Modernization of Real Estate Registration in Brazil in Light of the LADM: Advances and Challenges for Spatial Land Governance

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SUMMARY

Brazil has a vast territory and, for many years, lacked effective mechanisms to control property transfer and spatial land governance. The creation of the General Mortgage Registry in 1843 represented the Brazilian state's first step toward legalizing property ownership, land control, and land security. This traditional registration model, although it has undergone modifications, remains in force today, but it presents significant limitations, particularly regarding the discrepancy between the property information recorded in the registration and the reality found on the ground. In recent years, initiatives have sought to align registry data with international land administration standards, notably the Land Administration Domain Model (*LADM*), established by ISO 19152:2012, recently updated to the ISO 19152-1:2024, -2:2025, -3:2024, -4:2025, and -5:2025 families. Notable in this context are the creation of the National Registration Code (CNM) in 2023 and the establishment of the Geographic Information System of the Real Estate Registry (SIG-RI) in 2025, which resulted in the consolidation of the Brazilian Real Estate Registry Map platform, made available free of charge to the public. This article analyzes these initiatives, with an emphasis on the current stage of development and application of geotechnologies to the Brazilian Real Estate Registry, assessing how they align with the LADM model. The research is qualitative and exploratory in nature. The results indicate that these initiatives align with the fundamental principles of the LADM, such as the unique identification of parcels and the spatialization of properties through georeferenced polygons, although they present weaknesses due to Brazil's vast territory and regional technological inequalities. Although in the initial phase of consolidation, they have shown promise for registry modernization and the strengthening of spatial land governance in Brazil, aligning with international standards.

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1. INTRODUCTION

Spatial land governance in Brazil presents historical challenges, stemming from a delayed process of property formalization. Until the mid-19th century, the transfer of real estate ownership was carried out by tradition—a simple transfer of the property—without any formal registration that would allow for state control.

This scenario began to change with the enactment of Budget Law No. 317/1843, which created the General Mortgage Registry, later expanded to include the General Real Estate Registry. Although initially focused on controlling mortgage guarantees, the law also encompassed the transfer of property, becoming a landmark in the Brazilian real estate registration system (Brazil, 1843).

For over a century, the transcription registration system was used, in which records were entered manually in books without unique identification for each real estate parcel. This model was replaced by the matrix system with the enactment of Law No. 6,015/73 (Public Records Law), which mandated the opening of a separate registry for each property, concentrating all information about the property, its owners, and the acts of registration of rights, provisions, and restrictions related to use.

Despite the progress, this model still did not fully meet current demands, as many land registrations lacked accurate spatial information about the properties. This limitation compromised the effectiveness of land governance, as it depends on the integration of registries, cadastres, and geotechnologies (Enemark et al., 2014).

In this context, initiatives have emerged aimed at modernizing the Real Estate Registry and converging with international land administration standards, especially LADM (ISO 19152), a conceptual model that unifies the relationship between people, rights, restrictions, responsibilities, and spatial units, configuring itself as a common model of 'people-land' relations (Lemmen et al., 2015). Among the most relevant measures in Brazil, the following stand out:

Provision 143/2023 of the National Council of Justice (CNJ), which established the structure, generation and validation of the National Registration Code (CNM), guaranteeing a unique identifier for each property, regardless of the service to which it belongs (CNJ, 2023).

Provision 195/2025 of the CNJ, which created the Electronic Statistical Inventory of the Real Estate Registry (IERI-e) and the Geographic Information System of the Real Estate Registry (SIG-RI), making the registration of polygons of properties subject to regularization mandatory (CNJ, 2025).

Map of the Brazilian Real Estate Registry, a platform developed by the National Real Estate Registry Operator (ONR), which integrates data from the CNM and allows the visualization of properties through georeferenced polygons (ONR, 2025).
These initiatives align with the principles of the LADM and represent an important step toward consolidating a more transparent, secure, and interoperable land registry system with geotechnologies, especially given Brazil's vast territorial scope. This study is set within this context, aiming to analyze the current status of these tools and their adherence to the LADM concepts, assessing their potential for modernizing the Real Estate Registry and strengthening land governance in the country.

