POLITECNICO
MILANO 1863

SCUOLA DI INGEGNERIA INDUSTRIALE
E DELL'INFORMAZIONE

EXECUTIVE SUMMARY OF THE THESIS

The use of wood in the construction industry in Italy: a SWOT analysis from the perspective of different actors

TESI MAGISTRALE IN MANAGEMENT ENGINEERING – INGEGNERIA GESTIONALE

AUTHOR: Angelo Mario Ferrario

ADVISOR: Nizar Abdelkafi

ACADEMIC YEAR: 2022-2023

1. Introduction

The construction industry is responsible for a conspicuous part of energy usage and CO2 emissions in Europe. Italy, as one of the leading economies in Europe, has a rich history of architectural and construction achievements, however, the country faces significant challenges in terms of environmental sustainability and the need to adapt to modern construction techniques and materials. One potential solution to these challenges lies in the increased use of wood as a primary building material. In Italy the construction sector has preponderous importance, employing a large workforce and contributing noticeably to the GDP of the country, as such the country should find an effective way to foster the adoption of wood in construction projects. The research will focus on the following questions:

1. Which are the strength, weaknesses, opportunities and threats associated to the use of wood in the construction industry in Southern European countries from the viewpoint of the actors involved in the construction project?
2. How can companies involved in construction project capitalize on the identified opportunities and reduce the identified threats?

This document aims to provide a comprehensive analysis of the use of wood in the Italian construction industry by conducting a detailed SWOT analysis from the perspective of various stakeholders.

2. Literature background

In literature there is wide availability of studies concerting several different aspects of wood-based applications in the construction industry. Firstly, researchers have focused on the mechanical and thermal properties of wood, as well as its CO2 storage capabilities. In construction, there are different types of wood that can be used and different wood-based components having different characteristics. Relevant to mention the contribution of Kretschmann in writing a book with in-depth insights about all the different mechanical properties of wood [1]. Literature

focuses also on other aspects concerning the use of wood in construction. There are studies tackling the supply availability in Europe, highlighting its non-criticality from a capacity viewpoint. Other researchers keep instead a focus on the different possible applications, highlighting the load bearing capabilities of such material and thus its important contribution in retrofit and restructuring applications. Is also important to note the availability of studies in relation to fire and moisture impact of timber-based solutions and the related protection mechanisms. Some scholars also study how LCA methodologies can highlight the long-term benefits brought using wood in buildings in comparison to traditional materials. Moreover, other studies focus on the theme of certifications and their application for building quality analysis and for tracing purposes. In relation to the market there are documents highlighting how concentrated the building market in Italy is and showing the value given to collaboration among companies in the construction industry for innovation creation. Other researchers keep the perspective of customers, studying their influence on companies operating in the market. To summarize, there is wide availability of studies tackling the use of wood, its characteristics and its supply chain. However, most of these studies keep the perspective of the application in northern Europe and keep the viewpoint of the final customer or focus on the material. This research document will detail the situation in the Italian market by keeping the perspective of the actors involved in the chain.

3. Methodology

To carry out such research work is needed to rely on qualitative research methods. Gioia et al. offer valuable guidance on how to carry out such work with rigor and letting the insights highlighted by the players to emerge [2]. Interviews have been conducted with people working firsthand with wood and other biobased materials and from there an abstraction process has been followed, to let emerge the main topics that are closest to the interviewees.

3.1. Research design

After having performed and explorative study on the existing literature, an interview guide has been elaborated to guide the conversation towards some selected topics of interest. The questions have been posed in a way such as to not lead the witness towards specific answers and have been posed to keep impersonality. To better structure the discussion, the interview guide has been divided into seven different sections, each one with specific aims. The sections are aiming to providing insights on one specific theme

3.2. Data collection

Several companies have been contacted for scheduling an interview, and Table 3.1 provides an overview of the companies that provided a positive answer with their correspondent role in the supply chain.

Role in the supply chain	Contacted companies	Interviews done
Suppliers and vendors of components	14	4
Building companies	47	7
Architects, advisors and engineers	13	4
Facility managers	5	0
Suppliers and vendors of raw material	11	1
Real estate companies	3	0
Regulators and legislators	7	3
Total	**100**	**19**

Table 3.1: companies overview

Of these 19 interviews, two were done in a joint session and one was impossible to record, thus the final number of documents to be considered is 17. The interviews have been done between May and July 2022 and have been recorded and faithfully transcribed.

