results of the study, displaying a 26.4 % difference in the GHGs emitted between the two house types (steel vs. Wood) in scenario 1. Wood emitting less GHGs having a smaller GWPI. This happened again in scenario 2. (concrete vs. Wood) with a 31.0% difference in GHGs emitted (with a smaller GWPI) wood turned out to be the environmentally friendlier option in both cases when the indicator for an environmentally friendly option is the mitigation of GHGs. Houses were built to the same standards, using similar construction materials, and each material accounting for the same mass as it would in its frame type counterpart (i.e. concrete vs. Wood frame). In the cold climate scenario, the wood-framed house had had the following proportions of material (counted by mass); 63 % concrete, 17 % wood, 5 %

roofing, 5 % sheetrock, 5 % insulation, 3 % metal and 2 % siding. For the steel framed house, the proportion of wood dropped to 8.6 % and steel was at 12.6 %, leaving other components roughly the same. (Wilson 2006.)

Both of the studies were conducted in the United States: the “cold climate” house in Minneapolis and the “warm climate” house in Atlanta. While this is only a study about wood frames, this case highlights the significance of some of the environmental benefits wood has to offer as a construction material. (Wilson 2006.)

Gustavsson and Sathre (2011, 130) found that comparing the energy use and CO₂ emissions of the construction of two buildings of equal functions (built with either wood or concrete frames) showed that wood frame buildings use less energy and produce less CO₂ emissions. They found that the energy made available by biomass residues resulting from logging, processing, constructing and demolishing was larger than the energy used to produce the wood buildings in the first place (Gustavsson and Sathre 2011, 135). Another study arrived at the same conclusion, namely that manufacturing wood products for construction requires less total energy (fossil energy in particular) compared to most alternative construction materials. (Sathre and O’Connor 2010.)

Various “Cradle to gate” analyses on material production (Cradle to gate analysis considers the following part of a product’s life cycle; Inception – Product leaving manufacturer); which includes acquiring raw materials, transportation, and processes to turn materials into products ready for use, showed that wood products needed less energy for production compared to equivalent amounts of metals, bricks or concrete. The need for less energy also translates to less embedded costs in energy use, especially since a considerable amount of energy in wood processing is thermal energy used for drying. (Takano 2015, 5). Often wood processing residues are used for this purpose, and according to Sathre and O’Connor (2010): *“the fossil carbon emission from wood product manufacturing is generally much lower than that of non-wood products”*. (Sathre and O’Connor 2010, 110)

Their research focused on the displacement of greenhouse gases in wood product substitution. Carbon storage aside, wood product substitution helps to avoid indus-

trial process emissions which are inherent in cement manufacture due to the chemical reactions (calcination) which happen during the transformation from raw materials to cement. While Sathre and O'Connor (2010) address the carbonation effect of cement products, (Carbonation is a slow reaction occurring over a cement product's life cycle, in which it absorbs some of the CO₂ emissions released previously) which causes some uncertainty as to what the real effect of cement usage is, they suggest that the emissions resulting from calcination overrule the absorption effect of carbonation. (Sathre and O'Connor 2010, 109.)

Forest thinning and harvest activities, as well as wood processing, produce significant amounts of biomass residues, which can be used for bio fuel purposes. At the end of a wood product's service cycle, unless recycled for similar material use, the wood itself can also be used as a combustible residue (i.e. fuel purposes). While this action releases the stored carbon back into the atmosphere, the impacts are noticeably lower than the fossil carbon emissions alternative (such as coal, petroleum, and natural gas). (Sathre and O'Connor 2010, 109)

Long-life products, such as wood products used for construction, also help support long-term carbon dynamics. According to Sathre and O'Connor (2010), the significance of carbon storage on the climate is dependent on the product pool dynamics not the carbon pool itself (Global Climate Cycle 2012). Hence, the size of the wood product pool affects the atmospheric carbon concentration by increasing, decreasing, or stabilizing the total carbon stored. By increasing the usage of wood products or using long-life wood products, the result is short to medium term climate benefits. (Bergman, Ritter, Skog 2011). After the stock of products stabilizes in the long term, benefits include a stable pool of carbon as the stock is balanced by old wood leaving the pool and new wood entering it (Sathre and O'Connor 2010, 111-112).

The EU has put in place tight regulations to lower GHG emissions. They use a progressively tightening cap and trade system called the European Union Emissions Trading System (EU ETS) which sets a limit on countries restricting the amount of GHGs allowed. The limit is set lower over time to drive a significant decrease in the total emissions in the EU. (Climate Action: The European Union Emissions Trading System 2015.)

A cap and trade system involves companies, falling under certain criteria, receiving or buying emission allowances, which they can trade between each other. This is also known as emissions trade (Callan and Thomas 2013, 267). To demonstrate the progressive element of this scheme, the EU states that by 2020 the emissions from the EU ETS covered sectors will be 21 % lower than they were in 2005. It is proposed that in 2030 the emissions would be 43 % lower. The GHGs involved with this scheme are CO₂, Nitrous Oxide (N₂O) and Perfluorocarbons (PFCs). The sectors covered include; steel works and production of iron, metals and cement; all major contributors to traditional construction methods. (*The European Union Emissions Trading System- fact-sheet* 2015.)

Although agriculture, forestry and other land use account for just under one quarter of GHGs globally, according to the Intergovernmental Panel on Climate Change emissions from the forestry sector seem to be declining due to more sustainable forest management practices. (IPCC 2014, 816.) This trend strengthens the argument for the need of more forests and “long age wood products” (which includes wood products used in construction). It shows that forestry is a major concern in meeting GHG emissions reduction targets and combating global warming, and forest management practices should be improved to match consumption rates with replenishment rates. (US Environmental Protection Agency, 2007)

2.3 Attitudes and perceptions regarding wood use

Apparently insignificant factors may have a significant effect on perception. Hughes and Winandy (2007) describe a 1980s case in the UK where peoples' perceptions about the durability of wood were affected by a TV documentary which exposed problems of rot in timber framed housing. After the documentary, there was a substantial decrease of local timber frame housing. Some even described it as leading to the decimation of the timber frame housing industry in the UK.

On the other hand, other factors can have an opposite effect on peoples' perceptions, leading to a boost in particular products and industries. For example, environmental consciousness has been proven to affect perceptions and ultimately consumer preferences. (Heikki, Toppinen & Wang 2014, 350.) Some consumer preferences

can change based on knowledge regarding the environmental impact of various materials (Høibø, Hansen and Nybakk 2015, 1620).

Whilst renters and homeowners generally have very little influence on the building material chosen for a newly created multi-family housing project, such as a high-rise residential building, their opinions are valuable for decision makers when introducing new building systems and opinions. Thus the context in which the material preference is seen, such as in those which have regional traditions with respect to specific building materials is important (Høibø, HaNsen and Nybakk 2015, 1617).

However, attitudes over wood as a construction material are mixed at best. On one hand, perceptions over fire safety and sound insulation are more prominent than factors such as environmental benefits of wood. Others may focus more on the financial risk of constructing wooden buildings, such as uncertainty over demand, which is likely to impact the building industry more broadly. (De La Roche, O'Conner and Tetu 2016.)

There are regional differences in attitudes towards wood construction. According to Gustavsson, Hemström and Mahapatra (2012, 65) in the USA some of the public were concerned about forest products that do not originate from sustainably managed forests. Many companies have used this information to their advantage in advocating non-wood building materials to builders and consumers by claiming that their non-wood products are in fact more environmentally friendly than other wood or wood-related products. In Japan, a significant proportion of the population enjoy living in single family housing built with wood-frames, although generally they had a lesser preference to live in multi-storey buildings built with wood-frames. (Gustavsson, Hemström and Mahapatra 2012, 65)

Hughes and Winandy (2007) mention barriers in wood construction, such as perceived fire performance of engineered wood, institutional barriers, technical barriers, economic barriers and other perception related barriers as in supposed lack of durability.

Gustavsson, Hemström and Mahapatra (2012, 65) refer to a survey of 220 people conducted by the Bavarian Ministry of the Interior (2003) which showed that peo-

ple's perception to wood construction was generally positive as the living quality in wood-framed apartment buildings was considered to be good or very good. Wooden apartments were considered warm, bright, cosy, dry and healthy. People from different backgrounds with respect to ongoing dwelling type considered wood to be environmentally friendly as a construction material, and capable of providing a healthy and comfortable living environment. The perceptions of the environmental friendliness of wood may in part be due to the stringent regulations and legislation the German federal administration has placed on sustainable forest management (i.e. usage of the Programme for the Endorsement of Forest Administration scheme). However, it is important to note from this study that consumers in Germany value housing quality, design, durability and price more than they value environmentally friendliness of a building.

There are other problems relating to increased wood use in construction, for example, entrenched attitudes amongst builders and property developers that the technical and qualitative features of wood are not as sound as non-wood materials. (Gold and Rubik 2009, 312). On top of this, insurance companies in Germany apparently placed wooden buildings in a higher insurance premium class in 2001. (Ibid) This can play a significant role in the perceptions of both builders and final customers of a region. No new evidence could be found that insurance premiums would have changed/or would have remained the same after 14 years. However, in a recent report, Finnish insurance company (IF insurance) stated that it is preparing for a future where wood construction is more prevalent in the Nordic countries. Through modernized construction techniques, their report forecasts an increase in prefabricated housing as well as wooden buildings. (IF oyj 2015)

In respect to perceptions and attitudes regarding cost, there is no conclusive evidence to suggest that the cost of the usage of wood materials in construction is radically different when compared to alternative materials. Some consider the cost of construction to be relative to the methods of construction and time used in the overall process, not the type of material used. For example, Gustavsson, Hemström and Mahapatra (2012, 64) mention a case from 2010 showed where a five-story passive house building (a building which has a reduced ecological footprint) in Berlin built with a standard wood frame was 10 % cheaper than one built using traditional

methods. This was mainly due to the time spent for construction. An alternative initiative by manufacturers from the brick and mortar industry in the 1990s, argued that it was cheaper to build detached or row houses with bricks and mortar than with a wooden frame. (Gustavsson, Hemström and Mahapatra 2012, 64)

In Sweden, multifamily houses (i.e. multi-story buildings) accounted for 54% of the residential building stock in 2000 (Boverket 2006). These types of buildings are being built in increasingly greater numbers compared to single-family houses. Most likely due to strong domestic supply, more than 90 % of single-family houses are wood-framed.

80 % of the tenants of wood-framed buildings who responded to surveys in two Swedish cities, Växjö and Sundsvall between 2006 – 2009 had reported positive attitudes towards living in wooden buildings. (Boverket 2006). A majority of the tenants also thought that safety issues and sound insulation had met their expectations. In 2008, 65 people involved with wood construction held a discussion over the strengths and weaknesses of wood construction in a specific project in the Swedish town of Skellefteå. They found the following strengths in wood construction; a great degree of prefabrication, a flexible construction system, relatively short construction time, environmental friendliness, strong domestic supply of wood resources, and an overall positive attitude towards the use of wood in construction. The weaknesses included; the project economy, sound insulation properties, the sensitiveness of the construction process to external disturbances such as strong wind, lack of competence to build high rise wooden buildings (on a company level), height related technical limitations, and finally the need for various complementary installations to meet special regulations (fire, sound and stability functionality, as well as air-tight conditions). (Walford 2006, 6-13.)

Considering building time, cost and engineering aspects, Swedish architects preferred the choice of concrete as opposed to wood or steel frames due the engineering aspects of the material; i.e. fire safety, stability, acoustics and sound insulation, even though they saw no difference in cost or construction time between concrete and wood framed buildings. (Walford 2006, 10.) In respect to fire, the Finnish company behind the Puukuokka complex, Lakea oy, consider their CLT construction to be

even safer than traditional concrete buildings (Lakea oy 2015).

Residents in the UK are reported to place more emphasis on location, layout, natural light, room sizes, energy efficiency and price, than they do on frame material used for construction. In 2001, a survey of 2 000 UK residents showed that a majority considered concrete framed buildings to have better resale value, durability, acoustic properties and stronger resistance against environmental changes (for example, storms and flooding). (Walford 2006, 209.)

The UK government has now promoted modern methods of construction (MMC) for several years to increase the building of good quality homes in less time (UK Timber Association, 2016). This mostly involves wood framed constructions produced in a factory and assembled on-site, such as the method used by Stora Enso, called prefabricated modular construction (Stora Enso 2015). The UK National Audit Office had compared traditional on-site masonry with MMC methods and found that the building performance of the MMC is at least as good as a building built with traditional techniques, contrary to public perception (UK Timber Association, 2016). Adding to this, the on-site labour requirement is reported as being reduced to a quarter of its size and on-site construction time reduced by more than 50 %. While the requirements for on-site labour and construction time are significantly lower, the overall costs were considered marginally higher for MMC compared to on-site masonry construction. However, the compliance costs for high-rise building regulations are considered to increase faster for brick and block construction than MMC. It is important to note however, that the overall cost ranges while comparable, are dependent on project specific circumstances. (Gustavsson, Hemström and Mahapatra 2012, 68.)

3 Theoretical Framework

The objective of this study is to identify perceptions and attitudes of end users towards wood as a primary construction material. It seeks to gain a sense of current Finnish-based consumer behaviour towards decisions on purchasing or otherwise living in residential properties, specifically in the context of wood construction.

Understanding how end users perceive the use of wood in construction provides an

interesting insight into the future of the re-emergence of wood as a primary construction material.

Attitudes and perceptions of people matter in studies that involve an element of innovation, such as finding new ways to create established products. According to Armstrong, Kotler, Saunders and Wong (2008, 258-259) the characteristics affecting consumer behaviour can be divided into four factors; cultural, social, personal and psychological. "Attitudes" and "perceptions", in the marketing context all belong to the psychological factors of consumer behaviour.

Armstrong, Kotler, Saunders and Wong (2008, 258-259) define perceptions as a process with which people select, organize and interpret information in order to form a meaningful understanding of the surrounding world. People perceive through their sight, hearing, smell, touch and taste. These authors describe perception in terms of three different perceptual processes, which they suggest to be the cause behind the differences in how different people perceive the same stimuli. These processes are;

- selective attention
(the tendency of people to screen out most of the information they are exposed to)
- selective distortion
(the tendency to fit incoming information into existing mindsets)
- and selective retention
(the tendency of retaining information which supports people's attitudes and beliefs)

They describe "Attitudes" (2008, 260), in relation to people's favourable or unfavourable evaluations, feelings and tendencies regarding an object or idea. They suggest that attitudes guide people's opinions by placing themselves into a frame of mind of liking or disliking things, and that since attitudes often fit into a pattern, they are difficult to change. Therefore, to alter one attitude may require altering others at the same time.

In their study on perceptions and attitudes, Gold and Rubik (2009) hypothesised that;

people give low ratings for fire resistance, longevity and stability on timber frame houses. So called soft factors, (wellbeing, aesthetics and eco-friendliness) would be rated high. However, consumers did not consider soft criteria as decisive for the choice of a particular construction mode. (Gold, S. and F. Rubik (2009.)). Gold and Rubik also mentioned that it had become obvious that the buying decision was a multi-dimensional process impacted by multiple different factors. It became clear that consumers are concerned about the durability, stability and acoustic insulation of wooden frames.

Adapted from Gold's & Rubik's questionnaire (2009), specific attributes which are considered to have an influence on consumer decision making, were chosen to build a theoretical framework. These include the following; eco-friendliness, health, durability and long-lasting, modern, a secure investment natural, cozy and comfortable living space, fire resistance, easy to maintain, good acoustics and supporting sustainability.

These factors will act as a base for perceptions and attitudes in terms of attributes in buildings, thus creating structure for the questionnaire when asking about people's preferences, and how they view wood as a construction material.

Therefore, in order to cover both attitudes and perceptions, the questions need to be set in the context of the following framework;

- 1) how people view these attributes in wood within the construction context and how they perceive different types of wooden buildings*
- 2) how people feel about these attributes, what is most important for them and what is their willingness to live in different types of wood constructed buildings*

The actual framework for this study is depicted in figure 3.1.