2. THEORETICAL BASIS

2.1 Real Estate Registry: evolution and limitations

The history of property ownership in Brazil dates back to the colonial period, when land was considered the patrimony of the Portuguese Crown and distributed to colonizers through the sesmarias system. Through this system, the King donated parcels of land for occupation and exploitation; however, there was no effective oversight of these concessions, resulting in abandonment and invasions (Tomaszewski, 2010); (Melo; Pugliese, 2009).
With this problem, it became necessary to create a system of state control over the transfer of these lands. Prior to this, the State had created the General Mortgage Registry through Budget Law No. 317/1843 (Brazil, 1843). Although initially restricted to mortgage guarantees, this instrument initiated the property registration system, consolidating itself as a milestone in the creation of the Brazilian Real Estate Registry – today a delegated public service (art. 236 of the CRFB/88), responsible for publicity and legal security in real estate transfers (Dip, 2005).
Over time, other regulations began to require the registration of property transfers, initially through the transcription system. This method did not ensure full legal certainty, as records were made manually, in books, without unique identification of the parcel and, often, without reference to the previous registration, which resulted in duplicate titles. This model persisted until the enactment of Law No. 6,015/1973, which replaced transcription with the registration system (Abreu, 2013).
Law No. 6.015/1973 was a pioneering move in establishing, in its art. 176, item I (Brazil, 1973), that each property should have an individual registration, a measure designed to prevent duplicate property registrations. Despite this progress, many registrations were opened without basic information, such as perimeter measurements and property location, and fraud involving the opening of new registrations for properties that no longer existed was common. This exposed structural flaws, exacerbating the lack of land ownership control, the consequences of which persist to this day.
To address these challenges, the National Council of Justice began working with registrars, leading to the creation of the National Real Estate Registry Operator (ONR) in 2020. The ONR is a private, nonprofit entity funded by registrars and dedicated to research, development, and technological innovation for the Real Estate Registry. It centralizes data from more than 3,500

real estate registry offices and is supported by state associations, promoting previously unimaginable changes in the sector (IRIB, 2025).
Notable among these changes is the creation of the National Registration Code (CNM), regulated by Provision 143/2023 of the National Council of Justice (CNJ, 2023), which unified registration numbering nationwide. This standardization ensured that a property registered in Florianópolis is identified differently from one in São Paulo, creating a unique national identifier for each real estate parcel, in addition to enabling interoperability with other registries such as INCRA, SPU, Federal Revenue, among others.
Recently, through Provision 195/2025, the National Council of Justice (CNJ) established the Geographic Information System for Real Estate Registration (SIG-RI), which incorporated geotechnologies into the Real Estate Registry system, allowing for the insertion of georeferenced data into real estate registrations. The SIG-RI functions as an integrated GIS platform, consisting of a graphical interface of the Brazilian Real Estate Registry Map, allowing public queries, visualization of the CNM (National Register of Land Titles), location, legal status, and the registry office where the property is registered. Furthermore, the real estate registrar can view georeferenced boundaries, generate technical reports, and issue inconsistency alerts, representing a significant advance for Brazilian land governance (IRIB/2025).
Despite these advances, the full implementation of SIG-RI faces limitations, especially due to the short adjustment period and regional inequalities: in many areas there is a lack of technological infrastructure and internet connectivity. These barriers, however, are expected to be gradually overcome. The following case study will demonstrate how this technology works and how it converges with the principles of LADM.

