Planning and Design Challenges for Smart Infrastructures: The Chiloé Island Case

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Abstract: The objective of this study is to explore how to plan and design a type of green construction along with implementing urban governance plans, facilitating smart infrastructure and, in turn, the sustainability of the territory. The island of Chiloé, in southern Chile, has been selected as a case study, due to: (1) it has a unique vernacular architecture based on Smart buildings (2) it has a geographic morphology that has allowed from its genesis as a city to build in wood and sustainable materials; (3) it is going through a transition towards gentrification, due to its tourist attraction; (4) has a governance system.
The methodology is developed through analysis of secondary sources, regarding interviews with: key actors of the place, together with developing a governance model adapted to the territory, finally a detailed analysis of a stilt house is made.
It is concluded that planning and designing a type of Green construction together with implementing urban governance plans, if it facilitates the Smart infrastructure and in turn the sustainability of the territory.

1 INTRODUCTION

The objective of this study is the exploration of planning and design of sustainable structures as a response to the territory. It's argued that exploring how to plan and design a type of green construction together with implementing urban governance plans, can facilitate smart infrastructures and in turn the sustainability of the territory.

Identity expressions, uses, ideas, social and cultural characteristics of a community are elements that make up vernacular architecture (ICOMOS, 1999). The Chiloé archipelago, in southern Chile, is a case study of vernacular architecture relevant in architectural terms due to the patrimonial and vernacular meaning of its palafittic constructions, related to Smart buildings terms: use of local materials and smart and functional constructions. These are important focuses to understand how to face the transition to gentrification through sustainable architecture according to an urban governance system that allows managing a complex system between cultural, social, political and economic aspects (Paddison, 2017) that promotes the revitalization and maintenance of heritage buildings.

The stilt houses are considered vernacular architecture constructions due to the response they have considering the territory: structures in border condition that are built with a series of piles driven with native wood, for example larch wood. They are a conjunction between the knowledge of the tenants with the Jesuit ideas, which arrived in the seventeenth century, where green architecture is prioritized without even knowing it.

The foregoing is rescued and explored, for the analysis of the fusion between vernacular architecture, sustainable architecture and a contemporary governance system, translated into a living and restored heritage in the Chiloe culture leaving a direct relationship with the place where it is located, as well as the ancestral construction techniques, inherited from generation to generation.

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2 THEORETICAL FRAMEWORK

Vernacular architecture is the characteristic architectural form and style of a region or area, where its architecture is defined by the knowledge and experience of the inhabitant, in addition to the use of local materials, which allows the realization of its constructions. This makes it constantly evolving looking for new ways of building. A stilt house is understood as a type of house built on stilts, generally made of wood, which maintains the entire house.

Most of these constructions in the world are located in lagoons, rivers, lakes or on the edge of the sea. The houses of Akit, vernacular houses built in wood on stilts made by the inhabitants, respecting nature, ecology and cultural values, being linked to the environment and traditional (Faisal, Firzal, & Rijal, 2019). The use of local materials such as larch wood, together with the knowledge of the tenants, are key to define the palafittic structures of Chiloé as architectural heritage and an example of sustainable architecture, where construction techniques that open the way to functionality and architectural diversity are evident. Cases such as Vâlcea, Sibiu and Buzău (Bartha, 2014) where the use of local wood in homes appears not only in the structure, but also in furniture, reflect that the use of this material is an indicator to classify those structures as vernacular that show evolution in the tradition and use of raw materials.

Given the tradition of wood construction, it can be understood that it has been an exchange of knowledge passed down through time. Those vernacular works can be classified into different typologies (Maudlin, 2010; Debaillex, 2010) having in common that they are traditional buildings presenting a duality between the social and the political of the time. There is little clarity regarding the tools that are used for the constructions due to their poor conservation, making their authenticity difficult, so we want to combine a system of recognition tools and reconstruct the forms of traditional constructions, giving space to two forms, for example recognition of typologies and also generate hypotheses with the types of structures over time helping a possible reconstruction.

In relation to sustainable architecture, it is a design method which seeks to minimize the impact of buildings on the environment, in addition to improving life and projecting healthy spaces for the inhabitants. There is a great urban expansion, being compact cities those that are more sustainable but lack green areas (Artmann, Kohler, Meinel, Gan, & Ioja, 2019), so they propose to generate a systemic conceptual framework, which is intended to be defined by two focuses: the first being smart cities responding to the needs of urban growth by giving smart limits, and the second being green cities that aim to conserve the environment both in its natural environment and urban context.