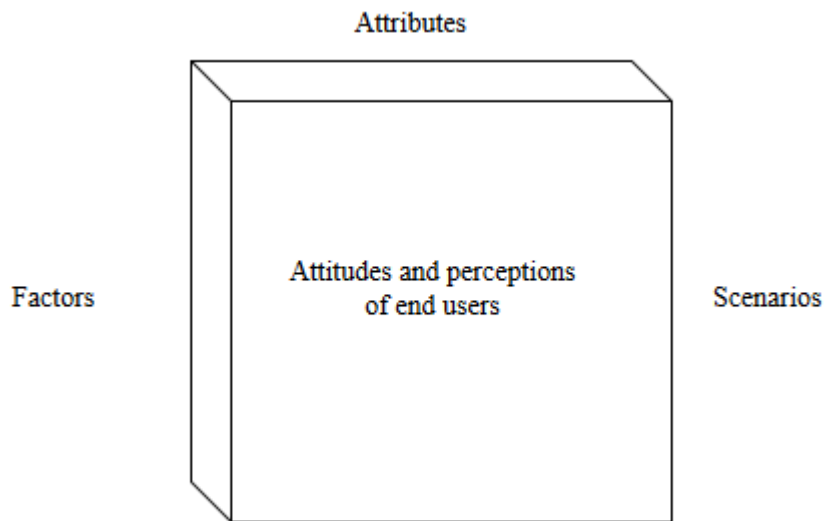


Figure 3.1. Established context and frame work

The established frame work and context for this study is depicted in Figure 3.1. On top of the above mentioned attributes, also seen in figure 3.1, factors are narrowed down to the different age groups of the respondents and the influence of the communications on their opinions, termed in this study “external influence”; specifically news or research reports they may or may not have been subject to and influenced by over the past ten years. Scenarios depict the different types of housing; low-rise residences (1-3 storeys), high-rise residences (4-8 storeys) and recreational low-rise properties. These are elaborated and differentiated as either wood constructed or concrete, brick and/or steel constructed buildings, in order to benchmark attitudes more precisely.

4 Methodology

Creswell, Gutmann, Hanson and Plano (2003, 209) describe a quantitative study as an inquiry into a social or human problem based on testing a theory made up of variables, measured with numbers, and analyzed with statistical procedures with the aim of confirming whether or not predictive generalizations hold true within the theory. Lewis, Saunders and Thornhill (2012, 162) describe data based on opinions as so called qualitative numbers.

This is a cross-sectional quantitative study, using the deductive approach. A cross-sectional study, according to Lewis, Saunders and Thornhill (2012, 190) is relatively

common especially in the academic context. The reason why a deductive approach was chosen rather than inductive, which is commonly used when studying opinions, is that the extent of previous surveys found in the same area, made it easier to narrow down the topic to a specific context, and adapt parts of these surveys. The Bavarian Ministry of the interior (2003), Gold and Rubik (2009) and Walford (2006) all found benefits for using the survey strategy to study perceptions and attitudes towards wood use.

4.1 Research design and strategy

Despite research on opinions being usually conducted using an inductive approach with qualitative methods, in this thesis a deductive approach was chosen due to the secondary data gathered showing existing framework and research on people's perceptions and attitudes. Lewis, Saunders and Thornhill (2012, 176) suggest that a deductive approach using the survey strategy is commonly used for exploratory and descriptive research, and to answer questions such as "what", "who", "where", "how much" and "how many". They consider the use of questionnaires to be beneficial when undertaking attitude and opinion studies, specifically in descriptive or explanatory research. (Lewis, Saunders and Thornhill 2012, 419).

The decision to use a survey method was based on the fact that it allowed for the collection of quantitative data and the analysis of this data using descriptive and inferential statistics (Lewis, Saunders and Thornhill 2012, 177). An adapted semi-structured questionnaire was designed to collect the primary data. Lewis, Saunders and Thornhill (2012, 171) suggest that researchers should be wary of relying merely on descriptive research, as it leaves little room for inference. Hence this research, whilst descriptive for some parts, leads through the research questions and sub questions to an explanation. These studies are also referred to as descripto-explanatory studies. (Lewis, Saunders and Thornhill 2012, 171.) Figure 4.1 depicts the research design chosen for this thesis.

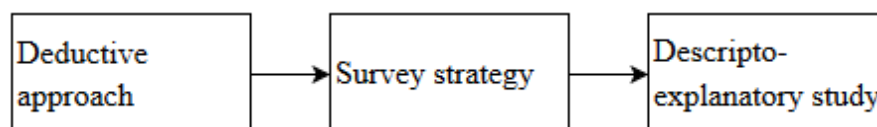


Figure 4.1 Research design

The sampling technique used for this study was a non-probability sample using volunteer sampling. Even though this technique is regarded as having low abilities to generalize and produce representative data, the self-selection sample was used intentionally in order to attract as many respondents as possible who felt strongly about the topic. (Lewis, Saunders and Thornhill 2012, 284) Using volunteer sampling also helped counter the challenge of limited access to respondents, resources and time, which often is the case when having to use non-probability sampling, Saunders, wis, Saunders and Thornhill (ibid) suggest.

Figure 4.2 depicts the sampling technique used in this study.

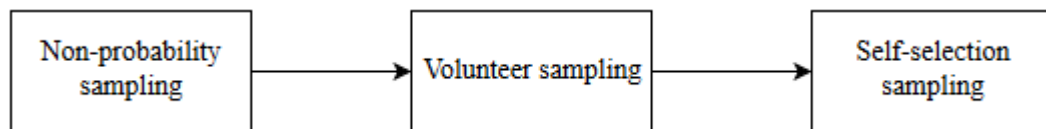


Figure 4.2 Sampling technique

After designing the questionnaire, it was distributed to potential respondents via email lists, an organizational intranet and posted on the social media channel Facebook to reach as many people as possible. There are many advantages to using social media channels in collecting data, specifically when using volunteer sampling. Social media represents a goldmine for the purpose of supplementing data. (Procter and Halfpenny 2015, 86) The topic of the research was presented through these channels, and the purpose of the study was clearly explained after which people were invited to take part voluntarily in this survey. Participants were required to allocate approximately 10 minutes to complete the survey, which would suggest that the participants had some level of interest towards the topic as they invested a reasonable amount of time for this study.

4.2 Designing and implementing the questionnaire

The questionnaire implemented was a semi-structured questionnaire (appendix 1). Ornstein (2013, 8) referred to Cantril and Fried's perception in 1944 regarding open questions, as having both advantages and disadvantages:

A major advantage of the open-ended or free-answer question is obviously its ability to record opinion which is catalogued to the minimum degree by the investigator. When issue has become fairly clear cut, however, or where common sense and experience have shown that meaningful alternatives can be posed, there is little advantage to an open-ended question from the point of view of reporting precise trends, keeping costs down, and avoiding bias in the coding of answers for statistical treatment.

The questionnaire was adapted from multiple different questionnaires; Gold and Rubik (2009) had listed attributes which embraced "the most essentially perceived characteristics of this material". These characteristics were adapted into the questionnaire (refer to appendix 1).

The questionnaire was a self-completed questionnaire (appendix 1) which had 25 questions divided into three areas; background questions (1-7), questions on attitude (8-9 and 11) and questions on perception (10 and 12-21). The last section included two questions asking whether the respondents had read or seen news or reports closely relating to the topic, which may have had an influence on their opinions. These questions were used to answer the second research question's sub question. The last two questions were optional open-ended questions; Question 24. asked if the respondents had anything to add to their answers and Question 25. was a text field for submitting an email address in case the respondent would like to receive a summary of the results, which is delivered after the data is analyzed. There was only one open-ended question in the end of the questionnaire. The fact that one open-ended question was used was based on the decision to mainly use multiple choice questions as these facilitated the respondents to keep to the framework of the survey. Respondents were allowed to answer the open-ended question freely, and it was enough to record in-depth insights that complimented the multiple choice answers and added value to the survey (Ornstein 2013, 8) and Lewis, Saunders and Thornhill 2012, 422).

4.3 Data analysis

Once the data had been collected, it was processed and downloaded onto the statistical analysis software called SPSS. There are many benefits to using SPSS in analyzing quantitative data, some consider it to be superior to i.e. Excel (Oakshott 2006, Preface to the 3rd edition).

First the data was analyzed using descriptive statistics, and the results were presented as such. After this, Pearson's product moment correlation coefficient was used to assess the strength of the relationship between a chosen set of variable pairs, mainly the relationship between age and both willingness to live in wood constructed buildings and their perceptions on wood's suitability as a construction material in high-rise residential buildings. The correlation coefficient was used to answer the sub-questions of both research questions (Oakshott 2006, 284).

5 Results

All in all 121 respondents took part in this questionnaire, 119 of which were chosen as valid to answer the research questions. Two respondents were left out because they reported living outside of Finland, leaving them out of the area of this research focus. Out of the 119 respondents; 64 were female and 55 male, this represents roughly 54% and 46% of all respondents (percentages are rounded, please refer to figure 5.1. for more accurate percentages).

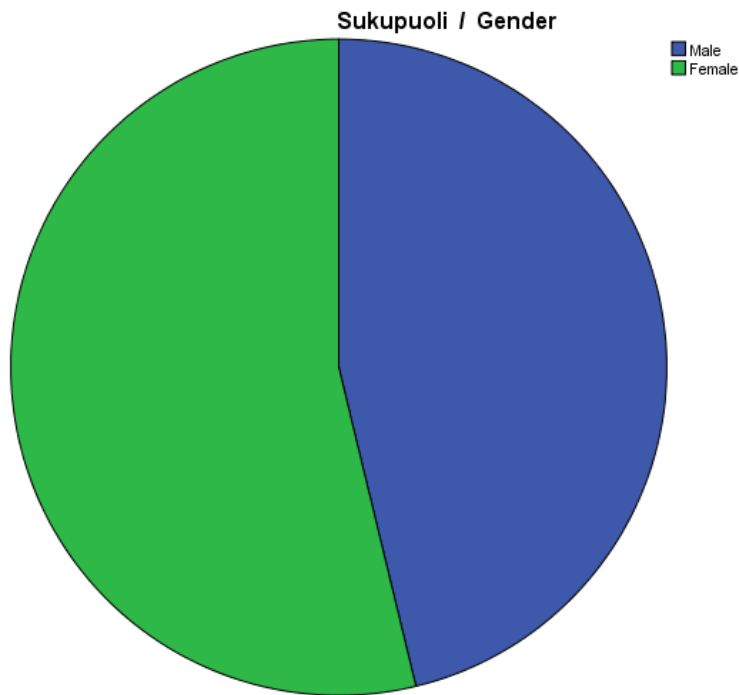


Figure 5.1. Gender of the respondents; 53.8 % female, 46.2 % male.

The respondents had divided into age categories the following way; 63 respondents were between 20-30 years, 27 were between 31-40 years, 9 were between 41–50 years, 14 were between 51- 60 and 6 respondents were over 61. This is represented in figure 5.2.

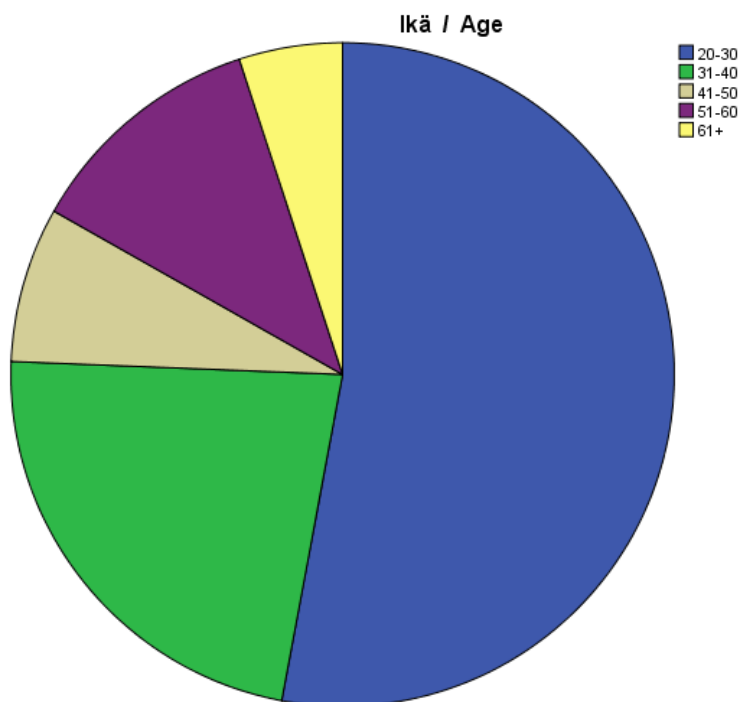


Figure 5.2. Age of the respondents; 59.2 % of the respondents were between 20-30 years old, 22.7% were between 31-40 years, 7.6% were between 41-50 years, 11.8% were between 51-60 years and 5 % were over 61 years.

A high majority of the respondents have a higher education background; 82 respondents reported having completed a degree/or other equivalent in higher education, 25 respondents reported having completed high school, 11 reported having a vocational qualification and one respondent had completed compulsory school education (figure 5.3).

Regarding the living situation of the respondents; 60 respondents reported living in a rented apartment in a high rise residential building, one respondent currently rents a semi-detached/ row house type apartment. Out of the owned apartments; 11 lived in an apartment in a high rise residential building, 12 lived in a semi-detached/row house type apartment and 32 lived in a detached house. 3 reported their living situation as other (figure 5.4).

A clear majority reported as not living in wood-framed buildings; only 28 respondents lived in wood-framed buildings, 89 didn't which amounts to a total of 117 answers. Two respondents skipped the question, as they were instructed to do so in the case they did not know the building material used in their residence, resulting in missing data (see figure 5.5).

Asutko tällä hetkellä puurakenteisessa asuinrakennuksessa? (Voit jättää vastaamatta, jos et ole varma asuntosi rakennusmateriaalista) / Do you currently live in a wood-framed residential building? (Please skip this question if you're unsure of the building material used)

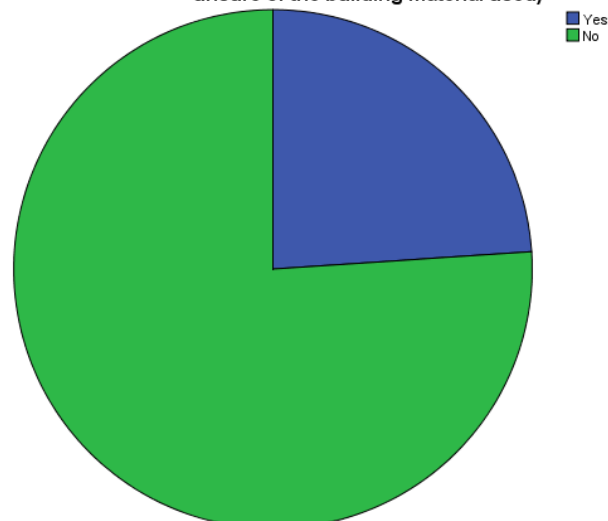


Figure 5.5. Respondents asked if whether they live in a wood-framed residential building; 23.5% reported living in wood-framed residences, 74.8% reported not living in wood-framed residences, 1.7% skipped the question (as instructed, if unsure of the building material used in their residence). This resulted in missing data.

5.1 Attitudes

Measuring attitudes, the respondents were first asked about their willingness to live in different types of residential buildings. The buildings were differentiated by 1) the construction material used and 2) the type of building (height specified in brackets; low-rise between 1 -3 stories and high-rise between 4-8 stories). After this the respondents were asked to rank specific attributes between the most important (1) to least important (10) regarding the purchasing or building of a new home. The attributes listed were; environmental friendliness, aesthetically pleasing, healthiness (allergies, room air quality), durability and long-lasting, modern, cozy and comfortable living space, fire-resistance, easy maintenance and good acoustics.

When asked whether the respondents would be willing to live in a wood constructed low-rise residence (i.e. a detached house, between 1-3 storeys); 103 respondents displayed willingness to live in a wood constructed low-rise residence, 13 would tentatively want to live in a wooden building and three were unwilling (figure 5.6).

Olisitko halukas asumaan puusta rakennetussa: / Would you be willing to live in a wood constructed: Omakotitalossa tai matalassa asuinrakennuksessa (1-3 kerrosta) / Detached or low-rise residential building (1-3 storeys)

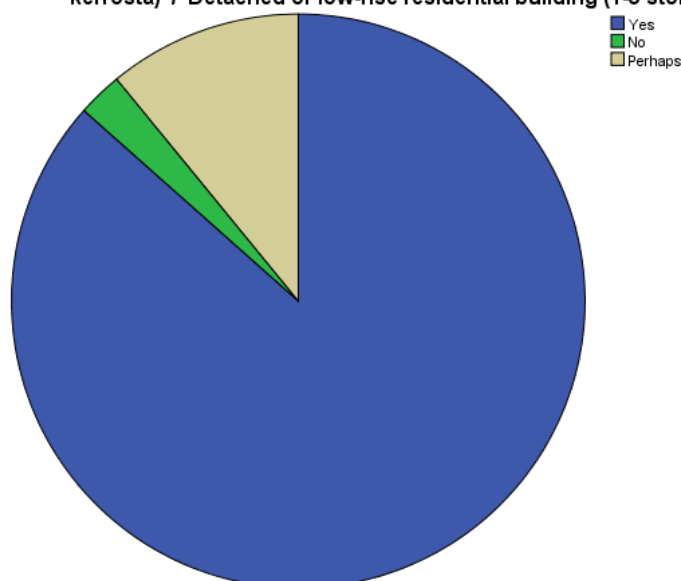


Figure 5.6. Willingness to live in a wood constructed low-rise residential building (1-3 storeys); 86.6% displayed willingness, 10.9% showed tentative willingness and 2.5 % were unwilling to live in a low-rise residence made of wood.