2.2 Land Administration Domain Model (LADM)

The Land Administration Domain Model *(* LADM) was defined by ISO 19152:2012, recently updated to the ISO 19152-1:2024, -2:2025, -3:2024, -4:2025 and -5:2025 family, and consists of a conceptual model, not a data product specification (ISO, 2012). It is an international model focused on land administration, with the objective of supporting land management projects in line with national and international policies (Lemmen, Oosterom, Bennett, 2015).
LADM has two objectives: (i) to provide an extensible basis for the development and improvement of land management systems, based on an architecture driven by pre-existing models, allowing different countries to adopt the same ontological basis for land administration; and (ii) to create standardized information services, at national and international levels, enabling the semantics of land administration to be shared between different countries (ISO, 2012).
The standard highlights that countries operate their property registration systems in different ways (centralized or decentralized, with general and fixed limits), but all are based on relationships between people and land, linked by property and use rights – a reality that is also present in Brazil (ISO, 2012).
In addition to land information, the LADM covers data related to water, subsoil and airspace, structured in four packages:
The first of these relates to people and organizations, and in Brazil the property registration system in the registry resembles this package.

The second focuses on basic administrative units, including rights, responsibilities and restrictions on property, and these specificities are also aligned with the Brazilian real estate registration system, as it is in the registration that the property is registered.
- The third package refers to spatial units represented by parcels, legal space of buildings and public service networks, this package also being similar to the registration model created in Brazil in 1973 through Law No. 6.015/1973.
- Finally, the fourth package is linked to spatial issues, such as topographic surveys and spatial representations, with this package resembling the current modernization movement experienced in Brazil at the time of this research work.

Oosterom et al. (2022) highlight the growing recognition of LADM in different countries, citing examples such as: a mobile application in Indonesia to complete land titling by 2024 (apud Aditya et al., 2021); analysis of the use and ownership of multi-unit buildings in Saudi Arabia (apud Alattas et al., 2021); implementation of a cadastral information system based on LADM in Serbia, Montenegro, and the Republic of Serbia (apud Govedarica et al., 2021); renewal of cadastral maps in the Netherlands (apud Hagemans et al., 2022); and a prototype for land valuation in Turkey (apud Kara et al., 2021). In South America, Colombia has adopted LADM on a large scale to overcome duplicated, redundant, and fragmented land data (apud Kalogianni et al., 2019), a situation similar to what is being done in Brazil.

The LADM framework provides standardization and formal language for representing legal and administrative aspects of land. This standardization provides countries with an organizational framework for implementing their land administration systems, assuming that a properly managed territory contributes to reducing social inequalities (Zamzuri et al., 2024).

The LADM is recognized as an essential tool for improving legal property security and is discussed by international institutions such as FIG, UN-Habitat, UN-GGIM, and the World Bank (Kalogianni et al., 2019). It is not intended to replace existing national systems, but rather to provide a formal language for describing them, functioning as a descriptive, not prescriptive, standard (ISO, 19152). However, it is noted that Brazil was not even among the countries that adopted LADM-based profiles, highlighting the delay in incorporating it. This is beginning to change with recent advances.

3. METHODOLOGY

This work is qualitative, exploratory, and documentary in nature, based on normative, bibliographical, and technical sources. Brazilian legislation related to the Real Estate Registry was analyzed, from its creation to the enactment of Law No. 6,015/1973, as well as the constitutive acts of the ONR and recent provisions of the CNJ.

The literature review focused on the development of the Real Estate Registry in Brazil and the LADM (ISO 19152:2012), updated in 2024–2025 for the ISO 19152-1/-5 family, and on studies that describe its international application. This phase allowed us to understand the model's uses in different countries and its potential for interaction with the Brazilian reality.

Subsequently, a functional analysis of the CNM, SIG-RI and the Brazilian Real Estate Registry Map platform was carried out, demonstrating the connection of these technologies with LADM principles.

Finally, a comparison was made between the platform elements and the structural concepts of the LADM, highlighting convergences, limitations and potential for strengthening spatial land governance in Brazil.

4. ANALYSIS AND DISCUSSION

4.1 Integration of CNM with LADM

The National Registration Code (CNM) was established at the national level and has 16 digits structured in mandatory fields, which range from the registry office code to the registration number, including verification digits generated by the Module 97, base 10, algorithm of ISO/IEC 7064:2003, which together form a unique number for each property in the national territory (CNJ, 2023).