Another case of green architecture is the green infrastructure model as a mitigation measure for environmental, social and economic sustainability (McMahon, Benedict, & T., 2002). Where there is conventional planning of open spaces in which it is sought to include the conservation of the environment. Green infrastructure must be addressed as a strategy towards the ecological and social impacts of open spaces, thus trying to generate a network linked to green spaces, as well as natural ecosystems, helping to conserve all these benefits to the inhabitants.

Smart cities are being promoted by new technologies (Ioanna & Dimitra, 2019), being a means of tool to reinforce the conservation of urban landscapes through the detection and processing of data and influential actors, which will be implemented to the users thus developing the interaction of these, being a challenge to take the city of today and that it be modified to the intelligent practices implemented by the infrastructure giving a new vision in the urban context. Taking into account that landscape urbanism must be modified to reformulate, repair and conserve the urban environment.

The inhabitants of smart cities should be older, since they are the ones affected in terms of accessibility given their experience in urban design, planning and management. In the Benalúa neighborhood of Alicante in Spain, the members of the neighborhood participate in providing information and problems of their environment (Pérez-del Hoyo, Andújar-Montoya, Mora & Gilart-Iglesias, 2018), concluding with a network of integration and feedback, thus generating good communication between the administration and its citizens, thanks to the support of new technologies.

Urban governance is defined as the structuring, organization, together with communities and citizens, to participate in the planning and design of the city. "The creative city" (Healey, 2012) proposes having innovation and creativity in its form of governance within a proactive urban context in social and economic boards, in addition to being focused on culture, thus creating innovative and ingenious activities of urban localities.

The city of Hong Kong has a governance model where urban governance and competitiveness for the new era of globalization are analyzed (Shen, 2004).

This indicates that it is necessary to generate changes in urban governance for the economic, social and environmental sustainability of each city, which must be supported by governments and local communities to be successful.

3 METHODOLOGY

The research is carried out through the study mainly of secondary sources, associated with relevant actors for the case study; architects of the area, authorities in charge, groups or consolidated foundations or neighborhood groups that propose a discourse according to what was investigated.

First, the concept of governance is theoretically developed in order to apply it to the case and generate a governance model that adapts to the needs of the object of study once the edges of interest have been studied, even more so when insularity is considered as the prevailing condition of the case. of study and the problems of connectivity and administration that this entails.

Secondly, Chiloé is analyzed from a general perspective, at the urban level, based on the urban ekistic theory of Constantinos Doxiadis (Doxiadis, 1970), mainly to understand the urban-geographical relationship of its conformation and how from this are taken the constructive decisions that are characteristic of the place, understanding the constant dialogue between the sea, the land and the seashore as the main elements to consider when thinking about living in Chiloé.

With this base, in the third place, we proceed to the analysis of the vernacular architecture of the island, closely related to the above, to finally land the analysis on the specific object of the study, the stilt houses, where it is studied from two perspectives, the aspect constructive-material, and the socio-cultural-immaterial aspect. This allows it to be related to concepts of sustainability and from there, to governance, in order to generate the model mentioned in the first paragraph of this section.

4 RESULTS

Referring to governance today is not the same as doing it 30 years ago or even more. Although the term can easily be related to the concept of *state* or the idea of a traditional government, today the concept has been democratized. Governance does imply government, but not just in the classic way mentioned recently; although this is still a governance model (Henao, 2014). This democratization has to do mainly with the descent of the concept towards more local and / or community organizational models, which respond to current and particular needs of each sector, never discarding more traditional or official organizational models, associated with established authorities since in this case, governance is exclusive. Simply put, governance is the process or system by which decisions are made, objectives are defined and progress is made towards an objective, mainly through cooperation. This is done at different scales and always ascribed to the particular context of each group that exercises governance, therefore, it is a dynamic model (Iza, 2006).

Understanding the geographical condition of Chiloé, an archipelago in the south of Chile where there is more sea than land, added to the territorial configuration and centralism of the latter, it is possible to recognize various difficulties to configure an efficient governance plan from high administrative positions such as what It would be the Chilean state, thinking about the sustainable development of Chiloé (Montecinos, et al, 2019). Thus, the presence of local governments, added to the work of various organizations and communities of islanders, are key to the configuration of a viable governance model focused on sustainability, where the community plays a fundamental role.