When asked about willingness to live in a concrete brick and/or steel built low-rise residential building; 66 respondents showed willingness, 33 displayed tentative willingness and 20 showed unwillingness to live in a low-rise concrete, brick and/or steel constructed residential building (refer to figure 5.7).

Olisitko halukas asumaan betonista, tiilestä ja/tai teräksestä rakennetussa: /
 Would you be willing to live in a concrete, brick and/or steel constructed:
 Omakotitalossa tai matalassa asuinrakennuksessa (1-3 kerrosta) / Detached or
 low-rise residential building (1-3 storeys)

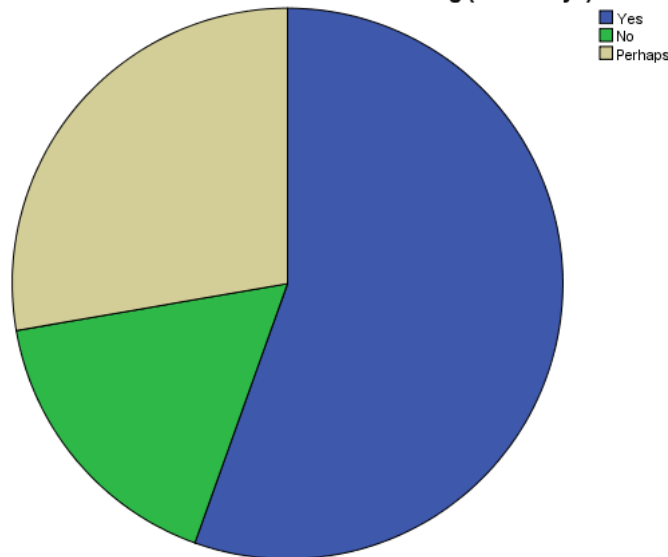


Figure 5.7. Willingness to live in a concrete, brick and/or steel constructed low-rise residential building (1-3 storeys); 55.5 % showed willingness, 27.7 % showed tentative willingness and 16.8 % showed unwillingness to live in a concrete, brick and/or steel constructed residential building.

When referring to high-rise residential buildings made of wood (categorized in this questionnaire as a building between 4-8 storeys); 51 respondents displayed willingness, 42 displayed tentative willingness and 26 displayed unwillingness to live in a wood constructed high-rise residential building (please refer to figure 5.8).

Olisitko halukas asumaan puusta rakennetussa: / Would you be willing to live in a wood constructed: Korkeassa kerrostalossa (4-8 kerrosta) / High-rise residential building (4-8 storeys)

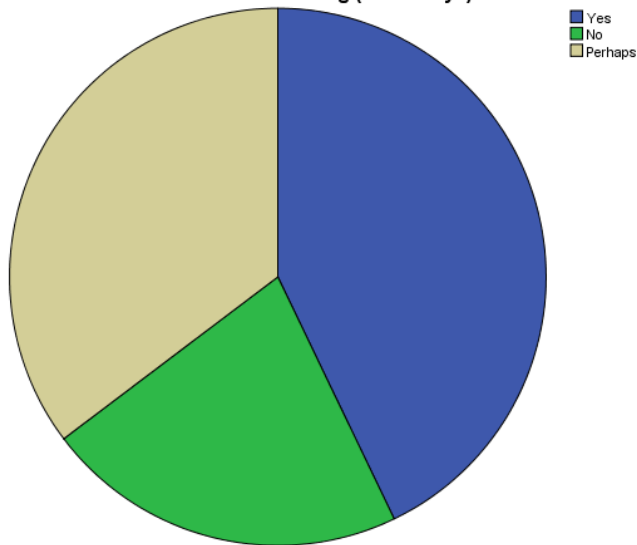


Figure 5.8. Willingness to live in a wood constructed high-rise residential building (4-8 storeys); 42.9 % displayed willingness, 35.3 % showed tentative willingness and 21.8 % showed unwillingness to live in a wood constructed high-rise residential building.

With high-rise residential buildings made of concrete, brick and/or steel; 62 respondents displayed willingness, 41 showed tentative willingness and 16 showed unwillingness to live in these types of residential buildings (see figure 5.9).

Olisitko halukas asumaan betonista, tiilestä ja/tai teräksestä rakennetussa: / Would you be willing to live in a concrete, brick and/or steel constructed: Korkeassa kerrostalossa (4-8 kerrosta) / High-rise residential building (4-8 storeys)

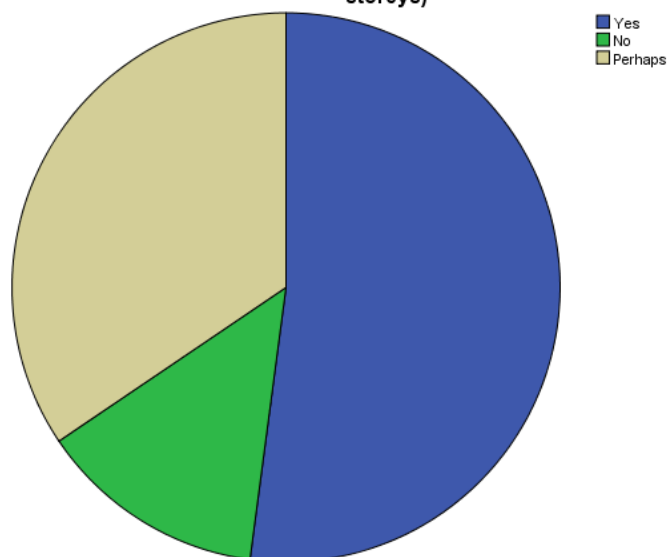


Figure 5.9. Willingness to live in a concrete, brick and/or steel constructed high-rise residential building (4-8 storeys); 52.1 % displayed willingness, 34.5 % displayed ten-

tative willingness and 13.4 % showed unwillingness to live in these types of residences.

When asked to rank the environmental friendliness attribute; 34 respondents ranked environmental friendliness between 1-3, 33 respondents ranked it between 4 – 6, and 40 respondents ranked environmental friendliness between 7 – 10 (see figure 5.10 for more accurate percentages)

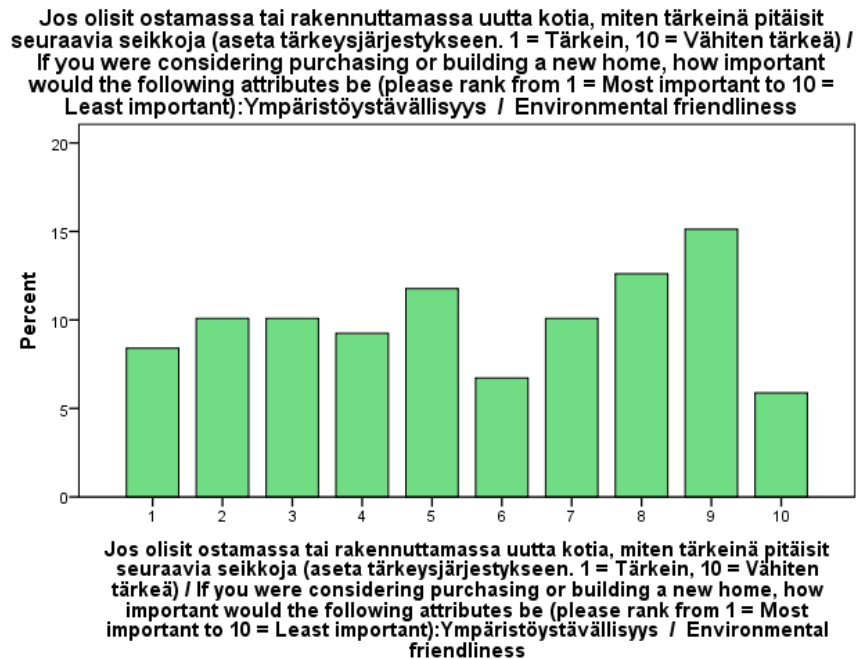
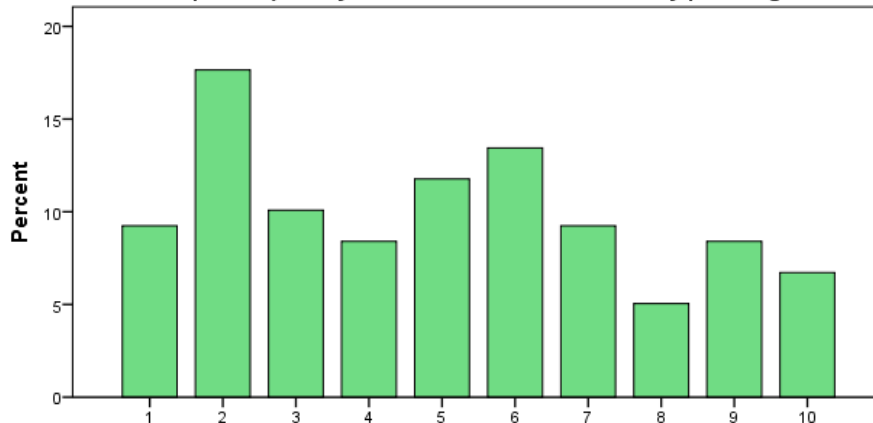


Figure 5.10. Ranking environmental friendliness; 28.6 % ranked environmental friendliness within 1-3 in importance, 27.7 % ranked between 4-6 and 43.7 % ranked between 7 – 10.

When asked to rank aesthetically pleasing as an attribute; 44 respondents ranked it between 1 -3, 40 respondents ranked it between 4-6 and 35 respondents ranked it between 7-10 (figure 5.11).

Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (asetta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important):Miellyttävä ulkonäkö / Aesthetically pleasing

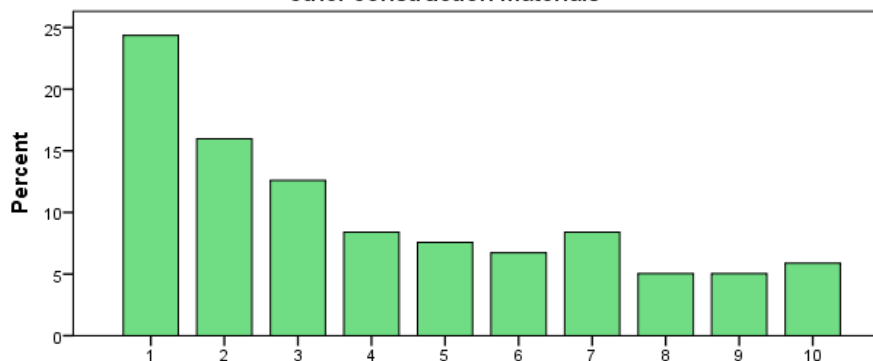


Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (asetta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important):Terveellisyys (allergiat, huoneilman laatu) verrattuna muihin rakennusmateriaaleihin / Healthiness (allergies, room air quality) compared to other construction materials

Figure 5.11. Ranking 'aesthetically pleasing'; 37 % ranked within 1-3 in importance, 33.6 % ranked between 4-6 and 29.4 % ranked between 7 – 10.

When asked to rank healthiness; 63 respondents ranked it between 1-3, 27 ranked between 4-6, 29 ranked between 7-10 (figure 5.12)

Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (asetta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important):Terveellisyys (allergiat, huoneilman laatu) verrattuna muihin rakennusmateriaaleihin / Healthiness (allergies, room air quality) compared to other construction materials



Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (asetta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important):Terveellisyys (allergiat, huoneilman laatu) verrattuna muihin rakennusmateriaaleihin / Healthiness (allergies, room air quality) compared to other construction materials

Figure 5.12. Ranking Healthiness; 52.9 % ranked it 1-3 in importance, 31.1 % ranked between 4-6 and 16 % ranked it between 7 – 10.

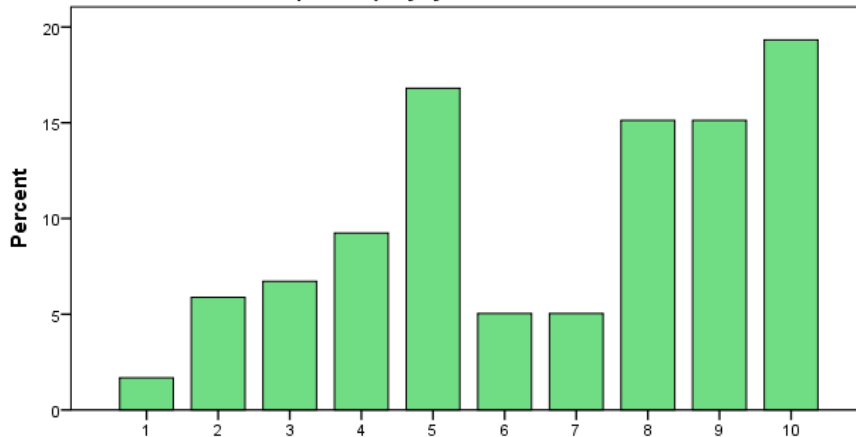
When asked to rank durability and long-lasting attributes; 52 respondents ranked them between 1-3, 37 ranked them between 4-6 and 30 respondents ranked them between 7-10 (refer to figure 5.13).



Figure 5.13 Ranking durability and long-lasting; 43.7 % ranked them between 1-3 in importance, 31.1 % ranked them between 4-6 and 25.2 % ranked it between 7 – 10.

When asked to rank modernity; 17 respondents ranked it between 1-3, 37 ranked it between 4-6 and 65 respondents ranked it between 7 – 10 (figure 5.14).

Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Nykyaikaisuus / Modern

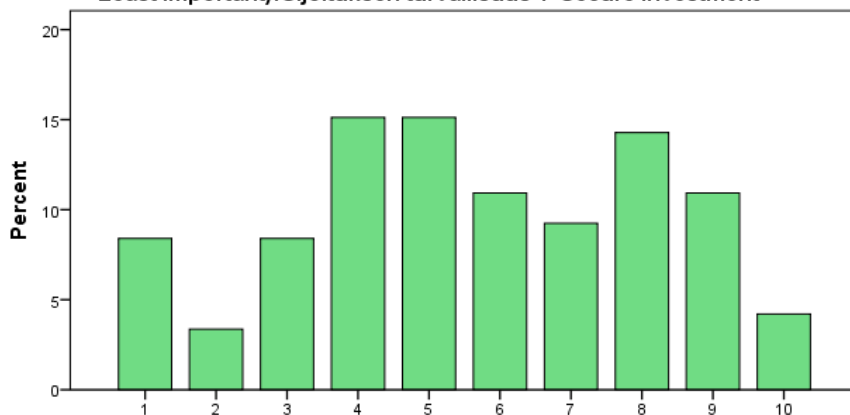


Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Nykyaikaisuus / Modern

Figure 5.14. Ranking modernity; 14.3 % ranked it between 1-3 in importance, 31.1 % ranked it between 4-6 and 54.6 % ranked it between 7 – 10.

When asked about secure investment as an attribute; 24 respondents ranked it between 1-3, 49 respondents ranked it between 4-6 and 46 respondents ranked it between 7-10 (figure 5.15).

Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Sijoituksen turvallisuus / Secure investment



Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Sijoituksen turvallisuus / Secure investment

Figure 5.15. Ranking secure investment; 20.2 % ranked it between 1-3 in importance, 41.1 % ranked it between 4-6 and 38.7 % ranked it between 7 – 10.

When asked to rank the cozy and comfortable living space attribute; 46 ranked it between 1-3, 45 ranked it between 4-6 and 28 respondents ranked it between 7-10 in importance (refer to figure 5.16).