According to Article 4 of CNJ Provision 143/2023, the creation and validation of the CNM is performed by a program provided by the ONR, avoiding duplication and ensuring that the property corresponds to a unique registration. After its creation, each property was given a unique identification, correcting historical practices of duplicate registrations.

In Brazil, the requirement for single property registration was already included in Article 176, § 1, I, of Law No. 6,015/1973, but this rule was applied in a limited manner. It was common for multiple real estate parcels to exist in the same registration, or even two properties with the same registration number.

With the National Land Registry (CNM), this practice was corrected: registrars began opening registrations to divide these properties and thus generate new registration codes. This created a unique registration number for each property nationwide, resulting in greater legal and spatial security, in addition to aligning with one of the central principles of the LADM: the unique parcel identifier.

For existing registrations, registrars must record the new electronic numbering in the document, while registrations opened after the provision takes effect automatically receive the numbering in digital format. Figure 1 illustrates this process, showing how the CNM is entered into the registration, ensuring unique identification for each real estate parcel.

Figure 1. Registration with the CNM. Source : Prepared by the Authors

The CNM directly meets the principle of unique parcel identification, established by the LADM, by connecting the real estate unit to the unique identifier at the national level, contributing to the elimination of duplicate records – a recurring problem since the transcription system and which persisted even after the creation of the matrix system in 1973. This national standard materializes the logic of the conceptual model proposed by the LADM (ISO 19152), by representing the spatial unit linked to people, rights, restrictions and responsibilities, consolidating the convergence between the CNM and the LADM.

Furthermore, the National Registration Code (CNM) also facilitates electronic property searches through the ONR platform, allowing users to locate properties based on the address provided. As illustrated in Figure 2, when entering the address in the "Address Search" layer, the platform displays symbols indicating the registered properties, as highlighted in red. Selecting one of these layers opens another (Figure 3) containing the property's complete information: registration number, National Registration Code (CNM), registry code, address, and the option to request a property certificate electronically.

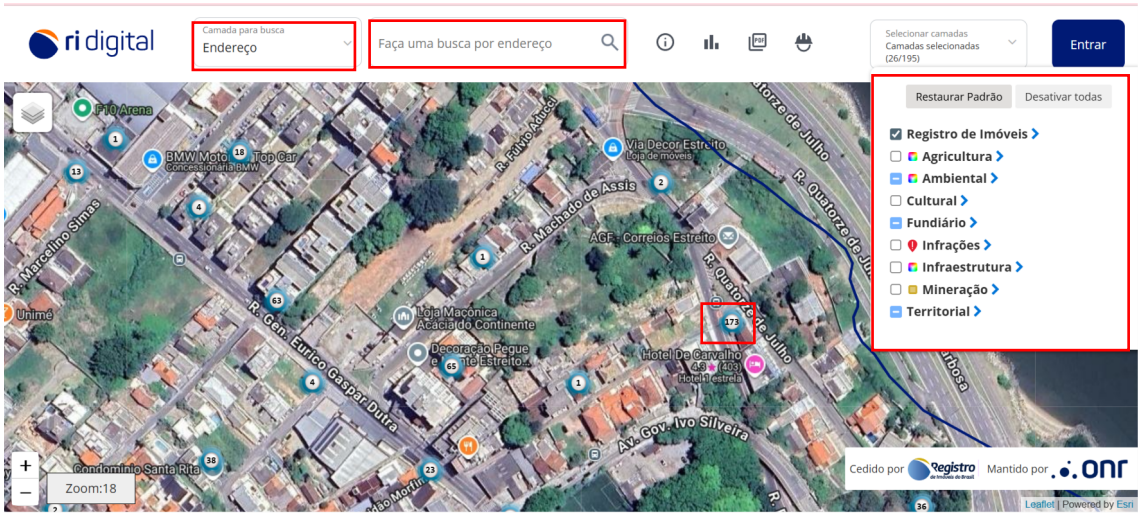


Figure 2. Real Estate Registry Map Interface. Source: Prepared by the Authors.

