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ARTICLE

A PROPOSAL FOR INTEGRATING DATA OF LAND REGISTRY AND URBAN CADASTRE

Proposta de Integração entre os Dados do Registro de Imóveis e do Cadastro Imobiliário Urbano

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Abstract:

It is noted a lack of integration between information of the Land Registration (LR) and of the Urban Cadastre in various Brazilian municipalities. Due to the lack of regulations at national level that define a conceptual model to organize the data from different entities, the design of integration systems geared to such a purpose is made difficult. Therefore, this study aims at developing an exchange prototype of the mentioned data from a previous research conducted by Paiva et al. (2016), concerning the modeling of the data resultant from LR and Urban Cadastre. To this end, we used the existing situation in the municipality of São José dos Pinhais, Curitiba metropolitan region, as a case study. There, the exchange of information between both entities is similar to that of many Brazilian municipalities. A conceptual model was generated and used to create an object-relational database, which then was used to develop an administrative and geospatial data consultation and editing prototype, based on technologies known as open-source. The use of such programs allowed us to verify the reproducibility possibility of the computational solutions referred herein to other cities with different economic situations.

Keywords: Urban Cadastre; Technical Multifinalitary Cadastre; Land Registration; Integration of Data; LADM. ET-EDVGDefesaFT.

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Resumo:

A falta de integração entre as informações dos Registros de Imóveis (RI) e dos Cadastros Imobiliários Urbanos (CIU) é uma constante percebida em diversos municípios brasileiros. Sabe-se que devido à falta de normativas em âmbito nacional, com respectiva definição de um modelo conceitual que permita organizar os dados de diferentes entidades, a concepção de sistemas de integração voltados a tal finalidade é dificultado. Diante disso, o presente estudo visa o desenvolvimento de um protótipo de intercâmbio dos mencionados dados, a partir de um estudo prévio realizado por Paiva *et al*. (2016), referente a modelagem dos dados do RI e do CIU. Para alcançar esse objetivo, utilizou-se como estudo de caso a situação existente no município de São José dos Pinhais, região metropolitana de Curitiba, em que a troca de informação entre os dois órgãos é semelhante à de diversos municípios brasileiros. Um modelo conceitual foi gerado e utilisado na concepção de um banco de dados objeto-relacional, que posteriormente deu origem a um protótipo de consulta e edição de dados administrativos e geoespaciais, a partir de tecnologias de código aberto, os chamados programas open source. A utilização desse tipo de programa permitiu verificar a possibilidade da reprodutibilidade das soluções computacionais aqui tratadas a demais municípios com situações econômicas variadas.

Palavras-chave: Cadastro Imobiliário Urbano; Cadastro Técnico Multifinalitário; Registro de Imóveis; Integração de Dados; LADM. ET-EDVGDefesaFT.

1. Introduction

Over the centuries, various definitions and views on the functions of the Cadastre have been disseminated according to the existing needs and technologies (OLIANE, 2015). The International Federation of Surveyors (FIG) is a non-governmental organization that has as its primary vision the support for international collaborations interested in the progress of science focused on studying the measurement of the terrestrial surface in all its areas and applications. It defines the Cadastre as: "a public inventory of methodically arranged data based on a survey of boundaries for the existing parcels of a certain territory".

In Brazil, the term Cadastre is related to the official and systematic territorial inventory of a municipality that is based on a survey of the boundaries of the parcel of real estate designed to map lots; land; public roads; squares; hydrography; etc. Additionally, it also states information that is fundamental to plan a city, such as tax register; public places; buildings; infrastructure; environment; socioeconomics; among others.

The Ministry of Cities, institution responsible for elaborating the public policies of urban development, by Directive 511, December 7th, 2009, defines the Guidelines of the Multifinalitary Urban cadastre (MTC), guiding municipalities to create, establish, and update their respective MTC. As part of MTC, Urban Cadastre is crucial for several other theme cadastres.

The Urban cadastre can be understood as a system for registering the parcel, made up in a geometric form, and presented cartographically (BLACHUT, 1974). In this system, the following items should be declared: existence; location; physical characteristics; type of realty; area; use and value.