At an urban level, the Chiloé archipelago is characterized by three primary conditions in its geographical makeup, the sea, the land and the edge of the sea. Beyond the obvious, the first stands out both for its role as a limit to be overcome when considering mobility and as a productive space, while the second stands out from the perspective of available land or useful space, both for living and for producing. Within this duality, the edge of the sea appears as a boundary strip between the two worlds, which, despite its hardness, is diffuse thanks to the prevailing tidal movements in Chiloé and where, thanks to constructions such as the palafitos, a mode of inhabit that dominates the three conditions achieving a unique habitability that combines sea, edge and land. The latter is a key part of the vernacular architecture of the archipelago, which, together with the Chiloé churches and minor elements such as the larch wood shingle among others, are the physical representation of a particular and rich culture based on the cultural syncretism of Jesuits and indigenous peoples, where there is a clearly identifiable architectural style that takes wood as a local imprint (Rojas, 2021).

Adding to the equation, ekistics as urban theory raises the understanding of urban settlements through different scales relating physical aspects with social aspects (Doxiadis, 1970). Thus, he postulates that for a human settlement to be successful, there must be a balance in what are considered as the five ekistics units (nature, man, shelters, society and networks). Nature is the natural space where man is established, who becomes an inhabitant and therefore builds a refuge, understanding that the notion of refuge ranges from a tent to a building. By living with others, man forms a society where the first networks are created based on their social relationships. The networks also make literal reference to mobility, that is, roads and sea or air routes that allow the transfer of man between refuges and nature. Thus, it is enough that one of these units is taken over for an imbalance to begin that will eventually bring negative consequences for the settlement.

Applying the theory to Chiloé, nature is geographic space; sea, land and border, together with their natural resources that, from the insularity, become fundamental given the difficulties of connectivity. The chilote becomes the man. He is the one who, along with other Chilotes, build their cities and towns across the various islands, where, given the aforementioned cultural syncretism, they now have a clear and defined identity based on both technical and ideological knowledge that make them Chilotes, as well, build society based on the consolidation of said identity that also generates social networks. The physical networks are all the roads along the islands, in addition to the maritime routes that allow the connection of the entire archipelago where travel by sea is mandatory under certain circumstances.

This analysis seeks to establish the urban structure of Chiloé as a self-sufficient unit in itself, with clear and definable elements that become key variables to propose a governance model. In this sense, emphasizing once again how the territorial conformation of Chile encourages centralisms that hinder governance models from official bodies that respond to local needs, in Chiloé as an area there are three elements to consider when proposing a model. These would be the geography, cultural heritage and tourism, understood as the historical conditions of the place (Rojas, 2021) and, therefore, maintaining the balance between these is key for the sustainable development of the archipelago, these three fundamental parts of the landscape that characterizes it.

Given the difficulty of accessing external resources, Chiloe architecture was consolidated based on wood. The aforementioned syncretism between native peoples and Jesuits also gave way to a carpentry school of its own style that ends up configuring a clear architectural image, where it also becomes one more element of those that make up the identity of Chilote and its vernacular architecture.

Regarding the latter, the use of wood was not only for its abundance, but also for its resistance to water (specifically native woods) and thermal characteristics, therefore, the result is an architecture that takes charge of its environment. and climatic characteristics with the resources it has available, postulated today related to sustainability but that in the case of Chiloé have been developing long before this was even thought (Rojas, 2021).

Even so, it is important to highlight how, despite the fact that today the use of wood is associated with the concept of sustainability given its low carbon footprint, the difficulty of accessing other materials within the islands and the overexploitation of wood did that various species were predated to the point of almost disappearing, being considered today protected species, an example of how, from the ekistics, the imbalance of a unit, in this case nature, alters an entire system. This is one of the edges to consider when you want to establish a sustainable governance model for the archipelago.

Within the Chilote vernacular, builder of its own architecture but in addition to an identity and a cultural heritage formed over years, fundamental for the social development of the archipelago, the palafito is presented as one of the characteristic elements of the archipelago's imaginary together with the scattered churches through the islands and the tile that covers almost all the houses of Chiloé. Taking care of the need for housing, the scarcity of land and the relationship with the sea, the palafito is built on the sea to also simplify the life of the fisherman who goes directly to his boat from the porch of his house. The relationship with its surroundings and the proposed habitability, both related to ekistics, allow the architectural element or object to be analyzed from the microscale as an example of Green architecture.

Formally, the palafito is a house that is built suspended over the sea, supported by a series of piles (Figure 1), which, like most of the Chiloé houses, is configured around the stove and has a low height to better preserve the temperature. of the predominance of the full over the void for the same reason. It is also characterized by being part of the phenomenon of self-construction, like a large part of the houses in the archipelago, and under this logic, it is also associated with popular knowledge and knowledge in the use of

wood characteristic of Chiloé's cultural wealth (Riveros & Tendero, 2021).