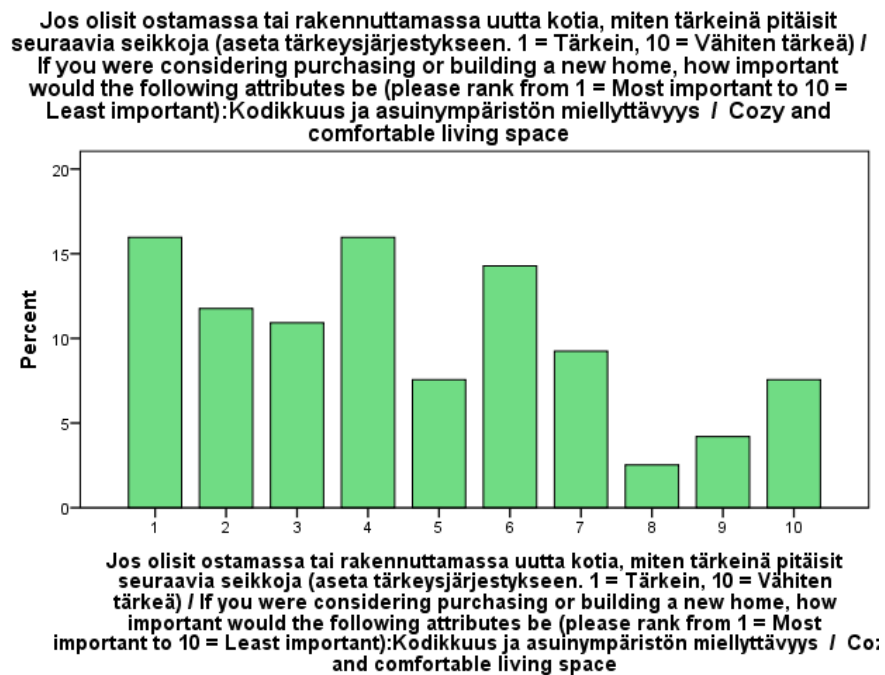
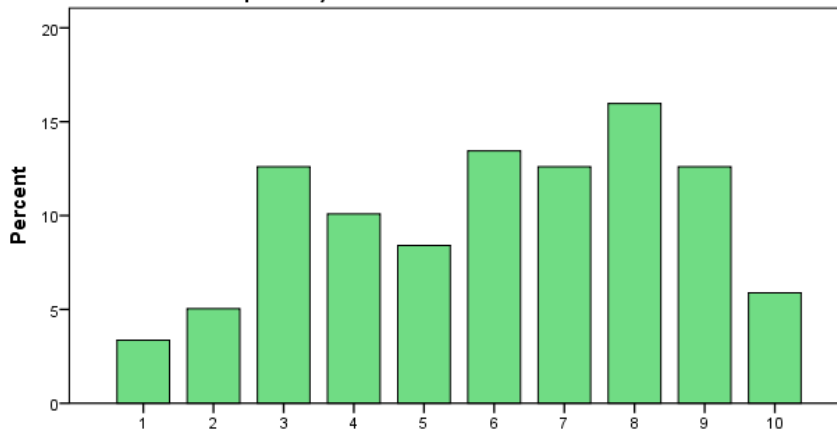


Figure 5.16 Ranking cozy and comfortable living space; 38.7 % ranked it between 1-3 in importance, 37.8 % ranked it between 4-6 and 23.5 % ranked it between 7 – 10.

When asked to rank fire resistance; 25 respondents ranked it from 1-3, 38 ranked it between 4-6 and 56 ranked it between 7-10 (figure 5.17).

Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Paloturvallisuus / Fire resistance

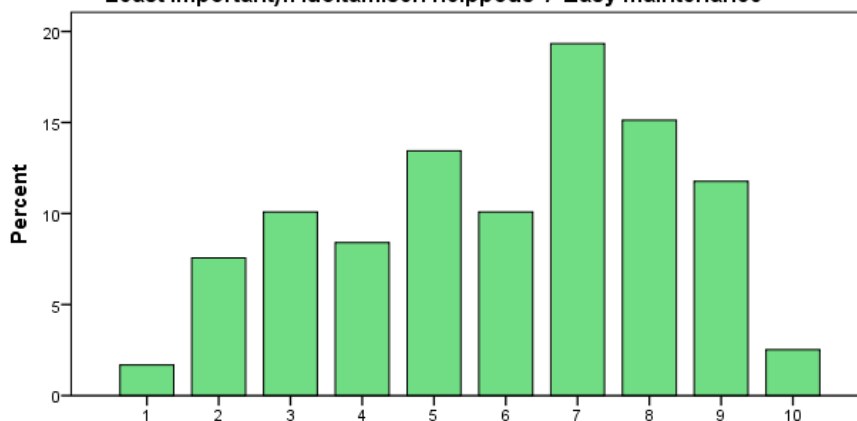


Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Paloturvallisuus / Fire resistance

Figure 5.17 Ranking fire resistance; 21 % ranked it between 1-3 in importance, 31.9 % ranked it between 4-6 and 47.1 % ranked it between 7 – 10.

When the respondents were asked to rank easy maintenance; 23 respondents ranked it from 1-3, 38 respondents ranked it between 4-6 and 58 respondents ranked it between 7-8 (figure 5.18).

Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Huoltamisen helppous / Easy maintenance



Jos olisit ostamassa tai rakennuttamassa uutta kotia, miten tärkeinä pitäisit seuraavia seikkoja (aseta tärkeysjärjestykseen. 1 = Tärkein, 10 = Vähiten tärkeä) / If you were considering purchasing or building a new home, how important would the following attributes be (please rank from 1 = Most important to 10 = Least important): Huoltamisen helppous / Easy maintenance

Figure 5.18 Ranking easy maintenance; 19.3 % ranked it between 1-3 in importance, 32 % ranked it between 4-6 and 48.7 % ranked it between 7 – 10.

When ranking good acoustics; 29 respondents ranked it between 1-3 in importance, 13 ranked it between 4-6 and 77 respondents ranked it between 7-10 (figure 5.19)

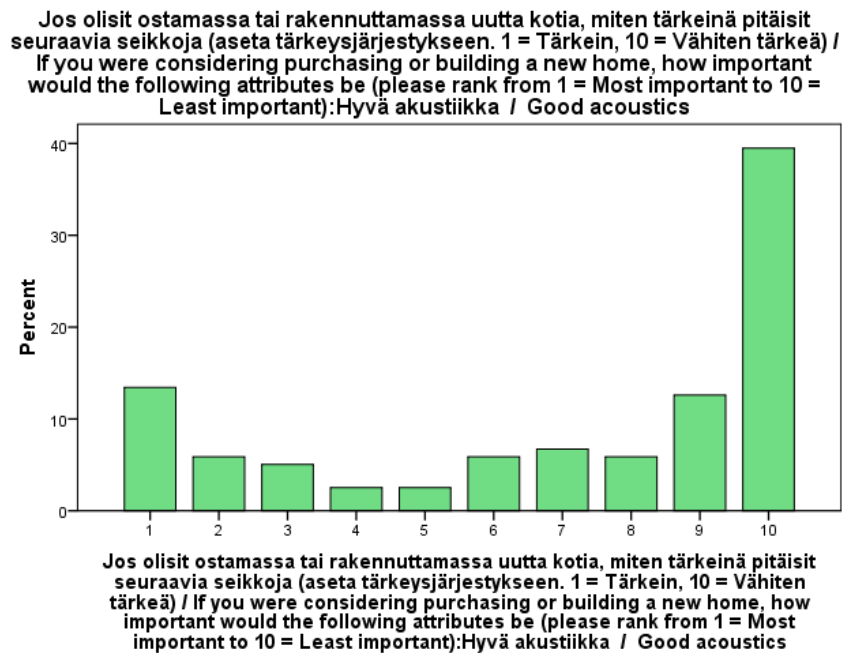


Figure 5.19 Ranking good acoustics; 24.4 % ranked it between 1-3 in importance, 10.9 % ranked it between 4-6 and 64.7 % ranked it between 7 – 10.

5.2 Perceptions

A series of statements were given for the respondents to measure their perception on wood compared to other commonly used construction materials. The statement was as follows; To what extent do you agree with the following statements; “Compared to other construction materials (concrete, brick or steel), wood as a construction material is; Environmentally friendly, Beautiful, Healthy (considering e.g. indoor air quality, allergies), Durable and long-lasting, Modern, a Secure investment, Natural, a Cozy and comfortable living space, Fire resistant, Easy to maintain and Provides good acoustics.” The answer alternatives given were; I agree fully, I somewhat agree, I somewhat disagree and I fully disagree.

After this the respondents were asked about their perception on wood's suitability as a construction material in different cases and different qualities relating to wood use in construction. When reviewing the respondents perceptions on wood's suitability as a construction material in different cases, the different cases were presented in identical statements [*i.e. Wood is a suitable construction material for low-rise residential buildings (1-3 storeys)*]. The different qualities relating to wood use in construction were presented in the following way; wood enables more environmentally friendly construction compared to other materials (i.e. concrete), the more environmentally friendly a construction is the more expensive it becomes, wood constructed buildings have good acoustics and sound insulation, wood constructed buildings have good indoor air quality, a wooden building is a more healthier living environment than others i.e. a concrete buildings, wood use in construction causes less negative environmental impact than other materials i.e. concrete, brick or steel and finally people living in wooden buildings feel close to nature. Each question required an answer, having the full 119 respondents answering each statement provided.

In the statement regarding environmental friendliness (concrete, brick or steel); 83 perceived wood to be more environmentally friendly, 34 agreed to some degree and two respondents disagreed to some degree. None of the respondents fully disagreed with this statement (see figure 5.20).

With regards to appearance and beauty; 95 respondents perceived wood as a beautiful construction material, 22 somewhat agreed, and two somewhat disagreed with this statement. Again none of the respondents strongly disagreed with this statement (refer to figure 5.21).

With regards to health (e.g. with indoor air quality and allergies); 76 respondents perceived wood as a healthy option, 38 agreed to some extent and 5 disagreed to some extent. None of the respondents fully disagreed with this statement (see figure 5.22).

When discussing wood as durable and long-lasting; 38 perceived wood as durable and long-lasting, 57 agreed to some extent and 24 disagreed to some extent with this statement. Again none disagreed fully with this statement (figure 5.23).

In the statement: “wood as a construction material is: Modern”; 44 respondents agreed with the statement, 50 agreed to some extent, 23 disagreed to some extent and two respondents fully disagreed with this statement (refer to figure 5.24).

With regards to wood as a secure investment; only 25 fully agreed, 63 agreed to some extent, 27 disagreed to some extent and four respondents fully disagreed with this statement (see figure 5.25).

With regards to wood being a natural construction material; 107 respondents perceived wood as natural with 12 respondents agreeing to some extent. None of the respondents disagreed with this statement (refer to figure 5.26).

Regarding wood in the context of cozy and comfortable living space; 93 respondents perceived wood as a construction material to provide a cozy and comfortable living space, 26 respondents agreed to some extent and none of the respondents disagreed (figure 5.27).

With the statement regarding fire resistance; 13 respondents perceived wood as fire resistant, 37 agreed to some extent, 52 disagreed to some extent and 17 respondents fully disagreed with this statement (figure 5.28).

In the context of easy maintenance; 14 respondents perceived wood as easy to maintain, 59 agreed to some extent, 43 disagreed to some extent and three respondents fully disagreed with this statement (figure 5.29).

With regards to wood providing good acoustics; 46 respondents agreed fully, 67 agreed to some extent and six respondents disagreed to some extent. None of the respondents fully disagreed with this statement (figure 5.30).

With reviewing wood in the context of supporting sustainability; 70 respondents perceived wood as supporting sustainability, 42 agreed to some extent, six disagreed to some extent and one fully disagreed with this statement (figure 5.31).

The respondents were then asked to review wood’s suitability as a construction material. In the case of low-rise recreational properties (i.e. summer cottages); 95.8 % viewed wood as suitable and 4.2 % agreed to some extent (table 5.1). With low-rise

residential buildings (1-3 storeys); 84 % viewed it suitable with 15.1 % agreeing to some extent and 0.8 % disagreeing to some extent (table 5.2). Regarding high-rise residential buildings (4-8 storeys); 23.5 % viewed wood as a suitable construction material with 46.2 % agreeing to some extent, 24.4 % disagreeing to some extent and 5.9 % perceived it unsuitable (table 5.3).

When the respondents were asked about their perceptions on different qualities relating to wood use in construction, 46.2 % of the respondents perceived wood to be more environmentally friendly in construction than other materials (i.e. concrete), 50.4 % agreed to some extent and 3.4 % disagreed to some extent (table 5.4). With wood constructed residential buildings having good acoustics and sound insulation; 14.3 % of the respondents fully agreed, 72.3 % agreed to some extent and 13.4 % disagreed to some extent (table 5.5). With regards to indoor air quality; 29.4 % perceived wood constructed residential buildings to have good indoor air quality, 65.4 % agreed to some extent, 4.2 % disagreed to some extent and 0.8 % fully disagreed (table 5.6). With the statement regarding wood buildings being healthier living environments than others i.e. concrete buildings; 26.9 % fully agreed with the statement, 58.8 % agreed to some extent with 14.3 % of the respondents disagreeing to some extent (table 5.7). When asked about the negative environmental impacts of wood compared to brick, concrete or steel; 36.1 % perceived wood as causing less negative environmental impacts than the usage of brick concrete or steel, 56.3 % agreed to some extent, 6.7 % disagreed to some extent and 0.8 % fully disagreed (table 5.8). With regards to people feeling close to nature; 32.8 % of the respondents fully agreed, 54.6 % agreed to some extent, 10.9 % disagreed to some extent and 1.7 % fully disagreed (table 5.9).

An embedded generic question was asked in order to highlight the respondents' perceptions towards environmental friendly construction and cost in general. The statement given was: *the more environmentally-friendly a construction, the more expensive it becomes*. 8.4 % of the respondents fully agreed with this statement, 45.4 % agreed to some extent, 37.8 % disagreed to some extent with another 8.4 % fully disagreeing with this statement. With only a cumulative 53.8 % agreeing with this statement and 46.2 % disagreeing, demonstrates the high variance in the respond-

ents perceptions regarding additional costs tied with environmental friendly construction (table 5.10).

5.3 Communications and information influence

In order to map out influence respondents may or may not have been subject to prior to this questionnaire, two further questions were asked before the open-ended question and submitting the questionnaire;

1) Have you seen or read any news or research reports on the use of wood in construction (over the past 10 years)?

2) If yes, has the information influenced your opinions on wood use in residential construction?

With question 1; 68.1 % had seen or read news or research reports over the past 10 years, 13.4 % answered maybe and 18.5 % had not (figure 5.10). From those who had; 57.1 % were influenced positively with 16 % reporting no effect (figure 5.11).

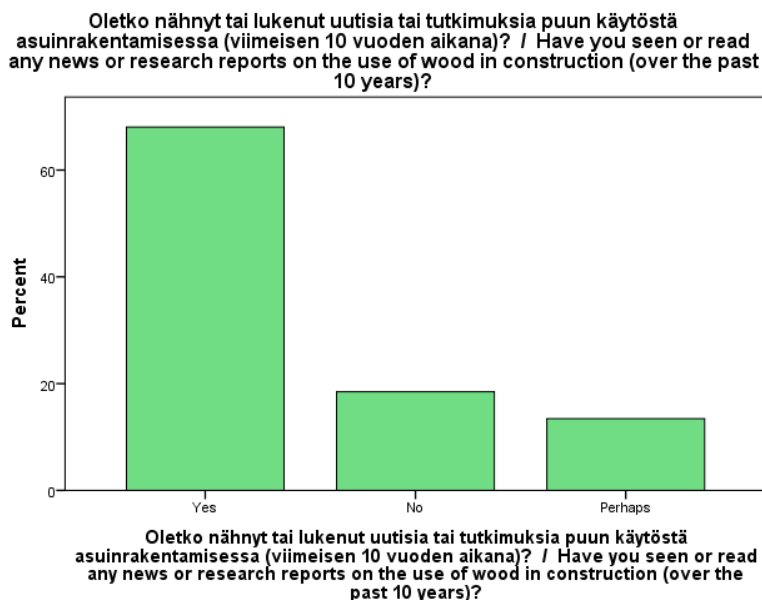
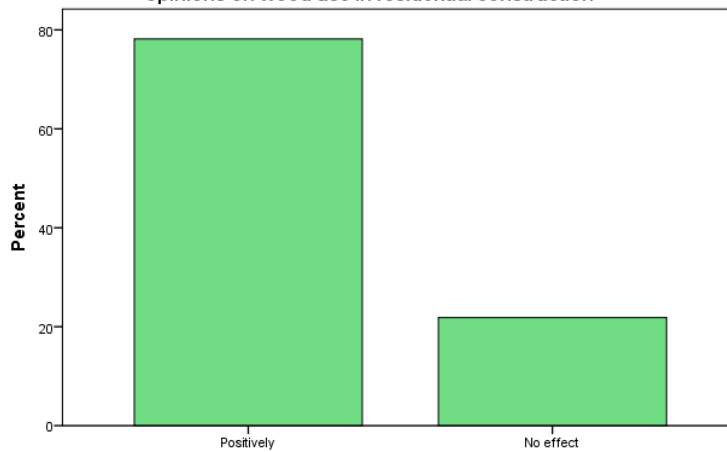


Figure 5.10. Respondents subjected to news and/or media reports on the use of wood in construction (over the past 10 years).

Jos vastasit edelliseen kysymykseen kyllä, onko tieto vaikuttanut mielipiteisiisi puun käytöstä asuinrakentamiseen / If yes, has the information influenced your opinions on wood use in residential construction



Jos vastasit edelliseen kysymykseen kyllä, onko tieto vaikuttanut mielipiteisiisi puun käytöstä asuinrakentamiseen / If yes, has the information influenced your opinions on wood use in residential construction

Figure 5.11. Influence of media and/or research reports on respondents opinions.

