



The future of wooden multistory construction in the forest bioeconomy – A Delphi study from Finland and Sweden[☆]



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ABSTRACT

The rise of wooden multistory construction (WMC) in the Nordic countries has turned out to be the most evident construction-related new business opportunity in the emerging bioeconomy. Based on earlier literature, the future growth prospects for the rise of WMC are rooted in the concerns regarding environmental issues, as witnessed in a plethora of studies focusing on carbon footprinting. But do new (performance-based) regulations ‘favor’ WMC or do they give a more ‘just’ comparison of alternative building concepts? Therefore, more information is needed on the role of growing environmental awareness and preferences for wood as a renewable and recyclable material in the markets. Our paper presents results from a two-round Delphi study focusing on the relative strength and perceived interplay between likelihood and the desirability of environmental concerns in driving WMC in Finland and Sweden. Using qualitative analysis of expert interviews in the first Delphi round, the issues related to sustainable development appear to have growing importance in the marketplace. However, the panelists perceive that the emphasis on sustainability is mainly driven by the changing regulation reflecting societal needs, and only few experts saw it as echoing directly from changing individual consumer needs. In the second Delphi round, implemented with an online survey, the likelihood and desirability of sustainability as a megatrend in housing was perceived to gain further impetus toward 2030, both in the form of consumer demand for sustainable living and wood construction as a modern way of living. However, future research is needed to get a better understanding on the strength and scope of these drivers.

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Introduction

Sustainable construction is a way for the building industry to contribute toward sustainable development, where according to Bourdeau (1999, p. 364) the main challenge is “to transform the demand for sustainable development into an opportunity, to create and access new markets, and to innovative responses which satisfy traditional industry demands and the new societal demands for sustainable development”. The building sector contributes to

as much as 42% of final energy consumption, 35% of total GHG emissions, 50% of the utilization of extracted materials, and 30% of water consumption in the European Union (EU) (European Commission, 2011). Thus, construction and housing play a fundamental role when aiming at enhancing societal goals for sustainable development. For example, by developing the construction and utilization of buildings in the EU, it is claimed that the total final energy consumption could be decreased by approximately 40%, total greenhouse gas (GHG) emissions by 35%, and the use of building materials by 50%, respectively (Herczeg et al., 2014).

In recent years, the positive trend of the spread of wooden multistory construction (WMC) in the Nordic countries has turned out to be among the most interesting new business opportunities in the emerging forest bioeconomy. Also according to Bosman and Rotmans (2016), in the Finnish national level transition to bioeconomy, bio-built environment based on wooden buildings and the use of renewable construction materials is among the focal activities.

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The market share of wooden multistory apartments completed in Finland was only 1% in 2010, whereas the share had grown to 10% by 2015. In Sweden, local examples exist of strategic targets where even up to a 50% market share in WMC may be gained by 2020. Many reasons exist behind the increase of WMC in Nordic countries, but for Finland some studies (e.g. Hurmekoski et al., 2015b) mainly credit the increased popularity to a change in building regulations in 2011, which allowed the construction of WMCs up to eight stories high compared to the earlier three-story limit. Thus, in addition to environmental issues, changing building regulations are also bound to be one key driving force for the future of WMC.

According to Hurmekoski et al. (2015a), environmental impacts of construction practices are associated with material renewability and recyclability, as well as in the possibilities for contribution of the construction material choice into climate change mitigation. Recently macro objectives encompassing not only resource efficiency considerations, but also other significant environmental or functional performance aspects that have an influence on the lifecycle of buildings have been emphasized. While addressing sustainable development is a key topic in reaching the acceptability of solutions based on building and living with wood in the forest bioeconomy (Pätäri et al., 2016), in the background there is a larger environmental change in societal values toward sustainability and sustainable development. From this point of view, the relationship of environmental concern and consumer behavior regarding food, mobility, or general environmental attitudes can be useful in framing the research on the role of consumer lifestyle regarding sustainability (e.g. Autio et al., 2009; Maniatis, 2015).

