



Design and Research of a Multipurpose Cadastre for the Development of Smart Communities in Municipalities of Chile [†]

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Abstract: In many governments, a digital transformation is gradually taking place in their municipal governance, not without many difficulties due to the lack of resources and qualified professionals. This is where the cadastre, understood as a multifunctional tool, provides a strategic vision of the socio-economic situation of the territory through geospatial data. If environmental conditions are added to this information, a diagnostic tool can be used by citizens under the concept of “Smart Communities” for the application of public policies to ensure that the administration of the territory is more efficient and to strengthen decision making.

Keywords: smart communities; citizen empowering; multipurpose cadastral; local government; digital governance; digital transformation; cadastre; crowdsourcing



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1. Introduction

The objective of this research is to establish a multifunctional geospatial data model for Chile based on the ISO 19152:2012 standard for the development of smart communities at the local level. It is also intended to be used for land planning and community scenarios, improving their quality of life and making the territory more resilient and sustainable.

Smart communities involve multisectoral participation (authorities, citizens, and companies) within an intelligent, collaborative, and interconnected ecosystem with a forward-looking vision. Therefore, the use of collective geographic intelligence for decision making is established as a variable of study in this research [1].

This involves standardizing information in such a way that allows us to generate a model to be replicated at a municipal level, based on the centralization of information, in which we could interact with only unique sources of data from different areas of the organization, departments, or sub-units from each municipality. This means organizing and accessing data under administrative rules and permissions granted by technical teams, avoiding data duplication or information fragmentation and improving the delivery of results to external actors through a Spatial Data Infrastructure (SDI), geoportals, or open data sites, allowing for community participation and information [2].

International experiences show different advances in this area, as in the case of Europe [3], Israel [4], Colombia [5], China, and other countries that have centralized their information and implemented a Multifunctional Cadastre to inform internal and external stakeholders of each Municipality or Local Government.

2. State of the Art

Chile is a country with more than 200 years of history. A young nation that has structured its growth and development based on strong policies in property taxation since its independence, Chile has stood out in relation to other countries in the region, due to a centralist culture founded on order, provided by the Portalian origin [6] that

has characterized Chile since 1830. This was reflected in authoritarian governments that postulated a political ideology of order and obedience from civil society to authorities [7].

This evolution over time favored and reinforced the Cadastre as a stable legal-administrative structure that addressed territorial issues and led to the creation of several public services that addressed the emerging needs and allowed for the organizational strengthening and gradual development of the country, including the Instituto Geográfico Militar, Ministerio de Bienes Nacionales, and the consolidation of Servicio de Impuestos Internos [7].

Currently, the interest and progress of the development of Smart Cities are, undoubtedly, a topic that has managed to capture the participation of public organizations, companies, the academic world, and civil society, sectors that have not remained indifferent to the significant achievements and advances that the technological interoperability and connectivity had brought to different areas of industry and organizations. In some cases, the technological implementation has been procured at the expense of addressing the problems or satisfying the needs of citizens. From this, it can be inferred that its contribution to the integration of the population in the growth and development of its environment has been deficient; that is, citizens have not been integrated in the territorial development as a fundamental actor in the articulation of smart communities, in which authorities and/or technologies are at the service of the internal and external actors of the organizations and civil society, with the citizens being an equally relevant participant in the achievement of these objectives [8].

3. Hypothesis and Objectives

The integral development of smart cities and communities in this era of digital transformation is possible through a multipurpose cadastre implemented on a Geographic Information System.

Objectives:

- Research international experiences in the implementation of a multipurpose cadastre.
- Design a multipurpose cadastre for the development of smart communities to optimize management, transparency, and citizen participation in local administration and as a contribution to the country's development.
- Establish an iterative implementation process based on phases that will allow for the development of a geospatial strategy at a municipal level.
- Validate, based on research, whether the current territorial development structure in Chile follows the recommendations of international organizations.
- Standardize a cadastral data model based on the ISO 19152:2012 standard [9] that allows for the implementation of a Spatial Data Infrastructure (SDI) at the municipal level.
- Implement a geospatial strategy to strengthen the implementation of a cadastral model based on phases that will develop a workflow at the municipal level.
- Carry out one/some pilot experience(s) (cases) with Chilean municipalities.

4. Methodology

The data will be obtained by researching the antecedents and records of planning processes and the property cadastre developed in Chile [10,11]. It will be established whether they have followed the recommendations of international organizations, such as the Economic Commission for Latin America and the Caribbean (ECLAC), and the analysis of cadastre models, such as the ISO19152:2012 (LADM) standard [9], implemented in other countries [3–5] from the territorial view, which support the implementation of a smart community in our country, considering methodologies that allow for generating a national standard from a multipurpose cadastre based on ISO 19152:2012.