5.4 Assessing relationships

		Age
Age	Pearson Correlation	1
	Sig. (2-tailed)	
	N	119
Would you be willing to live in a wood constructed: Detached or low-rise residential building (1-3 storeys)	Pearson Correlation	-,226*
	Sig. (2-tailed)	,014
	N	119
Would you be willing to live in a wood constructed: High-rise residential building (4-8 storeys)	Pearson Correlation	,103
	Sig. (2-tailed)	,263
	N	119
Wood is a suitable construction material for low-rise recreational properties (e.g. summer cottages).	Pearson Correlation	-,158
	Sig. (2-tailed)	,086
	N	119
Wood is a suitable construction material for low-rise residential buildings (1-3 storeys).	Pearson Correlation	-,252**
	Sig. (2-tailed)	,006
	N	119
Wood is a suitable construction material for high-rise residential buildings (4-8 storeys).	Pearson Correlation	-,204*
	Sig. (2-tailed)	,026
	N	119

Table 5.11 Correlation between age and opinions on wood as a construction material

The Pearson's product moment correlation coefficient was used to assess the strength of the relationship between different age groups and opinions on both wood constructions and wood's suitability for construction in different scenarios. Age and willingness to live in low-rise wooden residential buildings seem to have a weak negative correlation with a correlation of $-0,226$. This is considered by the SPSS software as statistically significant, as the significance in this case is lower than 0,05

(table 5.11). Age displayed no statistically significant correlation with willingness to live in high-rise residential buildings. However, when determining the suitability of wood as a construction material in both low-rise residential buildings and high-rise residential buildings, a weak negative correlation was found in both cases with statistical significance of 0,006 with low-rise and 0,026 with high-rise residential buildings.

		Have you seen or read any news or research reports on the use of wood in construction (over the past 10 years)?	If yes, has the information influenced your opinions on wood use in residential construction
N		119	87
Would you be willing to live in a wood constructed: High-rise residential building (4-8 storeys)	Pearson Correlation	-,092	,116
	Sig. (2-tailed)	,321	,285
	N	119	87
Wood is a suitable construction material for high-rise residential buildings (4-8 storeys).	Pearson Correlation	,240**	,358**
	Sig. (2-tailed)	,008	,001
	N	119	87

Table 5.12. The effect of communications on people's perceptions and attitudes towards wooden built high-rise residential buildings.

After this the same model was used to assess the strength of the relationship between having read or seen news or research reports regarding wood use in construction, and their reported influence, and willingness to live in a wood built high-rise residential building and the suitability of wood as a construction material in the same scenario. There is no visible correlation between having been subjected to information and willingness to live in wood constructed high-rise residential buildings, even if the information had influenced the respondent positively. However, when reviewing wood's suitability in high-rise residential buildings, there was a weak positive correlation between having been subjected to this information and considering wood as a suitable construction material for high rise residential buildings, with a correlation of 0,240. With regards to the influence of the information received and considering wood as a suitable construction material in these cases, there was a moderate positive correlation of 0,358. Both instances were considered statistically significant with respective levels of 0,008 and 0,001. (Table 5.12.)

6 Discussion

This section is divided into five separate areas: Scenarios help answer research question 1 and 2. Attributes help highlight the respondents' preferential attributes relating to buildings and Factors help answer both sub questions. The open question is then assessed in light of the findings in additional insight. Validity and limitations are discussed last, in which the credibility of this study, validity of data gathered and limitations of this study are evaluated.

6.1 Scenarios

The data shows that the respondents preferred wood constructed low-rise residences over concrete, brick and/or steel constructed low-rise residences (i.e. detached houses). However, when asked about different types of high-rise residential buildings, preferences leaned more towards concrete, brick or steel constructed buildings. In fact, there was almost a 10 % difference between people unwilling to live in wood constructed high rise buildings than were unwilling to live in concrete, brick or steel alternatives. Specifically, 22 % were unwilling to live in wood constructed high-rise buildings with 13 % unwilling to live in the concrete, brick or steel high rise buildings. Despite this difference, nearly 43 % still displayed willingness to live in wooden high-rise buildings, covering over a third of the respondents.

When reviewing wood's suitability as a construction material, the overall perception of wood as a suitable construction material was positive; nearly 96 % strongly agreed with the statement that 'wood is suitable for low-rise recreational properties', 84 % viewed wood suitable for low-rise residences and nearly 25 % viewed wood suitable for high-rise residences (additionally, over 46 % agreed to some extent).

Finland has hundreds of thousands of summer cottages used as recreational properties and the majority of these are made of wood. This could help explain why the overall attitude towards wooden recreational properties was positive. Low-rise residences are also very commonly made of wood, which reflects again on traditions and customs, and may explain why there is more willingness to live in wooden low-rise

residential buildings compared to high-rise, as wood constructed high-rise buildings are still relatively uncommon.

6.2 Attributes

The ranking system was divided into groups; 1-3 is considered important, 4-6 is considered of mediocre importance and 7-10 is considered low in importance.

When the respondents were asked to rank the selected attributes; *Healthiness* was ranked as important by most respondents (53 %) when considering purchasing or building a new home. *Durability and long-lasting* came second with 44 % ranking it as important. Finally, 38 % of the respondents ranked *cozy and comfortable living space* as important. *Good acoustics* was considered amongst the least important attributes by most respondents (65 %), followed by *Modernity*, which was ranked among the least important by 55 % and *Easy maintenance* by 49 %.

An overwhelming majority of the respondents viewed wood as *environmentally friendly, beautiful, natural, healthy and providing a cozy and comfortable living space*.

However, mixed responses were displayed in the attributes; *durability of wood, modernity, good acoustics and wood as secure investment*, with a majority of the respondents only tentatively agreeing with these attributes.

Only 10.9% of the respondents perceived wood as *fire resistant* and only 11.8% considered it *easy to maintain*. Interestingly, a clear majority of the Finnish respondents in this study tentatively disagreed with these two attributes. In contrast, a comparative study on consumer attitudes towards wood construction conducted in Slovenia and Croatia showed that the respondents strongly disagreed with the statement that wood constructed buildings are fire resistant. (Bicanic, Kuzman, Oblak 2012, 73.)

Health, durability and cozy and comfortable living space are all very practical attributes. Which leads to question, practicality is the reason why these attributes were placed high up in importance, thus leaving environmental friendliness as more mediocre in importance. Good acoustics, modernity and easy maintenance are under-

standably ranked low in importance, if compared with the other attributes on the list.

6.3 Factors

The relationship between the age factor and willingness to live in wood constructed low-rise residential buildings showed weak negative correlation, with a statistical significance of 0,026. However, with regards to high-rise buildings, there was no correlation.

On the other hand, when the respondents were asked to present their view on wood's suitability in construction, a weak negative correlation was discovered between the age factor and both low-rise and high-rise variables, with respective significance figures of 0,006 and 0,026. This shows an interesting indication that different age groups may view wood's suitability in construction differently, even though the relationship between age and willingness to live in high-rise wooden buildings is insignificant.

The second factor, termed external influence, again displayed no visible correlation between 'being subjected to news or research reports about wood construction' and willingness to live in high-rise residential buildings. But when reviewing wood's suitability as a construction material with regards to high-rise buildings, a weak positive correlation was again found with a significance level of 0,008. With regards to the reported influence of this information, a moderate positive correlation exists between this and perception on wood's suitability as a construction material in the context of high-rise buildings, with a significance level of 0,001.

Therefore, age and external influence may have an effect on how people perceive wood's suitability in construction and their willingness to live in wood constructed low-rise residences, but not on their willingness to live in high-rise wooden buildings.

The negative correlation displayed between age and willingness to live in low-rise wooden constructions, shows that older generations are tentatively more likely to prefer low-rise wooden constructions compared to younger generations.

External influence on the other hand, having displayed weak positive correlation towards perceiving wood as a suitable construction material for high-rise residential buildings, shows that the effect of communications on perceptions can be statistically significant. Having been positively influenced by this information had a stronger relationship, as a moderately positive correlation was discovered.

6.4 Additional insight

The open question section had a very low response rate, with only seven responses. On the one hand, a respondent viewed wood construction as having enormous potential in Finland. Two respondents referred to the Puukuokka building in Jyväskylä as being impressive, and widening the other respondents' perspective on wood use in construction. Two respondents were concerned with indoor air quality; the indoor air quality should be ensured despite the chosen construction material and the use of fire safe chemicals in the construction process, which may produce toxins harmful for human health. Finally, one respondent reported having hesitated answering his or her willingness to live in wood constructed high-rise residential buildings, as the respondent normally prefers low-rise constructions anyway. Two respondents added that they found the topic interesting.

The responses here are mixed, but health was brought to light by a few respondents, supporting the overall view of the importance of health as an attribute. Two respondents also mention that a recently erected high-rise residential building, called Puukuokka, was impressive, and had an influence in their interest in this project. This tentatively shows that influence from an event in the surrounding environment (i.e. new construction projects) can have an influence on a person's perceptions and attitudes.

6.5 Validity and limitations

Ornstein (2013, 45) wrote that the success of survey research depends more on the strategic choice of questions rather than the design of individual questions. However despite Ornstein's view, it is essentially important that the questions laid down in the survey are clearly and easily understood. In addition, a two-way relationship of asking and answering in a deliberate way is attained for the validity and reliability of the

answers must be provided; the question must be understood by the respondent in the way the researcher intends it, and the answer given by the respondent must be understood by the researcher in the way the respondent intends it to be understood (Armstrong, Kotler, Saunders and Wong 2008, 429). Ornstein (2013, 47-48) agrees that providing a coherent experience and maximizing the respondent's ability to provide good answers is more important than the technique of rapid changes in topics and questionnaire format used to test the respondent's alertness.

Hence, both the research process and the questionnaire were planned and designed in a precise and deliberate manner. Using clear and coherent questions for people who may or may not be construction- or wood industry professionals, and by choosing questions strategically in order to gain an accurate profile of end-users was essential in order to reach the objectives and provide primary data for the research questions in both consecutive topics; perceptions and attitudes. Whilst these two main topics were embedded in questions across the questionnaire rather than presented in any specific order according to topic, the questions were presented in a very clear manner, leaving little to no room for interpretation by both the researcher and the respondents (appendix 1).

The sampling technique used in this study places limitations on the ability to generalize on the results. The likelihood of a self-selection sample being representative is low, and often respondents have chosen to take part in these surveys due to their feelings or opinions about the topic or research questions. In some cases this is an intentional move by the researcher, as it was in this case. (Lewis, Saunders and Thornhill 2012, 284, 290). In order to gain a profile of the respondents who would likely be interested in the concept, as it is hard to identify interested people who do not currently necessarily live in wooden buildings themselves, self-selection sampling was chosen in order to increase the likelihood of this happening. It does, however, also present potentially biased answers, reducing the objectiveness of the results.

Ornstein (2013, 82) mentions that probability samples are the "gold standard" when it comes to producing unbiased estimates of the characteristics of a population, which remains a limitation for this study, having used non-probability sampling. This

places strains on this study's external validity (Lewis, Saunders and Thornhill 2012, 194).

Lewis, Saunders and Thornhill (2012, 429-430) discuss assessing validity in five different categories; external validity, internal validity, content validity, criterion-related validity and construct validity. They place emphasis on the design of the questions, structure of the questionnaire and the rigour of pilot testing having great influence over the internal validity and reliability of data collected. (Lewis, Saunders and Thornhill 2012, 428). Internal validity has been reached through the examination of age and external influence as factors, and how they relate to the willingness to live in different types of wood constructions and the respondents' views on wood as a suitable construction material in different scenarios. This will be discussed more in the conclusion.

Criterion validity was shown in the multiple correlation tests conducted using SPSS software. Particularly interesting results were displayed in the effects of communications on people's willingness to live in wood built high-rise residential buildings and their view on wood's suitability in those cases. This will also be expanded on in the conclusion. Content validity has been reached, as the research questions have been answered by the data provided in the questionnaire.

Establishing construct validity can be challenging, due to the difficulty of validating data against existing constructs; ensuring that attitudes and perceptions have been satisfactorily studied was essential for reaching the research objectives and therefore, a lot of emphasis was placed in the research design and the design of the survey tool implemented. Having reviewed the questionnaire tool used, objectives, and the data used to answer the research questions, construct validity has been satisfactorily reached for the purpose of this thesis. The correct attributes were used in the questionnaire design and the right context was placed on its structure. However, it is unfeasible to state that this questionnaire would specifically attract people with special interest towards the topic, as it is very difficult to verify.

7 Conclusion

The results and conclusions presented in this study are not meant to be used to generalize on a population. But rather to raise interesting contrast between various attributes, factors and scenarios which have influence over end user choices. The potential for further research in this area is highly recommended, i.e. quantitative research using probability samples, or using a more inductive approach in order to gather additional richness to the data. Please note that due to the limitations on this study, the results are tentative.

The decision making on construction materials for residential buildings may not be strongly influenced by end users, as Høibø, O., et al. (2015) suggested, but end users are the market who make conscious decisions when deciding to purchase or build a new home. Some may even consider these attributes when renting a residential property, if the person happened to have strong views over specific construction materials or building types. Most people tend to take into consideration the attributes presented in this study, i.e. environmental friendliness, healthiness and aesthetics, similar to those Gold and Rubik (2009) used in their survey.

7.1 Business perspective

By reviewing the secondary data gathered for the background and theoretical framework, numerous benefits were found for new or upcoming construction companies if they considered getting better acquainted with wood use as a principal construction material;

- 1. If environmental regulations are measured according to GHGs (CO₂ especially) wood use in construction will make it easier to comply with increasingly strict environmental regulations from governments and international organizations, such as the EU or the UN.*
- 2. There is no conclusive evidence to prove wood use in construction would be more expensive, but rather the expenses resulting from change management within companies embedded with traditional construction methods.*

3. Wood construction can be prefabricated to a great degree; this minimizes waste, construction time and in some cases building cost.

4. With modern construction methods, it is possible to build functionally equivalent multi-storey buildings using wood or wood frames, meaning there are little downsides for new companies to adopt wood as a key construction material.

With regards to demand, the results of the primary data gathered support what the British Research Establishment (2004) listed as a barrier for the re-emergence of wood construction systems in Europe; uncertain demand. Whilst the demand is tentatively high for low-rise constructions, the demand for high-rise wood built residences faces a lot of uncertainty among the end users.

The results of this study show that, people prefer low-rise wooden constructions to their concrete, brick or steel counterparts. However, when discussing high-rise options the preference shifts back to the concrete brick or steel alternatives. This is most likely drawn from the long held embedded position and market dominance of concrete high-rise buildings in Finland.

The re-emergence of wood in modern construction could well be a “disruptive” emergence. McKinsey consulting group describe disruptive as a new displacement phenomena, which means instead of improving an existing business model in order to compete, business models are subject to displacement and disruption by new controversial ideas; such as Uber vs. licensed taxis, Coursera and edX open online courses vs. traditional business schools etc. (McKinsey & Company 2015.) However, perception barriers may hinder the successful disruption of wood use in modern construction, if concerns are too deeply embedded in the minds of the end users.

Communications as an external influence, such as news or research reports, have positively influenced people’s opinions. Particularly on how people view wood’s suitability as a construction material. However, transforming this into positive attitudes and willingness to invest or live in wood constructions is still completely different to ‘perceiving wood as suitable’, therefore achieving positive influence on end users willingness and attitudes is the next step in order to increase demand for high rise wooden constructions.

Many of the respondents viewed wood as an environmentally friendly alternative for construction. However, more emphasis was clearly placed on healthiness and durability with regards to construction materials. Least emphasis was placed on good acoustics, modernity and easy maintenance. We cannot assume that these are the attributes construction companies should focus on in their marketing communications; it does however show that environmental friendliness is not as important among end users when it comes to residential buildings, than one might assume. Despite environmental consciousness being a rising trend.

The other relevant issue to consider, is the preference of high-rise buildings being built with more traditional materials among the end users compared to wood use. With a minimal market share of high-rise residences in Finland, an increase in more substantial construction projects may increase people's positive perception and trust towards wood as a construction material in high-rise residences.

7.2 Suggestions for further research

There is no essential way to determine any specific interest the respondents may have towards wood use in modern construction. Having volunteered for this survey would likely indicate some interest or feelings towards it, but it cannot be verified. Some respondents expressed interest to this topic in the open questions. Therefore, the context of the participants having some specific interest towards the topic cannot be added to the study. However, a majority viewed wood positively in the construction context, even showing relatively high levels of tentative willingness to live in wood built high-rise buildings. This leads to two options, both of which would be interesting to study further:

- 1) The respondents do indeed share interest towards the topic. The idea of wood constructed high-rise buildings may fascinate the respondents, but there is not enough evidence available on the long term success of wood constructed high-rise buildings.
- 2) Long-rooted regional traditions affect the respondents' views towards wood use in modern construction in a positive way, even with new innovations. A

great level of trust may exist between the end users and domestic expertise regarding wood use in construction.

