POLITECNICO
DI TORINO

Honors thesis

MASTER OF ARCHITECTURE FOR THE SUSTAINABLE PROJECT

(Classe LM-4)

WOOD CONSTRUCTION. The roots of innovation

The Historical Evolution and the Future Prospects for Construction in Lightweight Prefabricated Systems

Thesis Adviser
Guido Callegari

by
Silvia Botta

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In analyzing the current scene for construction, and in particular the data contained in reports about the housing market, a significant fact comes to light: despite the sharp fall in the construction sector in many countries, due to the global economic crisis, one of the few particular sectors to increase steadily is the prefabricated wooden housing market. In Italy, the market share for timber construction has increased from 0.5% in 2008 to 6% in 2014 and is expected to reach 15% by the end of 2015.
Such data are still relatively small compared to those in other countries—especially northern and central Europe—such as Austria, Germany, and Scandinavia. Yet the data demonstrate that, although in Italy its use is still considered a niche area, construction in wood is a growing trend with great future potential.
Today wood has been given a new role as an innovative material – referred to as "engineered wood" -- employed to build modern, multistory buildings and elevations, to renovate pre-existing buildings, to build additions and other interventions intended to increase real estate value.

This master thesis—"Wood Construction. The Roots of Innovation"—offers an in-depth examination of the subject of prefabricated wooden buildings, paying particular attention to technological processes and the innovations within technology that have been implemented over the last two centuries. During the last twenty years in particular, technology has been the engine that enabled the prefabricated wooden housing sector to evolve and expand, thereby transforming primitive wooden huts into true urban buildings.

The first part of the thesis describes the evolving systems for prefabrication from 1800 to the present day, with a timeline graphic divided into two sections: from 1800 to 1990 and from 1990 to the present. This representation highlights in particular the use of wood and different areas of experimentation in the field of construction where today projects and processes "drag and drop" individually patented technologies.

Figure 1 – Developmental diagram of trials and design research on lightweight prefabricated systems from 1990 to today (as outlined by Silvia Botta)

The following section traces back the timeline, beginning with the most recent period, by studying contemporary projects (from 1990 to the present). Here two **prefabricated systems for wood construction** have been highlighted: systems for lightweight construction and systems for massive construction. A graphical display is dedicated to describing the roots of these building systems, pointing out the relationships between different systems and different forms of hybridization and technological innovation in order to understand the achievements of today.

The third part covers the methods used for the production and manufacture of timber construction systems, with particular emphasis on **"Digital Fabrication,"** representing the latest innovations and experiments in the field of lightweight prefabrication. This section discusses the innovations achieved today in lightweight prefabricated systems thanks to digital production, bringing forward in particular three significant innovations: innovation in wooden components, innovation in joining systems, and innovation in the manufacturing process.

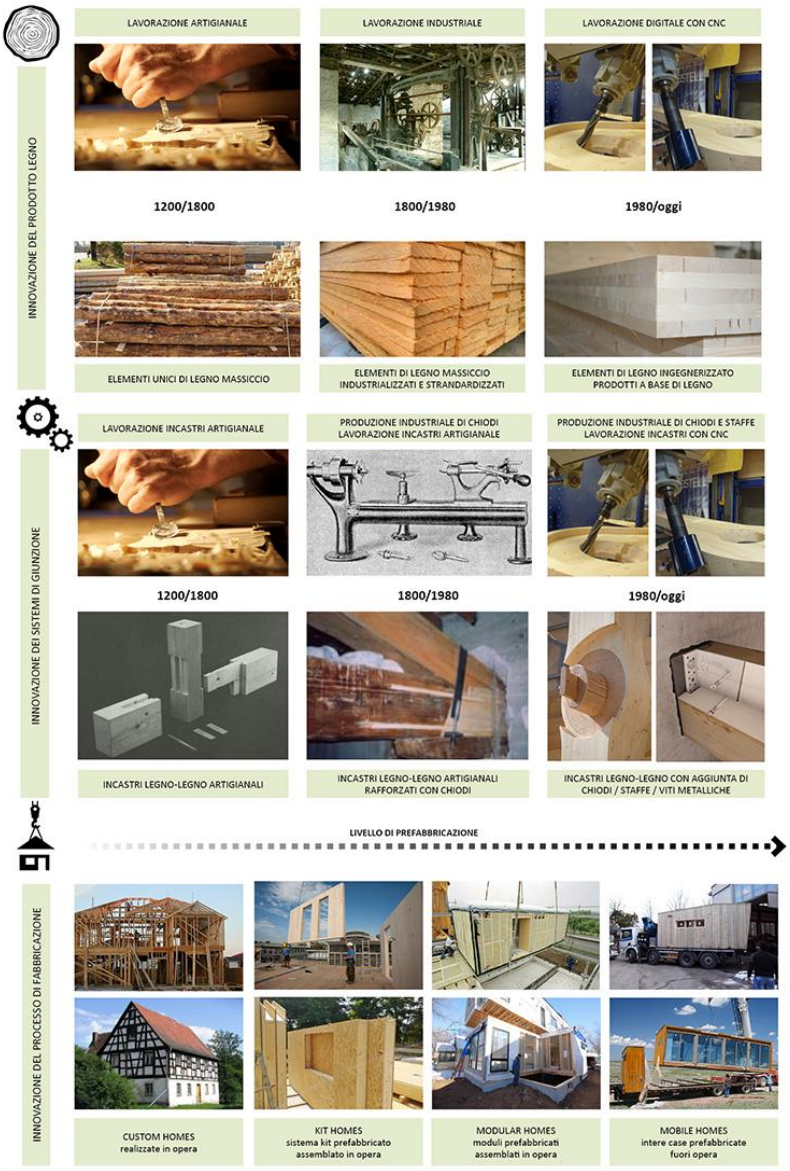

Figure 2: Diagrams of the three significant innovations: innovation in wooden components, innovation in joining systems, and innovation in the manufacturing process (as outlined by Silvia Botta).