Based on this multifunctional cadastre, the adoption of Geographic Information Systems by local governments allows for balanced development, when they are focused on people or citizens [8]. This provides models, benchmarks, and analytical capacity to support the establishment of resilient and sustainable communities [12]; therefore, this research

addresses civic inclusion at the level of local governments that allows us, based on spatial analysis, to understand the community's needs, collaboration aspects, and communication of initiatives that allow for the harmonious development of the territory.

On the other hand, in a cadastral implementation model, it is important to establish an architecture based on a geospatial strategy, which involves an iterative implementation process given by four phases that we will address in our methodology: understand, plan, act, and review. This is given by a framework that enables different flows with different types of users (field, public, back office) and that allows for the implementation of a geospatial infrastructure [12]. This includes understanding municipal regulations and standards, as well as the objectives and expectations of internal users. In planning, a geospatial architecture will be established, which involves determining the spatial data structure, the tools, and technologies to be used, and the applicable norms and standards. The cadastral model will be implemented, analyzing the results, and comparing them with the objectives established in the planning phase and in this thesis.

This framework also focuses on the creation of a Spatial Data Infrastructure (SDI) based on a Geoportal HUB. The goal of this infrastructure is to enable efficient management and the availability of municipality information to both internal and external stakeholders, while also promoting citizen participation. The Geoportal HUB will feature tools, such as field registries, 2D and 3D geospatial analysis, and dashboards, which will enhance management and facilitate information access for all involved parties.

The implementation of this framework aligns with the concept of smart cities and communities, which address the economic, environmental, and social aspects present in a city. In the case of this municipality in Chile, the objective is to provide real-time services to citizens and gather information from them, treating them as sensors for territorial development. This approach allows for the identification and resolution of everyday city problems.

Information and Communication Technologies (ICTs) play a crucial role in this framework, as they enable citizens to actively participate in local decision-making processes. Additionally, the rapid growth of cities emphasizes the importance of resource management to maintain a high quality of life, protect health, and preserve the environment.

In summary, this framework aims to implement a Spatial Data Infrastructure (SDI) based on a Geoportal HUB to promote efficient management, information availability, and citizen participation in line with the principles of smart cities and communities.

5. Contributions to Research

The proposed geospatial strategy, based on the standardization of a multipurpose cadastre and the establishment of a Spatial Data Infrastructure (SDI) as a national standard for Chile's municipalities, aims to foster the development of smart communities and promote efficient territorial management in accordance with digital governance policies [13]. By implementing a standardized multipurpose cadastre, a large amount of territorial information will be generated and managed through the Spatial Data Infrastructure. This infrastructure will allow for the integration and interoperability of geospatial data with other systems, which will facilitate a better targeting of public resources and the strengthening of territorial policies.

The implementation of this geospatial strategy improves the quality of life of citizens by providing an identity to the territory in which they interact. In addition, it creates communication spaces between the different actors that coexist in the territory, such as social actors, authorities, private companies, academia, and citizens. These communication spaces facilitate collaboration and the exchange of information, which contributes to a more participatory and efficient management of the territory.

In summary, the proposed geospatial strategy, which includes the standardization of a multipurpose cadastre and the establishment of a Spatial Data Infrastructure as a national standard, aims to develop smart communities and promote efficient territorial management in line with digital governance policies. This strategy uses geomatics to

model the impacts of territorial development, address demographic and climate changes, and promote resilience and sustainability. In addition, it fosters communication and participation among the various actors interacting in the territory, thus improving the quality of life of citizens.

6. Conclusions

The implementation of a multipurpose cadastre in Chile's municipalities, starting with a pilot municipality, is a strategic measure that will centralize and make available the municipality's internal information. This means that data from various areas and sectors, such as infrastructure, services, urban planning, among others, can be gathered on a single platform. The main objective is to make this information accessible, both to the municipality's internal stakeholders and to external stakeholders, such as citizens, companies, and other institutions. By adopting the ISO 19152:2012 standard, it ensures that the information is consistently structured and interoperable with other geospatial systems, which facilitates the integration and exchange of data with other entities.

The multipurpose cadastre, thus, becomes a basis for the territorial development of the commune, providing a comprehensive vision of the territory and its resources. This database will be fundamental for the development of smart cities and the smart community, as it will allow for the integration of public services and improve their efficiency. In addition, it will contribute to the promotion of a more sustainable environment and the economic growth of the community.

One of the highlights of this implementation is citizen participation, considering citizens as drivers of development and growth in the municipality. Citizens act as sensors by providing relevant information to authorities through different channels, which allows for the articulation of public policies and decision making based on real and updated data. In a highly technologized and constantly changing world, this citizen participation becomes even more crucial to ensure effective territorial management.

In summary, the implementation of a multipurpose cadastre in Chilean municipalities, following the ISO 19152:2012 standard, seeks to centralize and share internal information, promoting interoperability with other systems. This initiative aims to boost territorial development, foster a smart city and community, improve public services, protect the environment, and stimulate economic growth, all with a focus on citizen participation as a driver of development and growth in the municipality.

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