Therefore, interesting topics for further research could include:

- 1) Studying end user preferences towards construction material attributes: specifically the role of health, durability, fire resistance and environmental friendliness with regards to wood as a key construction material.
- 2) Using a probability sample to make predictive generalizations on the effects of external influence on end user opinions towards wood as a key construction material in high-rise residential buildings.
- 3) Exploring key attributes preferred by people resident in Finland.
- 4) What are the important factors which influence willingness to live in wooden high-rise buildings?

7.3 Future implications

What is certain however, is that wood holds great potential from the both the environmental and economical perspectives. Perceptions of end users, while not the most influential on choice of construction material, are valuable as they can be influenced significantly by things which may not seem very significant. On a business perspective, wood can be considered a potential key construction material on an international scale (even though some regions are better equipped with wood resources). It can be prefabricated to a large degree, minimizing both waste and in some cases cost, it can offer a healthy living environment for the end user, and it enables the company to follow environmental regulations more easily, which are being tightened periodically in order to combat climate change.

References

- Akhtar, S., Hewage, K., Hossaini, N., Resa, B. & Sadiq, R. 2015. AHP based life cycle sustainability assessment (LCSA) framework: A case study of six storey wood frame and concrete frame buildings in Vancouver. *Journal of Environmental Planning and Management*, 58(7), 1217-1241.
- Armstrong, G., Kotler, P., Saunders, J. & Wong, V. 2008. *Principles of Marketing*. 5th ed. London: Financial Times/Prentice Hall.
- Barnes, H. 2006. *Proceedings of Wood Protection*. New Orleans: Forest Products Society.
- Bergman, R., Ritter, M. A. & Skog, K. 2011. *Science supporting the economic and environmental benefits of using wood and wood products in green building construction*. Page on the US Department of Agriculture website. Accessed on 11 November 2015. Retrieved from http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr206.pdf
- Bicanic, D., Kitek Kuzman, M., Motik, D., Oblak, L. & Vlosky, L. 2012. A comparative analysis of consumer attitudes on the use of wood products in Slovenia and Croatia. *Drvna industrija*, 63(2), 71-79.
- Boverket. 2006. Sundsvalls inre hamn – ett utvecklings- och informationsprojekt för trähus- byggande i massivträ. [Sundsvall's inner harbour – a development and information project for solid wood construction]. Page on the Boverket website. Accessed on 4 May 2016. Retrieved from <http://www.boverket.se>
- Building Research Establishment BRE. 2004. *Barriers to the enhanced use of wood in Europe: Particular attention to the regulatory barriers*. Page on the BRE website. Accessed on 15 April 2016. Retrieved from: http://www.fagosz.hu/fataj/Roadmap2010CEIBois/PDFs/4_Reports/BRE_Report.pdf
- Bysheim, K. & Nyrud A. 2010. Norwegian architects' and civil engineers' attitudes to wood in urban construction. *The Future of Quality Control for Wood & Wood Products*, 3, 4-7.

Callan, S. & Thomas, J. 2012. *Environmental Economics and Management: Theory, Policy, and Applications*. 6th Ed. Mason, Ohio: South-Western Cengage Learning.

Castells, F., Ortiz, O. & Sonnemann, G. 2009. Sustainability in the construction industry: A review of recent developments based on LCA. *Construction and Building Materials*, *23(1)*, 28-39.

Crews, K., Ding, G. & Thomas, D. 2013. Medium-rise structural timber apartment: Luxury or long-term carbon storage solution?. *Sustainable Buildings-Construction Products & Technologies*, *1*, 647-654.

Creswell, J. W., Gutmann V.L, Hanson W.E & Plano M.L. 2003. Advanced mixed methods research designs. In Tashakkori A., Teddlie C. 2003. *Handbook of mixed methods in social and behavioral research*. 209–240. Thousand Oaks, CA: Sage.

De Jong, M. & Van Dijk, M. 2015. Disrupting beliefs: A new approach to business-model innovation. *McKinsey Quarterly*. Accessed on 29 October 2015. Retrieved from http://www.mckinsey.com/insights/innovation/disrupting_beliefs_a_new_approach_to_business-model_innovation?cid=other-eml-ttn-mip-mck-oth-1509

De La Roche, I., O'Conner, J. & Tetu, P. 2016. *Wood Products and Sustainable Construction*. Page on the UN Food and Agriculture Organisation FAO website. Accessed on 6 May 2016. Retrieved from <http://www.fao.org/docrep/ARTICLE/WFC/XII/1039-A2.HTM>

Eriksson, L.O, Gustavsson, L., Hänninen, R., Kallio, M., Lyhykäinen, H., Pingoud, K., Pohjola, J., Sathre, R., Solberg, B., Svanaes J. & Valsta, L. 2012. Climate change mitigation through increased wood use in the European construction sector—towards an integrated modelling framework. *European Journal of Forest Research*, *131 (1)*, 131-144.

European Commission. 2015. *EU ETS Fact sheet*. N.d. Page on the European Commission website. Accessed on 2 November 2015. Retrieved from http://ec.europa.eu/clima/publications/docs/factsheet_ets_en.pdf

European Commission. 2015. *Climate Action: The European Union Trading System (EU ETS)*. N.d. Page on the European Commission website. Accessed on 2 November 2015. Retrieved from http://ec.europa.eu/clima/policies/ets/index_en.htm

European Commission. 2016. Urban Development. N.d. Page on the European Commission website. Accessed on 8 May 2016. Retrieved from http://ec.europa.eu/regional_policy/en/policy/themes/urban-development/

Finnish Ministry of Agriculture and Forestry. 2016. *Forests and forestry in Finland*. N.d. Page on the Finnish Ministry of Agriculture and Forestry website. Accessed on 26 October 2016. Retrieved from http://www.mmm.fi/attachments/maatalous/julkaisut/64SkILQH4/MMM_forests.pdf

Finnish Ministry of Employment and Economy website. 2016. *Status of wood construction in Finland*. N.d. Page on the Finnish Ministry of Employment and Economy website. Accessed on 23 March 2016. Retrieved from https://www.tem.fi/files/40816/Wood_Construction_in_Finland.pdf

Finnish Ministry of Employment and Economy website. 2016. *Status and possibilities of wood construction in Finland*. N.d. Page on the Finnish Ministry of Employment and Economy website. Accessed on 15 April 2016. Retrieved from https://www.tem.fi/files/42112/Status_and_Possibilities_of_Wood_Construction_in_Finland.pdf

Finpro Invest in Finland. 2016. *Market opportunities in industrial wood construction in Finland 2016*. N.d. Page on the Finpro Invest in Finland website. Accessed 23rd of April 2016. Retrieved from http://www.investinfinland.fi/uploaded/files/Invest_in_Finland_-_Industrial_Wood_20160310_FINAL.pdf

Grant, T. & Ximenes, F. A. 2013. Quantifying the greenhouse benefits of the use of wood products in two popular house designs in Sydney, Australia. *The International Journal of Life Cycle Assessment*, 18(4), 891-908.

- Gold, S. & Rubik, F. 2009. Consumer attitudes towards timber as a construction material and towards timber frame houses—selected findings of a representative survey among the German population. *Journal of Cleaner Production*, 17(2), 303-309.
- Gustavsson, L., Hemström, L. & Mahapatra, K. 2012. Multi-storey wood-frame buildings in Germany, Sweden and the UK. *Construction Innovation*, 12(1), 62-85.
- Gustavsson, L. & Sathre R. 2011. Energy and CO2 analysis of wood substitution in construction. *Climatic Change*, 105(1-2), 129-153.
- Halfpenny, P., Proctor, R. 2015. *Innovations in digital research methods*. London: SAGE.
- Heikki, J., Toppinen A. & Wang, L. 2014. Use of wood in green building: a study of expert perspectives from the UK. *Journal of Cleaner Production*, 65, 350-361.
- Høibø, O., Hansen, E. & Nybakk, E. 2015. Building material preferences with a focus on wood in urban housing: durability and environmental impacts. *Canadian Journal of Forest Research*, 45 (11), 1617-1627
- Housing Finance and Development Centre of Finland ARA. 2013. *ARA toimeenpanee valtion asuntopolitiikkaa* [ARA implements the Government's housing policy] N.d. Accessed on 12 April 2016. Retrieved from http://www.ara.fi/fi-FI/ARAn_esittely
- Hughes, M., Winandy, J.E. 2007. Issues related to durability and protection affecting the acceptance and use of engineered wood composites in Europe. Page on the Forest Products Society website. Accessed on 15 April 2016. Retrieved from http://www.fpl.fs.fed.us/documnts/pdf2007/fpl_2007_hughes001.pdf
- IF oy. 2015. Kaupunki 2035: Viisi tulevaisuuden haastetta [City 2035: Five Future Challenges] N.d. Page on the IF Oy website. Accessed on 29 October 2015. Retrieved from https://www.if.fi/web/fi/SiteCollectionDocuments/About%20if/Vuosikertomukset/Kaupunki_2035.pdf
- Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Working group III: Mitigation of Climate Change*. Page on the IPCC website. Accessed on 6

May 2016. Retrieved from

https://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch1s1-3.html

Introduction to the Global Climate Cycle. 2012. N.d. Page on the University of New Hampshire website. Accessed on 6 May 2016. Retrieved from

<http://globecarboncycle.unh.edu/CarbonCycleBackground.pdf>

Lakea oy. 2015. *Puukuokka markkinointiesite. [Puukuokka marketing brochure]*. N.d. Page on the Lakea oy website. Accessed on 26 October 2015. Retrieved from

<http://www.lakea.fi/documents/key20151026141344/pdf/puukuokka-esite-2015.pdf>

Lewis, P., Saunders, M. & Thornhill, A. 2012. *Research Methods for Business Students*. 6th Ed. Essex: Pearson Education Ltd.

Monahan, J. & Powell, J. 2011. An embodied carbon and energy analysis of modern methods of construction in housing: A case study using a lifecycle assessment framework. *Energy and Buildings*, 43(1), 179-188.

National Aeronautics and Space Administration NASA. 2016. *Global Climate Change: A blanket around the Earth*. Page on the NASA website. Accessed on 7 May 2016. Retrieved from: <http://climate.nasa.gov/causes/>

Oakshott, L. 2006. *Essential Quantitative Methods*. 3rd ed. New York: Palgrave Macmillan Ltd.

Oopeaa oy. 2015. *Puukuokka Housing Block Portfolio*. N.d. Page on the Oopeaa oy website. Accessed on 26 October 2015. Retrieved from

<http://oopeaa.com/project/puukuokka-housing-block/>

Orstein, M. 2013. *A Companion to Survey Research*. 1st Ed. London: SAGE.

Sathre, R. & O'Connor, J. 2010. Meta-analysis of greenhouse gas displacement factors of wood product substitution. *Environmental science & policy*, 13(2), 104-114.

Sevchenko, M. 2015. Urban jungle: wooden high-rises change city skylines as builders ditch concrete. Page on The Guardian website. Accessed on 30 December 2015. Re-

trieved from <http://www.theguardian.com/artanddesign/2015/dec/12/wood-high-rise-buildings-urban-architecture-skylines-new-york-city-oregon>

Stora Enso oyj. *Modular Construction*. N.d. Page on the Stora Enso Oyj website. Accessed on 26 October 2015. Retrieved from <http://buildingandliving.storaenso.com/products-and-services/modular-construction>

Takano, A. 2015. Wood in sustainable construction-a material perspective: Learning from vernacular architecture. Page at on the Aalto University Department of Forest Products Technology website. Accessed on 26 April 2016. Retrieved from <https://aaltodoc.aalto.fi/handle/123456789/17249>

UNESCO World Heritage Council. 1990. *World Heritage List: Petäjävesi No. 584*. 1 October 1990. N.d. Page on the UNESCO World Heritage Council Advisory Body website. Accessed on 24 April 2016. Retrieved from http://whc.unesco.org/archive/advisory_body_evaluation/584.pdf

United States Environmental Protection Agency. 2015. *Global Greenhouse Gas Emissions Data*. N.d. Page on the United States Environmental Protection Agency website. Accessed on 13 October 2015. Retrieved from <http://www3.epa.gov/climatechange/ghgemissions/global.html>

UK Timber Association. 2016. *Modern Methods of Construction*. Page on the UK Timber Association UKTFA website. Accessed on 22 February 2016. Retrieved from <http://www.uktfa.com/modern-methods-of-construction/>

Walford, G. 2006. *Multistorey wood building in UK and Sweden*. *NZ Wood Design Journal*, 2 (10), 6-13.

Wilson, J. B. 2006. *Using wood products to reduce global warming*. *Forests, Carbon and Climate Change: A Synthesis of Science Findings*. Page on the Forest and Government website. Accessed on 15 April 2016. Retrieved from http://www.oregon.gov/ENERGY/GBLWRM/docs/forests_carbon_climate_change.pdf?ga=t

Appendices

Appendice 1.

Puun käyttö modernissa asuinrakentamisessa / The Use of Wood in Modern Residential Construction

[Johdanto / Introduction](#)

Työ- ja elinkeinoministeriön mukaan Suomessa on noin puoli miljoonaa kesämökkiä, joista 99 % on rakennettu puusta. Maan lähes kolmesta miljoonasta asuinrakennuksesta yli 80 % on rakennettu ainakin osittain puusta. Näistä 10 % on hirsitaloja.

Kerrostalojen tärkein rakennusmateriaali viimeisten 50 vuoden aikana on ollut betoni. Viime vuosina kiinnostus puun käyttöön on lisääntynyt. Vuonna 2014 uusista kerrosta-loista kuitenkin vain 5 % oli puurakenteisia.

Tämän kyselyn tarkoitus on selvittää käsityksiä ja asenteita, joita liittyy puun käyttämi- seen asuinrakennusten pääasiallisena rakennusmateriaalina.

Arvostamme mielipidettäsi ja toivomme, että vastaat kyselyyn. Vastaamiseen kuluu ai- kaa noin 5 -10 minuuttia. Vastauksia käsitellään luottamuksellisesti.

Jos haluat tietoa kyselyn tuloksista, anna sähköpostoitteesi kyselyn lopussa.

According to the Finnish Ministry of Employment and the Economy, there are half a million summer cottages in Finland, of which 99% are made of wood. Out of Finland's nearly three million residential buildings, over 80% are at least partly made of wood. 10% of these are log houses.

For the past 50 years, the most important construction material for high-rise residential buildings has been concrete. In the past few years interest in using wood has increased. However, in 2014 the share for wood-framed high-rise buildings was only 5%.

The purpose of this questionnaire is to examine perceptions and attitudes relating to the use of wood as a key construction material for residential buildings.

Your opinions are greatly appreciated and we hope that you will take time to answer these questions. An- swering the questionnaire will take roughly 5 - 10 minutes. All answers are handled confidentially.

If you wish to receive information on the results, please provide an email address at the end.