3.3. Data analysis

Following the approach described by Gioia et al, all the transcriptions have been thoroughly analyzed and described using a SWOT classification. The ones that have been identified as relevant have been labeled allowing a 1st order categorization of the findings, adhering faithfully in using the informant's terms [2]. This first order categorization resulted in identifying 982 distinct labels which have then been abstracted and fit into

a 2nd order categorization consisting in 92 common themes identified. To conclude, 11 autonomous aggregated dimensions emerged, aggregating the results of the second categorization process.

4. Results

In this Chapter all the results will be summarized by keeping two different aggregation levels: a first overview will show the findings grouped by aggregated dimension, to have a complete understanding of the themes identified. The second overview will group the themes by actor presenting a SWOT analysis for each of them.

4.1. Aggregated dimensions

In the following section all the dimensions are tackled in alphabetic order and shortly presented.

4.1.1. Buildings

About the final output of the construction project, companies stress its cost structure, unbalanced towards the initial design. They also highlight how maintenance activities are not different compared to a traditional building and how the end-of-life management of every building is complicated because of several factors. Comparing timber buildings against traditional ones, they stress the enhanced quality of living offered by wooden solutions. They also highlight how wooden buildings are susceptible to fire and humidity, however given the wide variety of protections measures available this weakness is not crucial. Actors also stress how difficult will be in the coming years finding plots where to live and thus point at wood as a perfect solution for executing elevation, expansion and renovation works. They also highlight the shift needed to perceive existing buildings as material deposits and the possible advantages that this change may bring, above all from a financial viewpoint. Finally, they are confident that the market for sustainable buildings will grow, and wood will play a big part in it.

4.1.2. Certifications

Another important dimension is related to the wide availability of certifications in the market, addressing both the final building and the material. Great focus is placed on certifications used for tracing the material along the supply chain. Several protocols are available in the market and are applied in Europe for most construction materials. Companies then debate about the model that should be taken for certifications, understanding if these should be mandatory or kept on a voluntary basis. Surely, the impact that they have on the daily management of operations is noticeable, leading to process optimization and best practices diffusion, but also to a higher documentation workload. Finally, actors pose a remark about the comparability of certification schemes across national borders and across different building solutions, to have a clear benchmark to be referenced for evaluation.

4.1.3. Companies

Important to focus also on themes directly linked to organizational and internal topics. To start, is important to mention how the companies feel the presence of a collaborative environment in the market and how all actors have both horizontal and vertical links with partners in the supply chain, also through innovation hubs, working groups and national associations that allow the interaction and foster innovation. They only complain about a lack of contact with designers, often not included in such initiatives. This fertile ground for collaboration is also enabled by the size of companies operating in the Italian market. Most companies are small and need networking for engaging in big projects and remaining at the edge of innovative solutions. Companies are also exploring different choices for differentiating themselves in the market and define new value propositions to customers by offering support activities during the construction project. The biggest struggle comes from the lack of experienced and specialized labor, which is of uttermost importance given the complexity of highly engineered wooden solutions. Important to mention that the use of wood leads to lower margins but also to the possibility of anticipating the sale of the house before the actual construction, leading to a lower financial exposure.

4.1.4. Customer

Regarding customers, there are mainly three types of investors for wooden buildings. A private citizen, who chooses wood for the living quality it enables, a commercial investor who wants to capitalize on the added sustainability and the fast construction timings, and the public sector, which searches for advantages from both viewpoints. All actors agree that anyhow the demand for sustainable buildings is growing and that private and public sectors are tightly linked and carry each

other. It must be stated that the main choice factor for a building remains its location, thus the possibilities of exploiting the added sustainability offered by timber structures are narrow. Also, the perception of final customers is still biased towards wooden solutions and only the combination of time and the thorough awareness work done by the companies operating in the market will allow a paradigm shift.

4.1.5 Design

The next big topic involves the design phase, extremely important in every construction project but above all for timber solutions. Design should anticipate all the possible issues that may occur during the building lifecycle and ease their impact, also driven by the greater need of detail coming from the precision needed for wood design and production. Actors also highlight how important is using resources correctly, exploiting also the possibility of combining and hybridizing materials, at the cost of having a more complicated management of their end-of-life. They also stress how this greater focus on the design activities carries costs to be faced and how in the market there is a lack of specialized designers and widespread knowledge about wood design. Some innovative solutions proposed focus on finding a balance between design standardization and customization, using modular solutions. Another direction focuses on the application of design paradigms such as design for disassembly and tentatively Cradle to Cradle, even if its application in building contexts results complex.