Although there was a time when the palafito was a symbol of poverty and bad living (Rojas, 2021), today it takes its place as an object of identity, being a key attraction for tourism and for architectural interventions. These, added to awareness for the environment, which implies a regulation in the use of native woods and technological advances that allow the redefinition of certain traditional architectural decisions (such as the existence of a stove, for example) are the new precepts. to take into account if you want to implement a governance system based on sustainable architecture, understanding Chiloe architecture as the materialization of a unique cultural heritage and the realization of a way of living.

Thus, today the palafito went from being just a home to hosting programs such as boutique hotels, cafes and even churches, where new technologies are also applied to redefine spaces and create a new habitability that adapts to current needs (Ibid.). Although this implies the redefinition of constructive traditions and cultural aspects, the proper performance of said operations is part of the considerations that a governance system must have that seeks to take advantage of tourism in the area, but always respecting a key cultural wealth to the understanding of Chiloé.

It is then worth asking how the stilt house as an object reflects the needs to establish a sustainable governance model with a Smart focus. Thus, it is essential to think about how to develop a wooden architecture based on the vernacular with the current climatic and productive challenges, where the exploitation of ancient native species is no longer possible, which also implies that the climatic factor that these supplied must be approached otherwise. This also entails the consideration of new technologies, mainly climate, as part of this new Chiloe architecture, where their inclusion must always be in pursuit of a specific architectural type without the intention of transforming it into something new, but rather adapting it to new needs; allow progress, but always maintaining the essence of Chiloé architecture. In addition, Chile's centralism with respect to the administration of the territory must be considered, where there is a historical debt with the territories and regions (Montecinos, et al, 2019), therefore, beyond proposing a model at the country level, It is necessary to propose a model based on communities, not only because of the aforementioned problem, but because these are presented as an opportunity for development as it is an established system throughout the archipelago given the condition of insularity, where the neighborhood support networks and community are already formed and are part of the identity of the place; Without going any further, much of the Chiloe worldview and its rites are based on community activities, including festivities (Ampuero, 1952). This approach also goes hand in hand with the promotion of popular knowledge, and, therefore, with the transmission of a cultural heritage thinking of future generations and not only in its exploitation as a product by the tourist activity. a human group, this implies both cultural and material aspects, therefore, the correct establishment of a governance system for Chiloé must take care of both material wealth and immaterial wealth since both go hand in hand for the correct understanding of the ekistic system of the archipelago; The focus on this object to develop the research has to see how the immaterial culture of Chiloé falls on the material culture, they feed back. In addition, in a place highly demanded from a tourist perspective, such governance must take charge of the correct development of cultural wealth, where although it becomes a product, it cannot lose its significance for those who practice it, ending in a bad caricature. of an entire identity-generating culture.

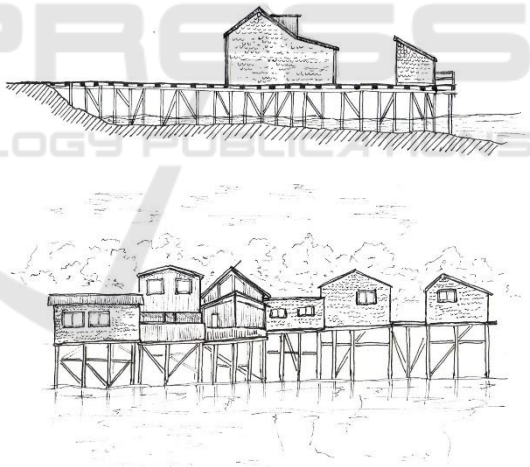

Figure 1: Stilt houses sketch. Own elaboration.

5 CONCLUSIONS

Since its beginnings in pre-Columbian times, the inhabitants of Chiloé have developed based on their context. This relationship takes shape in the development of a clear and defined architectural style always related to wood and in the domain of mobility over a territory that can become hostile when one thinks of moving from one island to another. Even within all this hostility and almost precariousness that