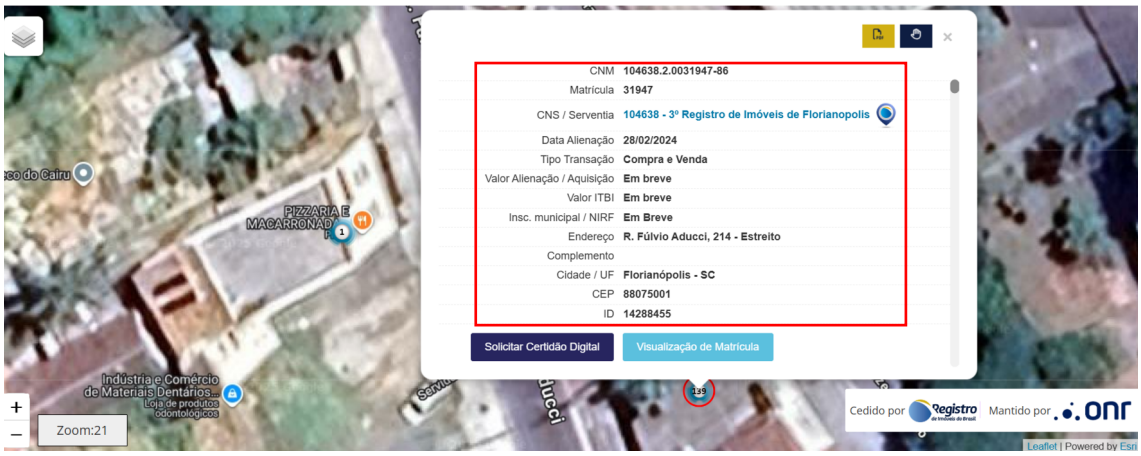


Figure 3. Property information. Source: Prepared by the Authors.

One challenge encountered in this interface is the full integration of records still held by the transcription system. Although CNJ Provision 195/2025 establishes rules for opening registrations for all existing records in this system, many do not have sufficient data to open new registrations, which could delay the consolidation of the CNM nationwide.

Despite this, the ONR platform, by combining the CNM with electronic search functionalities, in addition to creating a single record for the parcel, brings the Brazilian Real Estate Registry closer to the LADM guidelines, which allows citizens to access information from anywhere in the world, safely and accurately, in addition to creating mechanisms for spatial land security.

The CNM, when associated with the registration of georeferenced polygons – a topic addressed in the next subtitle –, presents even greater potential to significantly elevate land governance in Brazil to the aspects listed by the LADM.

4.2 Registration of the Polygon on the Real Estate Registry Map in Brazil and the LADM

The previous subtitle presented the integration between the CNM and LADM and how this interface has generated significant results for Brazilian land security. However, a single land registry is not enough: it is necessary to spatialize the property. It was with this in mind that the Geographic Information System for Real Estate Registration (SIG-RI) was created through Provision 195/2025, modernizing the Real Estate Registry system.

According to art. 343-G of the aforementioned provision, in procedures involving the subdivision of urban land – such as: subdivision, dismemberment, adverse possession, administrative rectification, among other procedures for legalizing properties -, the responsible technician must be registered on the Brazilian Real Estate Registry Map platform and register the geodetic coordinates of the property subject to registration.

To illustrate this practice, we present the case of a correction to measurements in a real estate registration. This procedure, provided for in Article 213 of Law No. 6,015/1973 (Brazil, 1973), consists of inserting the correct information to reflect the physical reality of the property. To this end, technical documents such as plans, descriptive memoranda, and, more recently, proof

of registration of the polygon on the Brazilian Real Estate Registry Map are required. This proof, generated by the platform, is now integrated into the registration process (Figure 4).