4.1.6. Digital solutions

Digital solutions are at the edge of innovation for building applications. They are still perceived as an added complexity from actors operating in the industry, however for big projects are often used as well as in continental Europe. In Italy their adoption is still rare despite their favorable impact on companies' processes, above all for construction site and operational life management. They allow the synchronization of processes among different actors, easing the interaction. The main drawback hindering their large adoption is the lack of a standard software language. Interesting applications of such solutions can be found above all in relation to building monitoring.

4.1.7. Government and politics

Companies find the actual geopolitical situation as unstable and threatening due to the consequences of covid pandemic and Ukrainian war. However, European institutions are fostering the adoption of biobased materials in the construction industry and the market share of such solutions is steadily increasing over time. Italy still has a long path to go for reaching satisfactory results, since several grey areas are present in the current legislation. Local administrations are trying to make up for this shortcoming, however the result is just fragmentation and differences in local prescriptions. Actors operating in the industry have plenty of suggestions on actions to be taken, spanning from incentives and bonuses to added taxation and carbon taxes. Nevertheless, they are aware of the risks of over-intervening, drugging the market and distorting reality, which in the long term will only hinder the sector. Finally, companies in the market are afraid about the tight connections present between banks, government and big national concrete groups and fear that these connections will be leveraged to hinder the development of timber construction.

4.1.8. Manufacturing

In relation to manufacturing, actors focus on the manufacturing strategy and the possibility of components storage. They highlight the importance and the need of off-site manufacturing as enabler for coherence between design and application and focus also on the importance about finding a balance between products customization and production standardization, concluding by stressing the importance of modular construction. The actors also highlight how wood products allow the reutilization of industrial scraps as energy source or as input for other industries.

4.1.9. Materials

Great importance is given to the material by all actors, by stressing its strengths and weaknesses as well as its performances. Players are also aware of the added cost coming from using timber and about its higher instability. The impact that such material has on buildings, however, is remarkable both from a structural and insulation viewpoint. Wood acts as CO2 storage, easing the carbon impact of the final building. By adopting comprehensive lifecycle evaluation techniques, the comparison with traditional materials is largely won, even if the part related to the end of life remains blurred and not clearly defined: the recyclability of the material is not always granted, and several factors influence it. Finally, the actors also tackle the process of new materials introduction, stressing the importance of developing technical standards for their use.

4.1.10. Supply

Companies mainly focus on supply availability in the long term, trying to ensure raw materials availability despite their cost. The materials availability depends mainly on the natural resources renovation rate and on the harvesting strategy adopted by producers. To conclude, companies adopt different sourcing strategies, focusing on yearly horizon or on decades.

4.1.11. Sustainability

Finally, the interviewees stress how the use of wood enables a circular economy paradigm, which however remains not useful if not accompanied by a systemic change. Also, they put the focus on the advantages coming from an energetic viewpoint and on how marketing and greenwashing practices can be dangerous for the final customer perception. They conclude by stressing that among the pillars of sustainability profit has higher weight that other dimensions and by discussing the dichotomy between durability and reusability, whereas the more durable is a building, the more difficult is reusing its components.

4.2. SWOT analysis

This section provides a summary by actor of the SWOT analysis results.

4.2.1. Design firms

The main strengths highlighted are related to the presence of a collaborative environment, the use of certified materials and the expansion interventions enabled by wood. The main weaknesses instead are represented by an incorrect use of resources, the difficulty in applicating new design paradigms in construction projects and the lack of embodied and operational carbon targets for buildings. From the opportunity's viewpoint, they rely on government intervention to foster the market and in the paradigm shift that will occur when companies retain responsibility about the buildings delivered. The main threats identified are aggressive marketing that gives a wrong perception of the sector and the negative trend being registered in personnel availability.

4.2.2. First transformation companies

These players highlight as main strength the possibility of storing components as well as the usage of industrial waste as input for other processes. At the same time, complains that the value brought by sustainability is quantifiable only if brought in a broader scenario such in LCA applications. The main opportunities identified lie in the value embedded in existing buildings to be recovered and in monitoring solutions to be implemented. Finally, the main threats identified are related to greenwashing practices and the dichotomy profit-environmental sustainability.