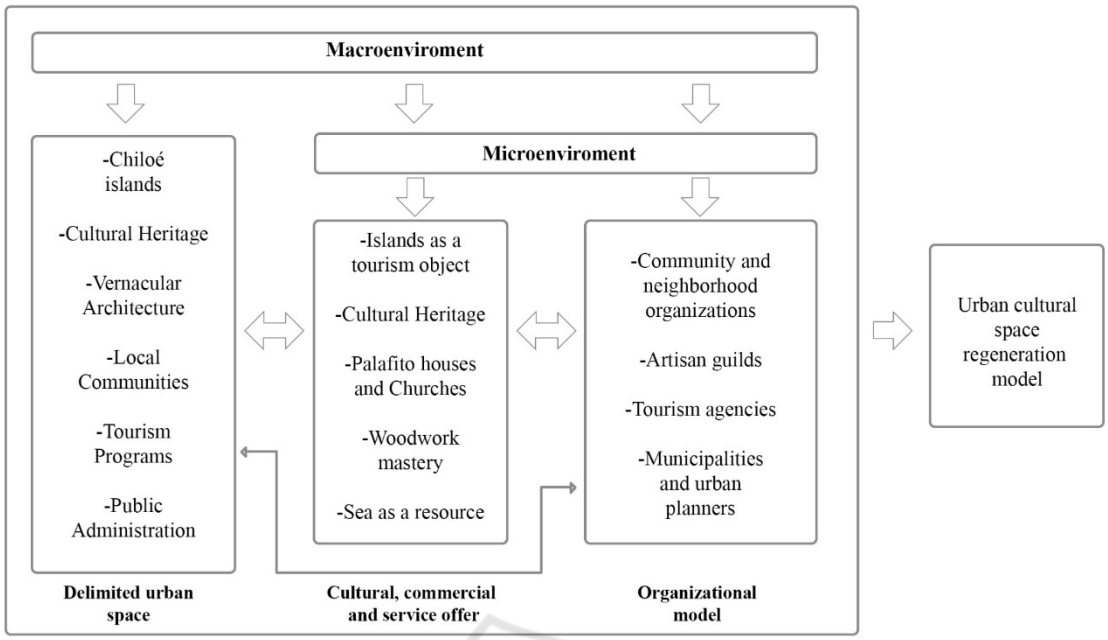

Figure 2: Schematic basis proposed for the model. Own elaboration.

can imply a degree of isolation, a particular and efficient way of living was created with respect to what it sought to solve, mixing all the knowledge that being Chilote can offer. Although the result is an architecture that can be associated with sustainability postulates, without a regulatory framework, a correct governance model presents imbalances that clearly weaken its development over time. This way of living, materialized in a particular vernacular architecture, is presented as a palpable base of opportunities to establish sustainable development models capable of not only taking charge of what is built from an economic-tourist perspective, but also present as an opportunity to develop social elements grouped in a cultural heritage, also understanding that the true sustainability of a community does not depend only on maintaining the physical, but also the social. The consolidation of material and intangible elements should always be a fundamental part when thinking about green architecture, where the identity elements generated by cultural heritage also reveal the importance of these means of development and governance models being through work with communities , responding to needs and direct problems that allow the development of these, even more so when said communities are already consolidated, giving a work based firm enough to bear the burden of carrying out a particular and culturally rich governance model, materialized in the built elements.

Thus, the palafito stands out not only from a formal look or as an object to observe, it stands out for being the recipient of material and immaterial traditions, for being an example of an architectural style that knew and knows how to take care of its environment and its needs, where it also gives rise to social relations both with others and with the context, allowing both the development of traditional economic activities such as fishing, but also the evolution of the building and its configuration towards the new needs that urban development and the arrival of the Tourism implies, not staying stagnant in time and evolving to once again respond to a new context that surrounds it, but always with a solid base rooted in the Chilote cultural heritage.

Therefore, a governance model applied to the case and designed for sustainable urban development (Figure 2) must always, with cultural heritage as the right foot, think about the development of an architecture based on vernacular models, but adapted to the needs and opportunities current issues regarding how to respond to mainly productive and climatic problems. It should be focused from community development, understanding that these groups, as the basic unit of human settlements, have the necessary capacity to organize themselves with respect to their needs and
from there, propose solutions that may or may not rise up the hierarchies as necessary. In addition, they are those who carry out and on whom fall the knowledge and cultural richness that has been referred to so

much, therefore, empowering communities and focusing on them means focusing on these aspects. It must take charge of tourism, understanding it as a necessary economic activity and if it is worked well, beneficial, but which should not result in the theatricalization of cultural traditions and rites. Tourism should also be understood as one more condition for architectural development, providing the services and equipment necessary for its proper development, but always within the framework of vernacular architecture that knows how to work with its context. And so, finally, it must take charge of its geographical context, understanding both the sea, the land and the edge of the sea as the palafito already does. Understand the operation of movement networks, as despite the fact that Chiloé is made up of various islands, all are recognized as part of, and each inhabitant can be identified as Chilote, and understand how from the beginning the archipelago knew how to develop together with its ecosystem, in order, despite certain excesses that have already been regulated, to be what it is today materially, socially and culturally.

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