The impact changes caused by construction and the utilization of buildings can be affected e.g. by the selection and transportation of raw materials and products in construction projects, along with the utilization of renewable energy during the usage of buildings to maintain the intended indoor climate and air quality (Häkkinen, 2007). The positive prospects for the rise of wood in multistory constructions lay in the concerns regarding environmental impacts and the long carbon storage option of wood, as witnessed in a plethora of life cycle assessment studies focusing on carbon footprints (e.g. Cabeza et al., 2014; Gustavsson et al., 2010; Upton et al., 2008). Improving material efficiency, which in WMC can be achieved through industrial prefabrication, is one of the key issues in construction, which affects global warming through reduced greenhouse emissions (Ruuska and Häkkinen, 2014). However, based upon a backcasting study, Hurmekoski et al. (2016) concluded that only more stringent regulatory push for green building, and the courage of wood element suppliers to take new roles in the construction value chain could effectively boost the further diffusion of WMC. Nevertheless, these authors were rather pessimistic that even the most effective measures could only have a gradual impact, and mainly through an increasing number of successful reference projects.

In previous WMC studies, Roos et al. (2010) found that architects and structural engineers in Sweden value wood because of its strength, environmental friendliness, easy handling, and appropriateness for use in conjunction with other materials. Hemström et al. (2011) assessed the perceptions, attitudes, and interest of Swedish architects in using wood frames in multistory buildings, and found that architects and contract managers also associate it with several disadvantages and uncertainties, primarily with respect to fire safety, stability, durability, and acoustic properties. In addition, contract managers were found to have stronger faith than architects in the prospects of wood frames. Richelieu and Kozak (2012) found, when studying the views of architects on using wood in the US for non-residential buildings, that several information requirements must be met to enhance the usage of wood in the markets, including design possibilities, regulations and standards, environmental footprints, and sustainable design. Regarding the changing

trends in wood construction affecting the entire business, Wang et al. (2014) found in their study of the UK market that, as a part of the rise of the green building concept, the trend in wood construction increasingly includes the use of hybrid structures (e.g. combinations of wood and steel) or composites (such as wood and plastic).

According to Toivonen (2011, 2012), both consumers and construction material companies consider the environmental quality of wood to be important. In a study by Toppinen et al. (2013), elements related to the environmental sustainability of wooden products in housing, the social acceptability of products, and the esthetic characteristics of wood can all be associated with a distinct consumer lifestyle, consisting of a complex interplay between consumer backgrounds, values, and behavior. According to Toivonen and Hansen (2003), wood is additionally an attractive material compared to many other materials. However, environmental quality is typically not the main quality attribute driving consumers or organizational customers in their choice of construction materials. From the perspective of existing literature, only a few studies have directly linked the future of WMC to its key driver, i.e. changing societal values toward sustainable development, and the future perceptions of WMC value chain actors have scarcely been studied (see, however, Hurmekoski et al., 2015b, 2016; Wang et al., 2014).

Although the consumer perceptions of the environmental quality of wooden products can be identified and logical (Toivonen, 2012), the practical meaning of environmental attributes can still be vague for the majority of consumers. In a recent study by Hoibo et al. (2015) from Norway, younger people with strong environmental values were found to be the best target for increasing wood-based urban housing. The domestic origin of wood materials has been found to associate with environmental quality in Europe (Rametsteiner, 1998), and also in particular in Finland (Toivonen, 2012). Also in other contexts, the environmental quality of wood has been found to connect with consumer willingness to buy and even to pay premiums for products of higher environmental quality (Hansmann et al., 2006; O'Brien and Teisl, 2004). Overall, consumer knowledge probably is yet likely to be relatively low when it comes to building materials impact on human health (Keith, 2011).

To gain a better understanding on the role of perceived environmental sustainability and building regulations as the two driving forces for the future of WMC, we will study the value chain contexts in Finland and Sweden. These countries are of interest, not only because of their increasing shares of WMC, but also because of their national bioeconomy strategies strongly related to forests and the use of wood in construction. More precisely, a special focus of our study is on evaluating the perceived interplay between the likelihood and desirability of environmental value changes and regulatory factors in the context of WMC. Our two specific research questions are: (1) *How do value chain actors perceive the role of various environmental concerns when characterizing the sustainable future of WMC*; and (2) *What is the likelihood and desirability of sustainability-related demand and regulatory aspects for the future of WMC toward 2030*? Our study draws from a two-round Delphi study among Finnish and Swedish experts. Based on the analysis, we are able to more specifically point out potential pathways regarding the future development of WMC, and make more elaborate suggestions for future research needs in this emerging topic area within the forest bioeconomy.

Material and methods

Among various foresight approaches, the Delphi methodology has established a position as an effective tool for gathering expert opinions on a variety of problems in various domains under market and technology forecasting, especially in situations where expert

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