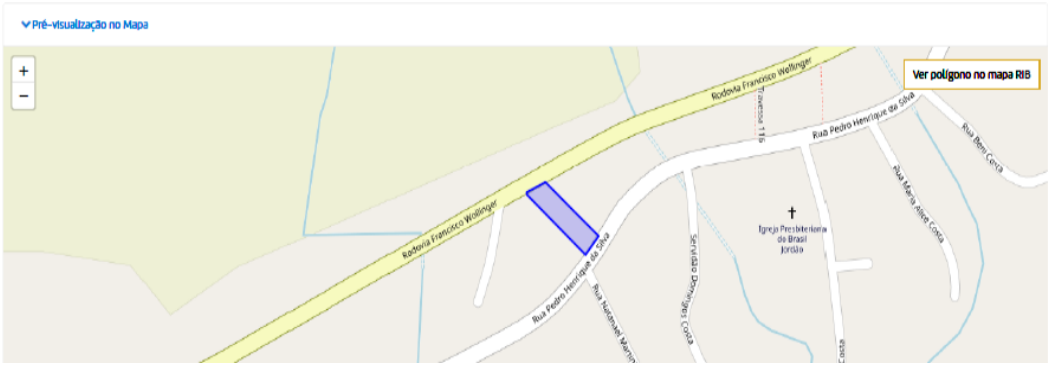


Figure 4. Registration of the polygon on the platform. Source: Prepared by the Authors.

After registration, the correction procedure was approved by the Real Estate Registry, opening a new registration for the parcel. This registration now contains all georeferenced coordinates and includes a sketch of the property's location, allowing the parcel to be viewed, as shown in Figure 5.

REGISTRO DE IMÓVEIS DA COMARCA DE BIGUAÇU - SC
Mauricio Passaia - Oficial Titular
Livro Nº 2 - Matrícula Nº 60.019 **CNM Nº 108423.2.0060019-65** **FICHA 01**

ABERTURA DE MATRÍCULA: 18/04/2024.
IDENTIFICAÇÃO DO IMÓVEL: um terreno com a área de **819,29m²** (oitocentos e dezenove vírgula vinte e nove metros quadrados), situado na Rua Pedro Henrique da Silva, n. 395, e na Rodovia Municipal Francisco Wollinger, bairro Jordão, na Cidade de Governador Celso Ramos, nesta Comarca de Biguaçu/SC, com a seguinte descrição: frente, face a Sudeste, em 1 (um) lance, partindo do vértice denominado '0=PP', georreferenciado no Sistema Geodésico Brasileiro, DATUM - SIRGAS 2000, MC-51°W, coordenadas Plano Retangulares Relativas, Sistema UTM: E= 737.232,926 m e N= 6.971.006,399 m, segue com o azimute de 219°33'13", na extensão de 15,11 metros até o vértice 'V1' (E=737.223,307 m e N=6.970.994,752 m), confrontando com a Rua Pedro Henrique da Silva. À direita, face a Sudoeste, medindo 57,68 metros, em 3 (três) lances, partindo do vértice 'V1', segue com o azimute de 311°43'27", na extensão de 24,52 metros até o vértice 'V2' (E=737.205,010 m e N=6.971.011,069 m); daí segue com o azimute de 312°45'34", na extensão de 31,75 metros até o vértice 'V3" (E=737.181,697 m e N=6.971.032,626 m), confrontando com o imóvel matriculado sob o n. 2.080; daí segue com o azimute de 343°57'44", na extensão de 1,41 metros até o vértice 'V4' (E=737.181,308 m e N=6.971.033,980 m), confrontando com terras de posse de Adilson Costa. Fundos, face a Noroeste, em 1 (um) lance, partindo do vértice 'V4', segue com o azimute de 65°12'59", na extensão de 15,20 metros até o vértice 'V5' (E=737.195,104 m e N=6.971.040,350 m), confrontando com a Rodovia Municipal Francisco Wollinger. À esquerda, face a Nordeste, medindo 50,82 metros, em 2 (dois) lances, partindo do vértice 'V5', segue com o azimute de 131°36'51", na extensão de 26,69 metros até o vértice 'V6' (E=737.215,060 m e N=6.971.022,623 m); daí segue com o azimute de 132°14'33", na extensão de 24,13 metros até o vértice '0=PP' (E=737.232,926 m e N=6.971.006,399 m), início da descrição, confrontando com o imóvel matriculado sob o n. 16.732, fechando assim o perímetro do polígono acima descrito. Dados cadastrais do imóvel: inscrição imobiliária n. **02.11.007.0179.001.**
Abaixo segue o **croqui do imóvel acima descrito:**