4.2.3. Components producers

Components producers focus on the material strengths and on the impact of biobased materials on the quality of living in the house, as well as the wide availability of protection measures against fire and humidity. They complain about how the critical points are managed only by designers and how is difficult to quantify the economic return coming from purchasing a timber house opposed to a traditional one. They also stress the opportunities coming from leveraging different characteristics depending on the customer being addressed and how much the government could do to foster market development. Finally, they are afraid of the future supply capability and of how costly the solutions available for closing the loop are, hindering the adoption of such practice.

4.2.4. Building companies

The core strengths highlighted by building companies are the wide adoption of tracing certifications and the presence of synergies with suppliers. Regarding weaknesses, they stress mainly the lack of technical preparation of the workforce. Focusing on opportunities, they highlight the role of the government once again and the evolving market demand that will drive the market. They are however afraid that the interventions of the legislators will not be long-term oriented and that they will lead only to distorting the market rather than fostering it.

4.2.5. Other actors

These interviewees are communication experts and exponents of one standardization institute, responsible for certification management. They report as main strength the wide adoption of BIM in Europe, being a positive signal for the Italian market, and stress the importance of using industrial waste as input for other activities, enabling circular practices. Regarding weaknesses, they stress how the main cost is related to the design phase. They also highlight how material hybridization practices prevent future disassembly. These actors are positive that in the future a servitization model will take place in this industry, and the first hints can already be seen in the real estate market. Finally, these actors are concerned about the end-of-life management of buildings and about the huge availability of

different materials, each of which requires specific knowledge to be installed.

5. Discussion

This section shows the similarities and differences between the SWOT results, the relevance of the results against the literature background and the managerial implications that can be derived.

5.1. Similarities and differences

The different SWOT analysis performed showed some common themes among all interviewers, relevant for the industry. Regarding strengths, the main common points are related to the acknowledgement of the presence of a collaborative environment and to the recognition of the wide adoption of certifications in the industry. It is contradictory, however, that some companies advocate for a collaborative environment while at the same time complaining about a lack of connection with the designers. Also, the interviewers pointed out that the impact of certifications is not always tangible and there is a debate about their nature: mandatory or voluntary. About weaknesses, companies mainly refer to the poor application of digital tools and question why in Europe there is a larger adoption of such tools. Also, the interviewers point out how short supply chains are advocated by several players but also how is impossible to apply such prescriptions in Italy due to a lack of wood suppliers. In relation to opportunities instead all companies agree that the government should intervene to foster the development of the market and there is wide availability of proposals. Most companies also stress the solution of material combination as the real sustainable solution in the long term, however they also point out how to manage at its end of life such hybrid material. Finally, the main concern about the future from the companies' perspective is the lack of supply and the lack of trained labor.

5.2. Comparison with the literature

The results obtained are aligned with the findings of the literature. Is relevant to mention however that the main difference lies in the approach taken. Researchers keep a detailed technical viewpoint while the results of the interviews tackle all round topics and keep a pragmatic viewpoint, stressing always the economic feasibility of the proposals.

5.3. Managerial implications

From a managerial viewpoint, the contribution of this work aims to propose solutions to capitalize on opportunities identified and act to reduce future threats. The purpose is to provide companies with a clear framework to understand the market from the perspective of their partners, enabling them to collaborate furthermore to foster the sector. Nevertheless, the proposals that emerge from the study should be thoroughly evaluated and studied before being implemented.

6. Conclusion

The relevance of this approach lays in giving voice to the different actors, presenting their viewpoint from an external and objective perspective to grasp the essence of their speeches. This work organizes unstructured information available in the market and spread among different actors in a well-known framework. With this, companies have a tool to understand which are the main strengths and pain points from the perspective of their suppliers and partners being able to focus on them and take eventual corrective actions. The main limitation of this work is related to the scope, which is focused only to the Italian market. Also, is important to highlight the unavoidable bias of the author in moving from the 1st to the 2nd order categorization while abstracting the results. Nevertheless, to continue in the direction of this research an option could be taking the results of this work as a starting point and build over it a research project for the implementation of short supply chains and new business models in this industry

7. Bibliography

[1] D. E. Kretschmann, "Mechanical Properties of Wood," in *General Technical Report*, USDA Forest Service, Forest Products Laboratory, 2010.

[2] D. A. Gioia, K. G. Corley, and A. L. Hamilton, "Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology," *Organ Res Methods*, vol. 16, no. 1, 2013.