Taustakysymykset / Background questions

1. Sukupuoli / Gender *

- Mies / Male
- Nainen / Female

2. Ikä / Age *

- 20-30
- 31-40
- 41-50
- 51-60
- 61+

3. Koulutustausta / Education background *

- Peruskoulu / Compulsory school education
- Ammatillinen koulutus / Vocational qualification
- Ylioppilas / High school graduation
- Korkeakoulututkinto / Higher education

4. Asutko tällä hetkellä Suomessa / Do you currently live in Finland? *

- Kyllä / Yes
- Ei / No

5. Mikä on nykyinen asumismuotosi? / What is your current living situation? *

- Vuokralla kerrostaloasunnossa / Renting an apartment in a high-rise building
- Vuokralla pari/rivitalossa / Renting a semi-detached/row house apartment
- Vuokralla omakotitalossa / Renting a detached house
- Omistusasunnossa kerrostalossa / Owned apartment in a high-rise building
- Omistusasunnossa pari/rivitalossa / Owned semi-detached/row house apartment
- Omistusasunto (omakotitalo) / Owned detached house
- Muu / Other

6. Asutko tällä hetkellä puurakenteisessa asuinrakennuksessa? (Voit jättää vastaamatta, jos et ole varma asuntosi rakennusmateriaalista) / Do you currently live in a wood-framed residential building? (Please skip this question if you're unsure of the building material used)

- Kyllä / Yes
- Ei / No

7. Oletko aikeissa ostaa asuinkiinteistön lähitulevaisuudessa (seuraavan 10 vuoden aikana)? / Do you intend to purchase a residential property in the near future (within the next 10 years)? *

- Kyllä / Yes
- Ei / No
- Ehkä / Perhaps

Osa 1 Asuminen erityyppisissä asuinrakennuksissa / Section 1 Living in different types of buildings

8. Olisitko halukas asumaan puusta rakennetussa: / Would you be willing to live in a wood constructed: *

Kyllä / Ei / Ehkä /

Yes No Perhaps

Omakotitalossa tai matalassa asuinrakennuksessa (1-3 kerrosta) / Detached or low-rise residential building (1-3 storeys)

Korkeassa kerrostalossa (4-8 kerrosta) / High-rise residential building (4-8 storeys)

9. Olisitko halukas asumaan betonista, tiilestä ja/tai teräksestä rakennetussa: / Would you be willing to live in a concrete, brick and/or steel constructed: *

Kyllä / Ei / Ehkä /

Yes No Perhaps

Omakotitalossa tai matalassa asuinrakennuksessa (1-3 kerrosta) / Detached or low-rise residential building (1-3 storeys)

Korkeassa kerrostalossa (4-8 kerrosta) / High-rise residential building (4-8 storeys)

Osa 2 Näkemykset puusta rakennusmateriaalina / Section 2 Perceptions on wood as a construction material

10. Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: *

	Täysin samaa mieltä / I agree fully	Jokseenkin samaa mieltä / I somewhat agree	Jokseenkin eri mieltä / I somewhat disagree	Täysin eri mieltä / I fully disagree
Ympäristöystävällinen / Environmentally friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kaunis / Beautiful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Terveellinen (ottaen huomioon mm. sisäilman laadun, allergiat) / Healthy (considering e.g. indoor air quality, allergies)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kestävä ja pitkäikäinen / Durable and long-lasting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Moderni / Modern	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Turvallinen sijoitus / A secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Miellyttävä ulkonäkö / *Aesthetically pleasing* ○○○○○○○○○○○○

Terveellisyys (allergiat, huoneilman laatu) verrattuna muihin rakennusmateriaaleihin / *Healthiness (allergies, room air quality) compared to other construction materials* ○○○○○○○○○○○○

Kestävyys ja pitkäikäisyys / *Durability and long-lasting* ○○○○○○○○○○○○

Nykyaikaisuus / *Modern* ○○○○○○○○○○○○

Sijoituksen turvallisuus / *Secure investment* ○○○○○○○○○○○○

Kodikkuus ja asuinympäristön miellyttävyys / *Cozy and comfortable living space* ○○○○○○○○○○○○

Paloturvallisuus / *Fire resistance* ○○○○○○○○○○○○

Huoltamisen helppous / *Easy maintenance* ○○○○○○○○○○○○

Hyvä akustiikka / *Good acoustics* ○○○○○○○○○○○○

Osa 3 Väittämiä puusta asuinrakennusten rakennusmateriaalina / *Section 3 Statements on wood as a construction material for residences*

12. Puu soveltuu hyvin matalien loma-asumusten (esim. kesämökin) rakennusmateriaaliksi. / *Wood is a suitable construction material for low-rise recreational properties (e.g. summer cottages).* *

○ Täysin samaa mieltä / ○ Jokseenkin samaa mieltä / *I somewhat* ○ Jokseenkin eri mieltä / *I somewhat* ○ Täysin eri mieltä / *I fully*

I agree fully hat agree hat disagree disagree

13. Puu soveltuu hyvin matalien asuinrakennusten rakennusmateriaaliksi (1-3 kerrosta). / Wood is a suitable construction material for low-rise residential buildings (1-3 storeys). *

Täysin samaa mieltä / I agree fully
 Jokseenkin samaa mieltä / I somewhat agree
 Jokseenkin eri mieltä / I somewhat disagree
 Täysin eri mieltä / I fully disagree

14. Puu soveltuu hyvin korkeiden asuinrakennusten rakennusmateriaaliksi (4-8 kerrosta). / Wood is a suitable construction material for high-rise residential buildings (4-8 storeys). *

Täysin samaa mieltä / I agree fully
 Jokseenkin samaa mieltä / I somewhat agree
 Jokseenkin eri mieltä / I somewhat disagree
 Täysin eri mieltä / I fully disagree

15. Puun käyttö mahdollistaa ympäristöystävällisemmän rakentamisen kuin muiden materiaalien (esim. betonin) käyttö. / The use of wood enables construction to be more environmentally friendly than other materials (e.g. concrete). *

Täysin samaa mieltä / I agree fully
 Jokseenkin samaa mieltä / I somewhat agree
 Jokseenkin eri mieltä / I somewhat disagree
 Täysin eri mieltä / I fully disagree

16. Mitä ympäristöystävällisempi rakennus on, sitä kalliimpi se on. / The more environmentally-friendly a construction, the more expensive it becomes. *

Täysin samaa mieltä / I agree fully
 Jokseenkin samaa mieltä / I somewhat agree
 Jokseenkin eri mieltä / I somewhat disagree
 Täysin eri mieltä / I fully disagree

17. Puusta rakennetuissa asuinrakennuksissa on hyvä akustiikka ja äänieristys. /
Wood constructed residential buildings have good acoustics and sound insulation.

*

- | | | | |
|---|--|---|--|
| Täysin sa-
<input type="radio"/> maa mieltä /
I agree fully | Jokseenkin samaa
<input type="radio"/> mieltä / I somew-
hat agree | Jokseenkin eri
<input type="radio"/> mieltä / I somew-
hat disagree | Täysin eri
<input type="radio"/> mieltä / I fully
disagree |
|---|--|---|--|

18. Puusta rakennetuissa asuinrakennuksissa on hyvä sisäilman laatu. / Wood
constructed residential buildings have good indoor air quality. *

- | | | | |
|---|--|---|--|
| Täysin sa-
<input type="radio"/> maa mieltä /
I agree fully | Jokseenkin samaa
<input type="radio"/> mieltä / I somew-
hat agree | Jokseenkin eri
<input type="radio"/> mieltä / I somew-
hat disagree | Täysin eri
<input type="radio"/> mieltä / I fully
disagree |
|---|--|---|--|

19. Puurakennus on terveellisempi asuinympäristö kuin muut (esim. betonista
rakennettu). / A wood building is a healthier living environment than others (e.g.
concrete buildings). *

- | | | | |
|---|--|---|--|
| Täysin sa-
<input type="radio"/> maa mieltä /
I agree fully | Jokseenkin samaa
<input type="radio"/> mieltä / I so-
mewhat agree | Jokseenkin eri
<input type="radio"/> mieltä / I so-
mewhat disagree | Täysin eri
<input type="radio"/> mieltä / I
fully disagree |
|---|--|---|--|

20. Puun käyttö aiheuttaa vähemmän ympäristöhaittoja kuin tiilen, betonin tai
teräksen käyttö. / The use of wood causes less negative impact on the environ-
ment than using brick, concrete or steel. *

- | | | | |
|---|--|---|--|
| Täysin sa-
<input type="radio"/> maa mieltä /
I agree fully | Jokseenkin samaa
<input type="radio"/> mieltä / I somew-
hat agree | Jokseenkin eri
<input type="radio"/> mieltä / I somew-
hat disagree | Täysin eri
<input type="radio"/> mieltä / I fully
disagree |
|---|--|---|--|

21. Ihmiset jotka asuvat puurakennuksissa kokevat olevansa lähellä luontoa. /
People who live in wooden buildings feel close to nature. *

- | | | | |
|--|--|---|--|
| <input type="radio"/> Täysin sama mieltä / I agree fully | <input type="radio"/> Jokseenkin samaa mieltä / I somewhat agree | <input type="radio"/> Jokseenkin eri mieltä / I somewhat disagree | <input type="radio"/> Täysin eri mieltä / I fully disagree |
|--|--|---|--|

Osa 4 Yleistä / Section 4 General

22. Oletko nähnyt tai lukenut uutisia tai tutkimuksia puun käytöstä asuinrakentamisessa (viimeisen 10 vuoden aikana)? / Have you seen or read any news or research reports on the use of wood in construction (over the past 10 years)? *

- Kyllä / Yes
- En / No
- Ehkä / Perhaps

23. Jos vastasit edelliseen kysymykseen kyllä, onko tieto vaikuttanut mielipiteisiisi puun käytöstä asuinrakentamiseen / If yes, has the information influenced your opinions on wood use in residential construction

- | | | |
|---|---|---|
| <input type="radio"/> Myönteisellä tavalla / Positively | <input type="radio"/> Kielteisellä tavalla / Negatively | <input type="radio"/> Ei vaikutusta / No effect |
|---|---|---|

24. Jos haluat täydentää vastauksiasi tai lisätä jotain, voit tehdä sen tässä. / If you would like to elaborate further on your answers or add something, you can do so here.

25. Jos haluat saada yhteenvedon tutkimuksen tuloksista, kirjoita sähköpostiosoitteesi tähän. / If you would like to receive a summary of the findings, please provide an email address here.

Sähköpostiosoite / Email address:

Figures

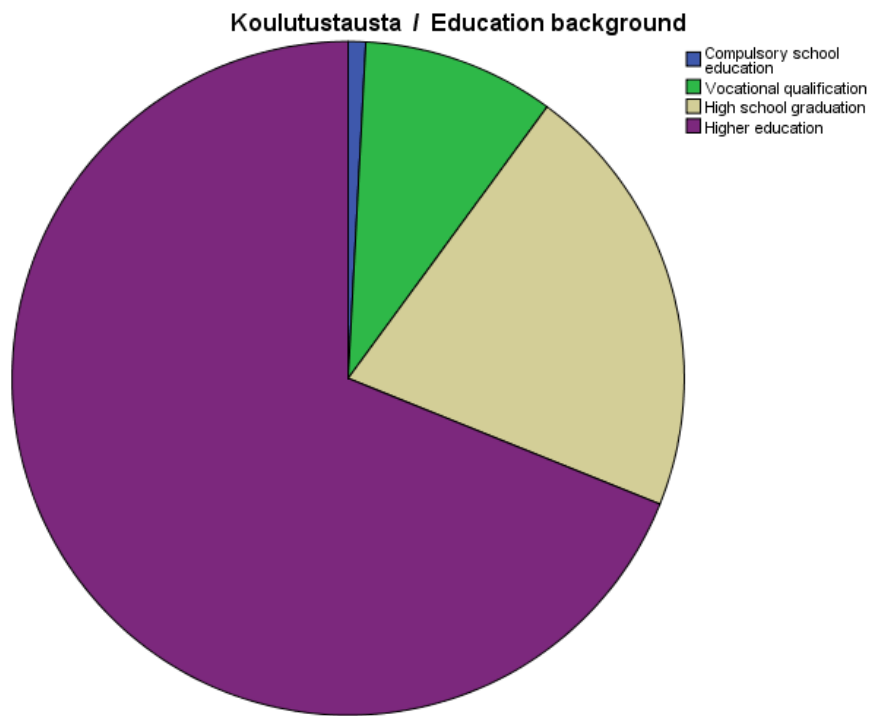


Figure 5.3. Education background of the respondents

68.9 % of the respondents had a background in higher education, 21 % had completed high school, 9.2% had vocational qualifications and 0.8% had only completed compulsory school education.

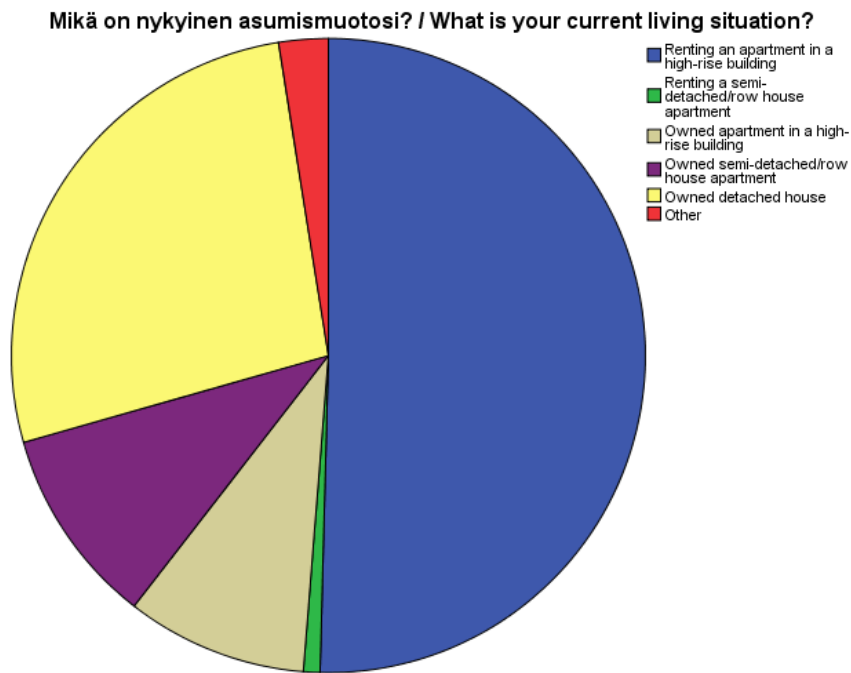


Figure 5.4. The current living situation of the respondents

50.4% rent an apartment in a high-rise building, 0.8% rent a semi-detached / row house type apartment. Out of the respondents reporting ownership as their living situation; 9.2% reported living in a high-rise building apartment, 10.1% lived in a semi-detached/row house type apartment and 26.9% lived in a detached house. 2.5% reported other as their living situation.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Ympäristöystävällinen / Environmentally friendly

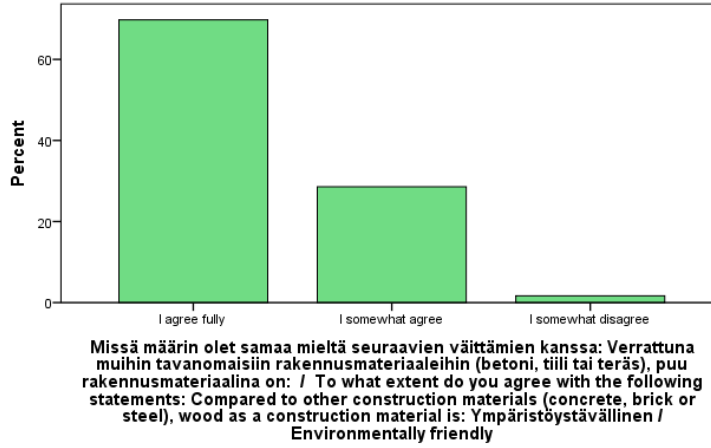


Figure 5.20 Comparing wood to other common construction materials in environmental-friendliness

69.7 % strongly agreed that wood is more environmentally friendly in comparison, 28.6 % agreed to some extent and 1.7 % disagreed to some extent. None of the respondents disagreed fully with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Kaunis / Beautiful

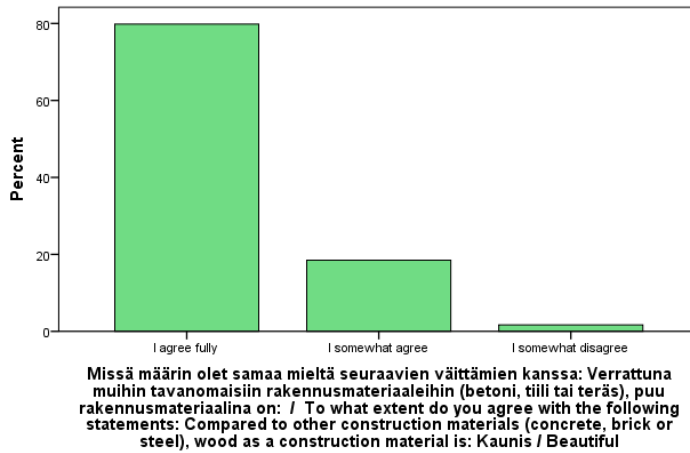


Figure 5.21. Comparing wood to other construction materials in beauty

79.8 % perceived wood as a beautiful construction material, 18.5 % agreed to some extent and 1.7 % somewhat disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Terveellinen (ottaen huomioon mm. sisäilman laadun, allergiat) / Healthy (considering e.g. indoor air quality, allergies)

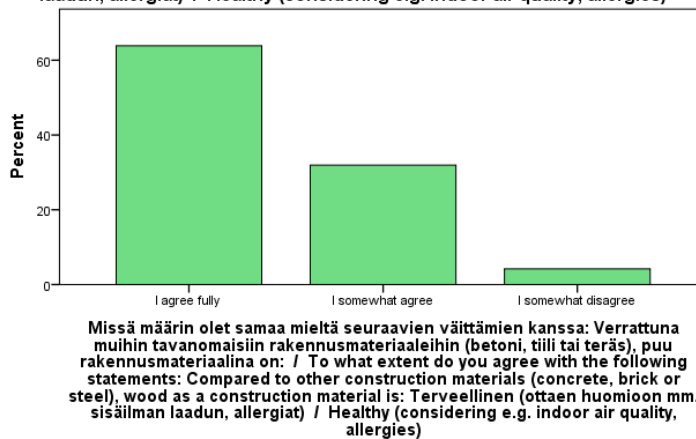


Figure 5.22. Comparing wood to other common construction materials in health

63.9 % perceived wood as a healthy option, 31.9 % agreed to some extent and 4.2 % disagreed to some extent. None of the respondents fully disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Kestävä ja pitkäikäinen / Durable and long-lasting