The fourth section deepens the discussion of **technology**, the main engine driving the changes described in previous chapters. This subject is analyzed through three case studies of different systems for prefabrication in wood:

- **Sofie Project**, CNR Ivalsa – Italy, 2007;
- **Villa Asserbo**, EENTILEEN Studio – Denmark, 2012;
- **Tamedia Office Building**, Shigeru Ban Studio – Switzerland, 2013.

The three case studies have been analyzed according to the three basic components of technology that define a project: hardware (the means), software (the rules), and brainware or knoware (the aim).

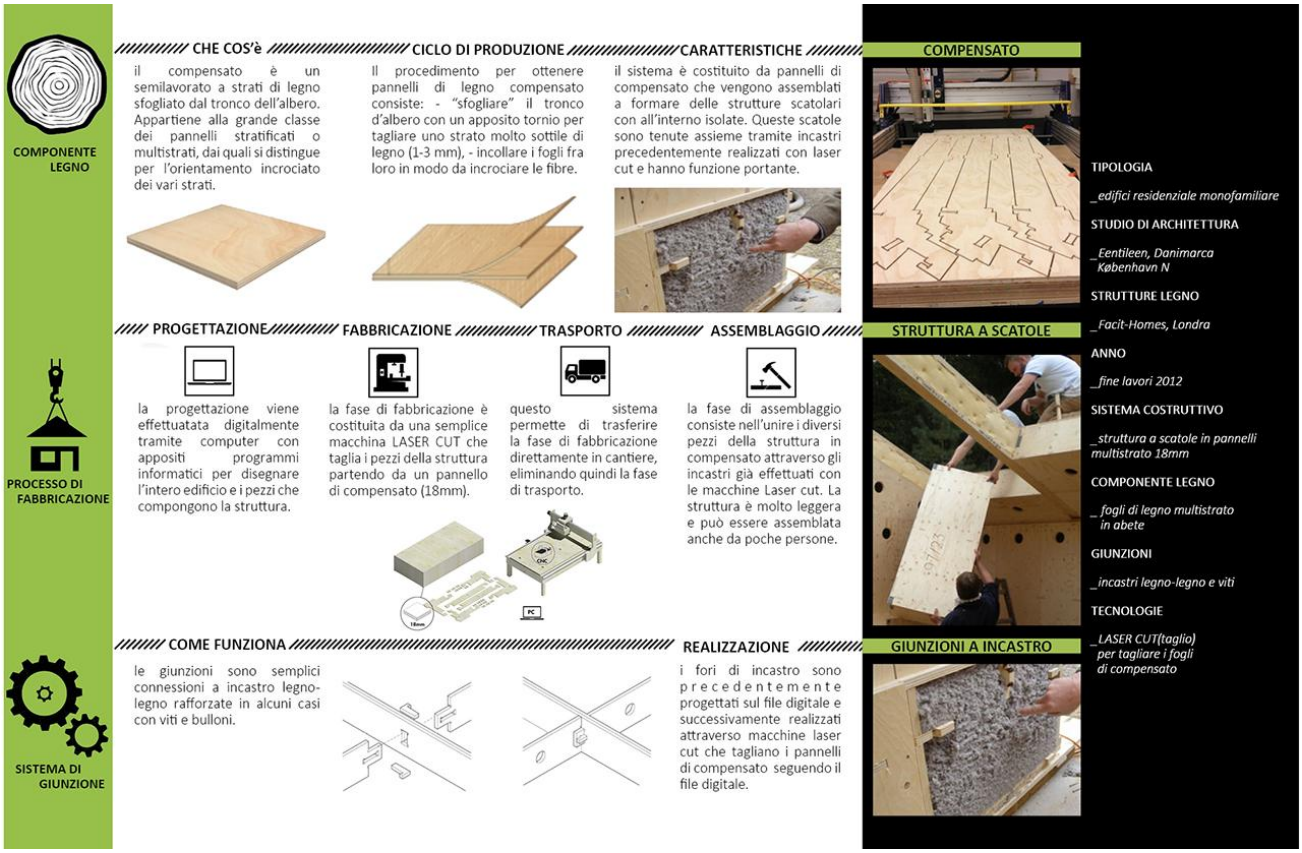

Figure 3: Diagram of a sample case study - Villa Asserbio

Finally, the last chapter defines the factors constituting **the support network of technology**, without which technology cannot be implemented: demand-pull, research-push, and governmental regulations. For each of these elements, particular attention has been paid to the case of Italy—analyzing policies, initiatives, and institutions that have promoted the construction of prefabricated wooden housing.

For further information please contact:
Silvia Botta, silvia.botta7@gmail.com