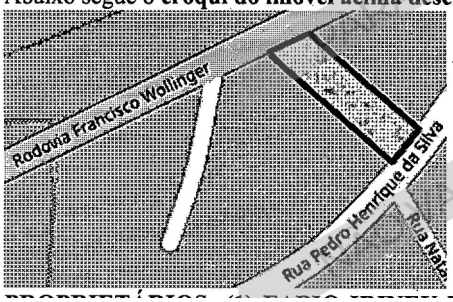


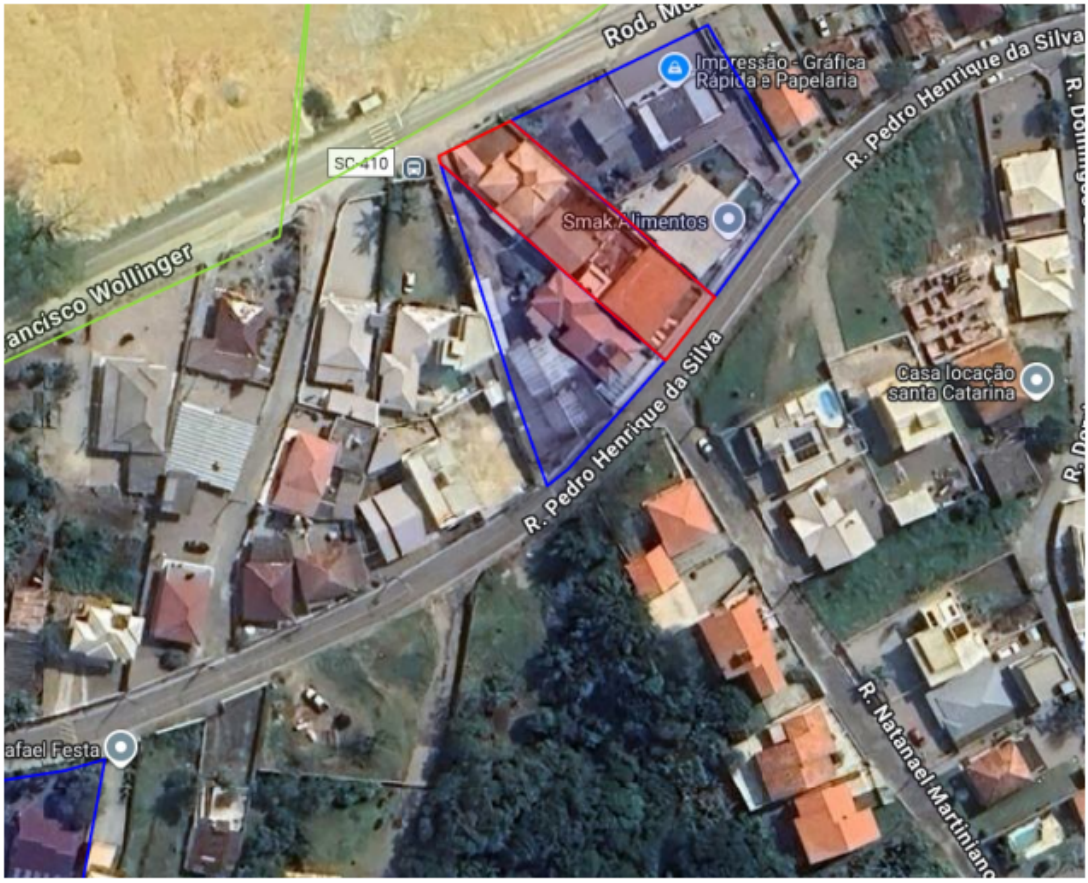
Figure 5. Registration plate with polygon on the platform. Source: Prepared by the Authors.