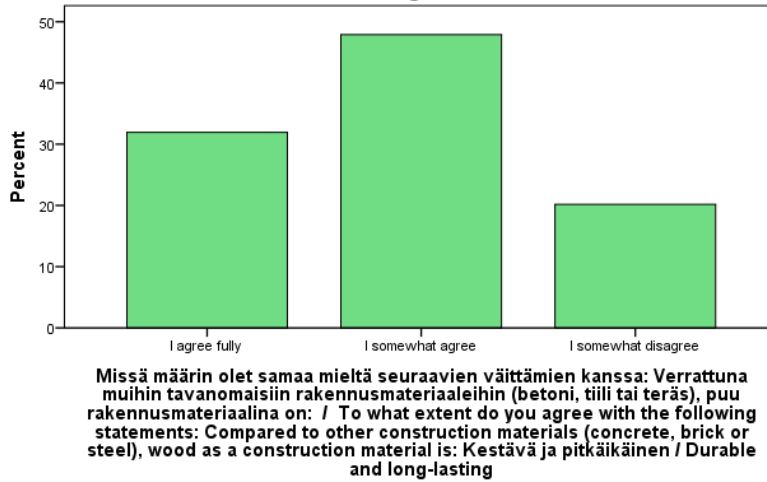
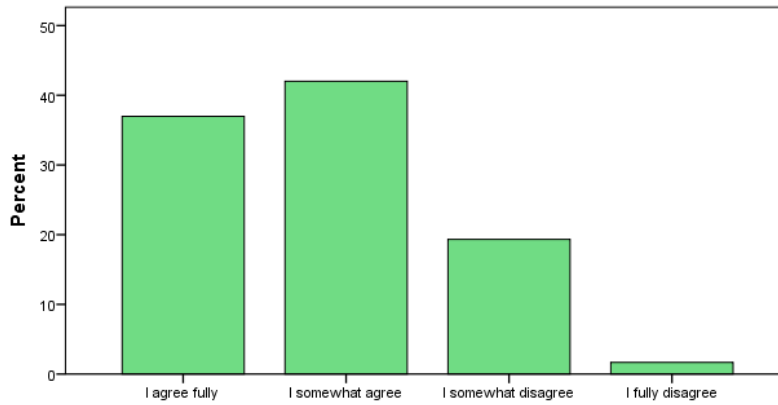


Figure 5.23. Comparing wood to other common construction materials in durability

31.9 % perceived wood as durable and long-lasting, 47.9 % agreed to some extent and 20.2 % disagreed to some extent. None of the respondents fully disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Moderni / Modern



Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Moderni / Modern

Figure 5.24. Comparing wood to other common construction materials in modernity

37 % perceived wood as a modern construction material, 42 % agreed to some extent, 19.3 % disagreed to some extent and 1.7 % fully disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Turvallinen sijoitus / A secure investment

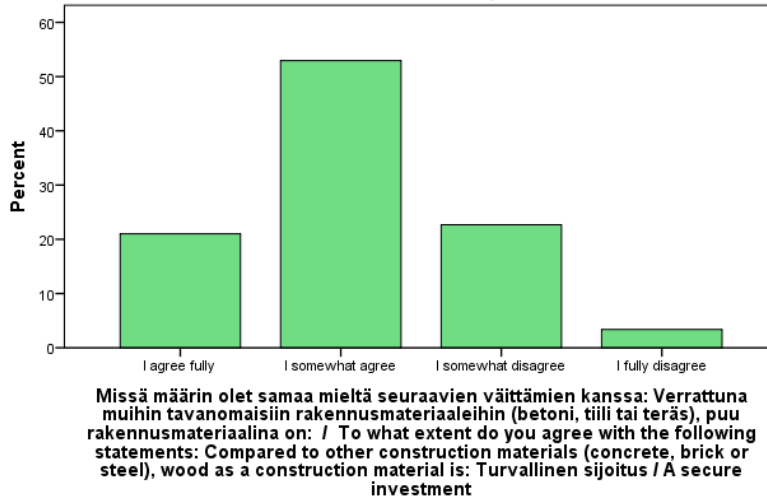
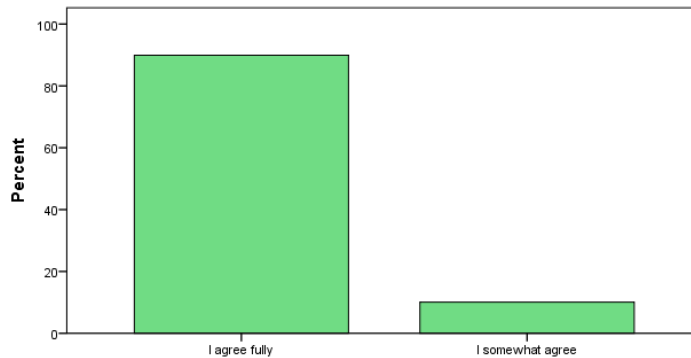


Figure 5.25. Comparing wood to other common construction materials in the context of secure investment

21 % perceived it as a secure investment, 52.9 % agreed to some extent, 22.7 % disagreed to some extent and 3.4 % of the respondents fully disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Luonnollinen / Natural

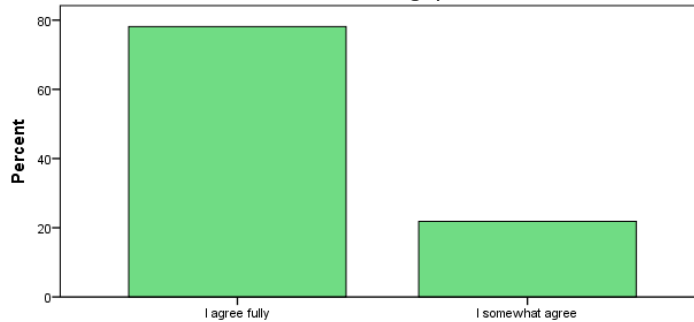


Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Luonnollinen / Natural

Figure 5.26. Comparing wood to other common construction materials in the context of being natural

89.9 % of the respondents perceived wood as a natural construction material and 10.1 % agreed to some extent. None of the respondents disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Kodikas- ja mukava asuinympäristö / Cozy and comfortable living space



Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Kodikas- ja mukava asuinympäristö / Cozy and comfortable living space

Figure 5.27. Comparing wood to other common construction materials in the context of cozy and comfortable living space

78.2 % of the respondents perceived wood as providing a cozy and comfortable living space with 21.8 % agreeing to some extent. None of the respondents disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Paloturvallinen / Fire resistant

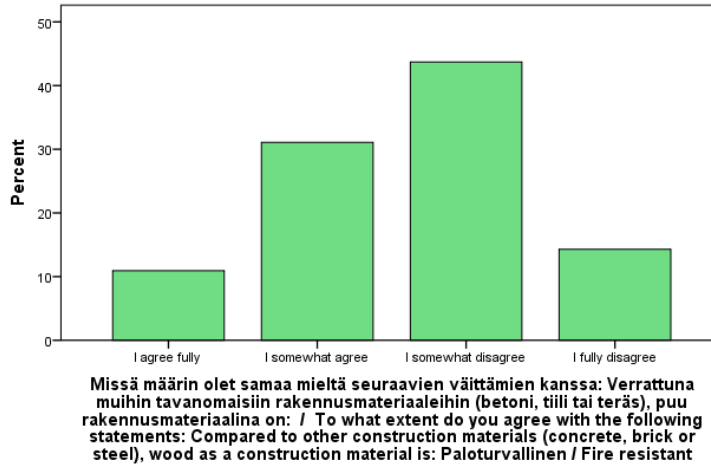
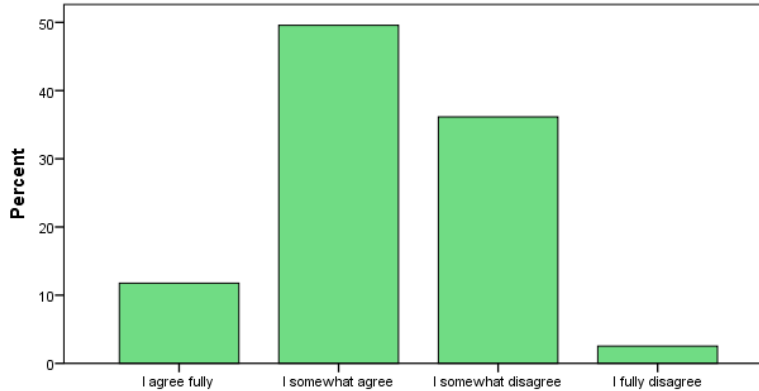


Figure 5.28. Comparing wood to other common construction materials in fire resistance

10.9 % of the respondents perceived wood as fire resistant, 31.1 % agreed to some extent, 43.7 % disagreed to some extent and 14.3 % fully disagreed.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Helppo huoltaa / Easy to maintain

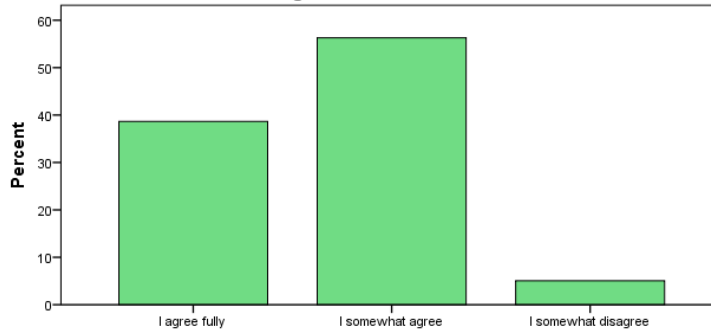


Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Helppo huoltaa / Easy to maintain

Figure 5.29. Comparing wood to other common construction materials in the context of easy maintenance

11.8 % perceived wood as easy to maintain, 49.6 % agreed to some extent, 36.1 % disagreed to some extent and 2.5 % fully disagreed.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Hyvä akustisilta ominaisuuksiltaan / Provides good acoustics

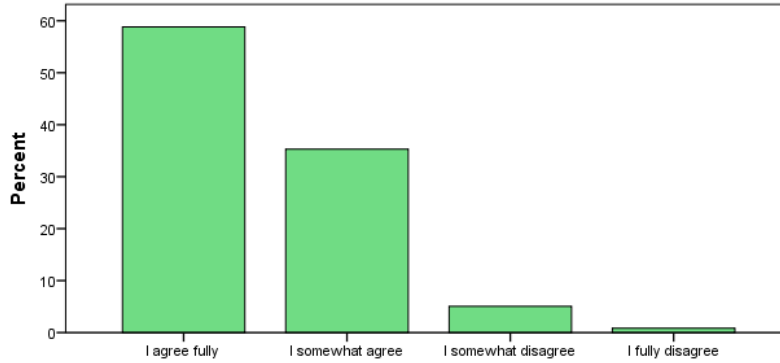


Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Hyvä akustisilta ominaisuuksiltaan / Provides good acoustics

Figure 5.30. Comparing wood to other common construction materials in the context of providing good acoustics

38.7 % perceived wood as having good acoustic properties, 56.3 % agreed to some extent and 5 % disagreed to some extent. None of the respondents fully disagreed with this statement.

Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Edustaa kestäväää kehitystä / Supports sustainability



Missä määrin olet samaa mieltä seuraavien väittämien kanssa: Verrattuna muihin tavanomaisiin rakennusmateriaaleihin (betoni, tiili tai teräs), puu rakennusmateriaalina on: / To what extent do you agree with the following statements: Compared to other construction materials (concrete, brick or steel), wood as a construction material is: Edustaa kestäväää kehitystä / Supports sustainability

Figure 5.31. Comparing wood to other common construction materials in the context of supporting sustainability

58.8 % perceive wood as supporting sustainability, 35.3 % agree to some extent, 5 % disagree to some extent and 0.8 % fully disagree.

Tables

Puu soveltuu hyvin matalien loma-asumusten (esim. kesämökin) rakennusmateriaaliksi. / Wood is a suitable construction material for low-rise recreational properties (e.g. summer cottages).

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	114	95,8	95,8	95,8
I somewhat agree	5	4,2	4,2	100,0
Total	119	100,0	100,0	

Table 5.1. The suitability of wood as a construction material in low-rise recreational properties.

Puu soveltuu hyvin matalien asuinrakennusten rakennusmateriaaliksi (1-3 kerrosta). / Wood is a suitable construction material for low-rise residential buildings (1-3 storeys).

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	100	84,0	84,0	84,0
I somewhat agree	18	15,1	15,1	99,2
I somewhat disagree	1	,8	,8	100,0
Total	119	100,0	100,0	

Table 5.2. The suitability of wood as a construction material in low-rise residential buildings (1-3 storeys).

**Puu soveltuu hyvin korkeiden asuinrakennusten rakennusmateriaaliksi (4-8 kerrosta). /
Wood is a suitable construction material for high-rise residential buildings (4-8 storeys).**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I agree fully	28	23,5	23,5	23,5
	I somewhat agree	55	46,2	46,2	69,7
	I somewhat disagree	29	24,4	24,4	94,1
	I fully disagree	7	5,9	5,9	100,0
	Total	119	100,0	100,0	

Table 5.3. The suitability of wood as a construction material in high-rise residential buildings (4-8 storeys).

Puun käyttö mahdollistaa ympäristöystävällisemmän rakentamisen kuin muiden materiaalien (esim. betonin) käyttö. / The use of wood enables construction to be more environmentally friendly than other materials (e.g. concrete).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I agree fully	55	46,2	46,2	46,2
	I somewhat agree	60	50,4	50,4	96,6
	I somewhat disagree	4	3,4	3,4	100,0
	Total	119	100,0	100,0	

Table 5.4. Qualities of wood as a construction material; Environmental friendliness in construction compared to other materials (i.e. concrete).

Puusta rakennetuissa asuinrakennuksissa on hyvä akustiikka ja äänieristys. / Wood constructed residential buildings have good acoustics and sound insulation.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	17	14,3	14,3	14,3
I somewhat agree	86	72,3	72,3	86,6
I somewhat disagree	16	13,4	13,4	100,0
Total	119	100,0	100,0	

Table 5.5. Qualities of wood as a construction material; Wood constructed residential buildings have good acoustics and sound insulation.

Puusta rakennetuissa asuinrakennuksissa on hyvä sisäilman laatu. / Wood constructed residential buildings have good indoor air quality.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	35	29,4	29,4	29,4
I somewhat agree	78	65,5	65,5	95,0
I somewhat disagree	5	4,2	4,2	99,2
I fully disagree	1	,8	,8	100,0
Total	119	100,0	100,0	

Table 5.6. Qualities of wood as a construction material; Wood constructed residential buildings have good indoor air quality.

**Puurakennus on terveellisempi asuinympäristö kuin muut (esim. betonista rakennettu). /
A wood building is a healthier living environment than others (e.g. concrete buildings).**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	32	26,9	26,9	26,9
I somewhat agree	70	58,8	58,8	85,7
I somewhat disagree	17	14,3	14,3	100,0
Total	119	100,0	100,0	

Table 5.7. Qualities of wood as a construction material; A wood building is a healthier living environment than others (e.g. concrete buildings).

**Puun käyttö aiheuttaa vähemmän ympäristöhaittoja kuin tiilen, betonin tai teräksen käyttö.
/ The use of wood causes less negative impact on the environment than using brick, concrete or steel.**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	43	36,1	36,1	36,1
I somewhat agree	67	56,3	56,3	92,4
I somewhat disagree	8	6,7	6,7	99,2
I fully disagree	1	,8	,8	100,0
Total	119	100,0	100,0	

Table 5.8. Qualities of wood as a construction material; The use of wood causes less negative impact on the environment than using brick, concrete or steel.

Ihmiset jotka asuvat puurakennuksissa kokevat olevansa lähellä luontoa. / People who live in wooden buildings feel close to nature.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	39	32,8	32,8	32,8
I somewhat agree	65	54,6	54,6	87,4
I somewhat disagree	13	10,9	10,9	98,3
I fully disagree	2	1,7	1,7	100,0
Total	119	100,0	100,0	

Table 5.9. Qualities of wood as a construction material; People who live in wooden buildings feel close to nature.

Mitä ympäristöystävällisempi rakennus on, sitä kalliimpi se on. / The more environmentally-friendly a construction, the more expensive it becomes.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid I agree fully	10	8,4	8,4	8,4
I somewhat agree	54	45,4	45,4	53,8
I somewhat disagree	45	37,8	37,8	91,6
I fully disagree	10	8,4	8,4	100,0
Total	119	100,0	100,0	

Table 5.10. The more environmentally friendly a construction, the more expensive it becomes.