

Product-service Systems for Regenerative and Long-lasting Buildings: Case of Wood in Finland

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Introduction

New market demands on building solutions both mitigating and adopting to both climate change and biodiversity are on the rise. Wood material has been considered to be renewable, low carbon and regenerative material for buildings. As a response to expected market growth there are many bundles of innovations brought forth by the companies and their collaborative partners in the realm of sustainable buildings and connected to wood material in a spectrum of ways. In our study we focus on mapping the range of innovations designed to make buildings and embedded materials longer lasting, encompassing new products, services, and most importantly enhancing product-service systems in Finland. By applying insights from 20 qualitative interviews and literature on product-service systems (PSS), sustainable innovation and different typologies of servitized, circular, and regenerative business models, we are able to shed light on new sustainable innovations developed by forefront companies and connected to the use of wood material. We elaborate on wooden construction and retrofit innovations with a focus on adaptive, flexible and extending building with longevity (Pelsmakers and Warwick 2022; Kuittinen, 2023). The main functionalities of these innovations centered around resource efficiency but could be bundled more tightly together to achieve greater sustainability impact to favor circular economy and resilience to environmental challenges.

Literature background

Conceptually our study draws from product service systems (PSS), sustainable innovation and business models. PSS have been depicted as promising new approach to business models (Ghafoor et al. 2023; Pelli and Lahtinen 2020). PSS represents a system of products, services, supporting networks and infrastructure

designed to be competitive, satisfying customer needs, but also lowering the environmental impact when compared to conventional business models (Mont, 2002). In circular economy, the focus on system solution is important, where the outcome ensures slowing or closing the loops. Reim et al. (2015) observe that the business model in PSS implementation is defining its success, and it is crucial to understand how the value creation, delivery and capture take place. In our study, we rely on the interlinked literature that brings forth servitization business models (Yang & Evans 2019; Pelli 2021), circular business models (Ghafoor et al. 2023; Rieke et al. 2018) and regenerative business models (Konietzko et al. 2023). Moreover, in the buildings context it is crucial to combine the business model thinking with the waste management hierarchy, as developed by Kuittinen (2023), positing that that existing buildings should be used and renovated as far as possible to ensure longevity and efficient use. In our study, we are interested in the shared value propositions of the building innovations. Sustainable innovation market diffusion has been investigated in the past by Fichter and Clausen (2016) and identification of new markets by Yang and Evans (2019). The focus of our study was to detect new market paths that could alternate from the current construction sectors path dependencies largely relying on new concrete-material based solutions as opposed to circular and hybrid-material solutions.

Materials and methods

Finland has strong traditions on building with wood in single housing sector, but at the same time its construction sector for multistorey buildings has a clear path dependency on concrete-material based practices and products with high environmental impact. Thus, Finland represents an interesting case study setting of how the capabilities in the construction sector

could be renewed with new sustainable innovations. Thereby, we collected and analyzed qualitative interview data of 20 Finnish company informants. Data was collected between 2021–2024. Data was coded and categorized using the Qualitative Data Analysis & Research Software ATLAS.ti 9. Key themes coded were connected to sustainable innovations of the services integrated to products and solutions to enhance longevity.

Indicative results

From our data, we were able to detect different types of sustainable innovations. The majority dealt with mere improved products or systems, such as introduction of cross-laminated timber (CLT) and wood frame elements that enable prefabrication. However, part of the sustainable innovations were representations of PSS that could be viewed as constellations of several connected innovations in an attempt to introduce systemic innovations to the markets. The innovations were connected to extending the lifecycle of certain existing buildings via renovation; adding on regenerative materials (such as wood) to the building stock to substitute concrete; introducing recycled construction materials as part of buildings; or through new service-innovation to avoid the excessive material-use altogether. Also, the service appears in the data as for instance installation services, or possibility to refurbish and reuse CLT elements.

The proposed hierarchy of Kuittinen (2023) for preferring use of existing spaces, renovating, adapting or extending the existing buildings over new construction is a useful frame for analyzing our data and it is gaining relevance with the European Renovation Wave and EU taxonomy to sustainable finance putting stricter requirement for material reuse share. In addition, we were able to detect some innovations that would have significant sustainability impact if they were connected to bigger bundles of multi beneficial construction solutions and having synergies with nature-based solutions. The most systemic concepts and ideas with widest sustainability impact are still mainly in pre-market phase.

Tentative conclusions

There is a need for sustainable and wood material related innovations for buildings that go beyond one company's value offerings. The product-service systems are being ideated as

conceptual designs and occasionally initiated as small-scale pilots. However, the need for radical and systemic sustainable innovations for buildings is growing simultaneously with the worsening environmental problems, creating new markets both domestically in Finland and internationally.

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