Figure 5 shows that the registration includes the CNM number, the property's georeferenced description, and the plot's location sketch, highlighting the connection between the unique national identifier and the property's geographic location. This demonstrates alignment with the LADM principles and its adaptability to the Brazilian reality, as the model must adapt to the local reality of each country (Lemmen et al., 2015).
Once the registration stage is complete, the property can be located directly on the Brazilian Real Estate Registry Map platform by accessing the different graphic layers. Figure 6 illustrates a section of the platform where the property subject to rectification is highlighted in red. Clicking on this polygon provides registration data, such as the responsible registry office, the National Registry of Municipalities (CNM) number, and access to services such as online issuance of a full certificate or viewing of the digitalized registration.

ri digital

Mapa do Registro de Imóveis

Mantido por onr



Camada:	RIB - Georreferenciamento - Retificação
Serventia:	Registro de Imóveis de Biguaçu
CNS:	108423
Cidade:	Biguaçu
Estado:	SC
Matrícula:	60019
CNM:	108423.2.0060019-65
Cadastro / Registro:	02110070179001
Tipo de Imóvel:	Terreno/fração
CNM	108423.2.0060019-65
Área calculada:	814,93 m²
Perímetro calculado:	138,82 m

Imagem retirada do Mapa do Registro de Imóveis do Brasil, ferramenta em que o usuário pode escolher as camadas em exibição. Para conferir todas as informações disponíveis, visite mapa.onr.org.br.

Figure 6. Registration after rectification. Source: https://mapa.onr.org.br/.

In addition to individualized plot visualization, the platform allows for verification of potential overlaps with neighboring properties. In the example presented, the adjacent properties—

represented by the blue lines—were also georeferenced, allowing for immediate verification of potential overlaps. This functionality embodies one of the core principles of LADM: the integrated management of spatial units and their legal and social interrelationships, in addition to the system's ability to interoperate with other platforms **(**Enemark et al., 2014); (Mader et al., 2015).

5. CONCLUSION

This article analyzed the modernization of the Real Estate Registry in Brazil in light of the LADM - ISO 19152:2012, updated in 2024–2025 and its interrelation with the National Registration Code (CNM) and the Geographic Information System of the Real Estate Registry (SIG-RI), which resulted in the creation of the Real Estate Registry Map of Brazil.

The results demonstrate the convergence of these new tools applied in the country with the principles of LADM, especially the unique parcel identifier and the spatial representation by georeferenced polygons included in the real estate registration. This transition from analog to electronic records simplifies data maintenance and increases its quality, enabling the dissemination of information through network services (Mader et al., 2015).

The case study demonstrated that the integration between the CNM, the polygon registry, and the public interface of the Brazilian Real Estate Registry Map increases transparency, mitigates overlaps, strengthens land governance, and enhances legal certainty. It is important to emphasize that all these updates and investments made to modernize real estate registration in Brazil are fully funded by the land registrars, without using public resources.

However, challenges persist: especially regarding the lack of data in transcripts for opening registrations at the CNM, as well as regional inequalities related to technology, as many property registries are located outside major urban centers, which hinders internet connectivity. Furthermore, the platform's overload of accesses causes it to experience numerous data loading issues and, at times, downtime.

Even so, the continuity of CNJ regulations, the maturation of the ONR platform, and the gradual adoption of best practices by both registrars and users tend to overcome these operational obstacles. The conclusion is that Brazil has advanced toward a more secure, interoperable, and data-driven real estate registry model, demonstrating the potential to transform land management by aligning the legal and spatial representation of property with an internationally recognized conceptual framework: the LADM (ISO 19152).

Beyond the technological aspect, it is important to highlight that the modernization of the Land Registry in Brazil also represents a transformation in processes, services, and the relationship with Land Registry users. The incorporation of the CNM and SIG/RI should not be seen solely as cartographic or digital innovation, but as part of a broader land governance movement that seeks to increase the transparency, accessibility, and efficiency of the Brazilian land registry service. In this sense, the solutions presented, although built on local challenges, connect with international experiences and offer valuable insights for other countries facing similar issues of standardization, interoperability, and legal certainty regarding land.

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