Another system of realty registration is the Land Registration (LR), which is responsible for declaring ownership of the property and for keeping its legal status updated (AUGUSTO, 2013). Governed by the judiciary, it is not its function to monitor the physical information of the parcel. Thus, LR does not have jurisdiction to declare unequivocally the actual dimensions and exact location of the real estate parcels, since this statement is under competence of the municipalities, by means of the Urban cadastre.

Since LR and Urban Cadastre are governed by different systems, the former by the Judiciary and the latter by the Executive, Carneiro (2005) points to the importance of the exchange of data between power systems. Since different aspects can be linked to the same property, this fact may impair decision-making regarding real estate and urban management issues.

In Brazil, despite Law 10.267 of August 28th, 2001 that establishes the exchange of information between LR and INCRA (National Institute for Colonization and Agrarian Reform) rural properties, such exchange is not well defined for an urban one (PAIVA, 2016). This is mainly due to a lack of a single regulation that provides guidelines at a national level for the establishment ofsystems capable of integrating data from LR and Urban Cadastre (CARNEIRO, 2003).

Since both Urban Cadastre and LR have their own regulation, which, although not specific, are related to the reference map of the municipalities, we believe it is necessary to structure the data from the different mentioned spheres within a single system. Such system would allow the cartographic data, core element to represent physical boundaries of the parcel, as well as other legal-administrative attributes and aspects of the real estate, are analyzed in a single search.

In order to achieve the integration of geospatial data in a national context, CONCAR (National Cartography Commission), a collegiate body of the Ministry of Planning responsible for coordinating policies of national cartography and supervising actions for the maintenance of the cartographic system, has created INDE (National Infrastructure of Spatial Data). With the purpose of cataloging, integrating and harmonizing geospatial data available in Brazilian government institutions, INDE aims to facilitate exploitation and access to these data. (PASCOAL et al. 2013).

Another related instrument is SINTER (National System for the Management of Territorial Information), coordinated by the Federal Revenue of Brazil. Established by Decree 8.764, May 10th, 2016, this system intends to receive and to share the information sent by the Electronic Records Systems of Brazilian register offices in a single platform. Still being studied, SINTER's goal of optimizing the access of information to different public administrations could be better achieved by using mechanisms that contribute to its deployment, such as the definition of models for homogenizing different data.

We believe the first step to integrate several data for later presentation in a single system is to structure data in a model capable of targeting the definition of databases as well as creating integration tools. In face of such an understanding, this study seeks to elaborate an integration system containing a spatial database and a graphical interface for the data provided by Urban Cadastre and LR. To do so, we sought to deepen the studies carried out by Paiva et al. (2016). The authors integrated two regulations, LADM (Land Administration Domain Model) and ET-EDGVDefesaFT (Technical Specification for Structuring Vector Spatial Data – Defense of the Land Forces), focused on issues of territorial and cartographic representation of urban topography, in order to create a generic conceptual model for data exchange.

As we gave continuation to Paiva et al. (2016), our first study resulted in a conceptual integration model adapted to a specific case study, the situation of the municipality São José dos Pinhais, metropolitan region of Curitiba/PR/Brazil. Due to the new model, we implemented a geoinformation system.

2. Basic Conceptual Model

The conceptual models used in the first project are the regulations LADM, a conceptual model developed by ISO (International Organization for Standardization), which deals with legal issues of the Earth, of surveying and representation. The LADM, according to ISO 19.152, proposes not to replace existing systems, but to provide a language that can clearly describe territorial management systems, providing the identification of the rights, constraints and responsibilities on land and other geospatial components to it trailers. To do this, it brings in its documentation UML (Unified Modeling Language) diagrams that specify and portray data models geared to land management, from four main packages, containing conventional information classes and spatial referenced class (LEMMEN & VAN OOSTEROM, 2010).

The second model, the ET-EDGVDefesaFT is a specification of the Brazilian Army Geographic Services Directorate, which, although not exclusively addressing the data of the municipal registers, it applies to topographic mapping and geo-information on large scales. Thus, it brings in its documentation, a series of categories of information that portray the relationships between the different features of the topographic cartography, in scales usually used by the urban cadaster.

The conception of a generic model of data integration is amongst the main developments of the study cited. Covered by the study are the relationships between owners and their rights, restrictions, and responsibilities on the real estate, with legal-administrative and spatial issues of the properties. An overview of the relationships between landowners and legal-administrative matters can be seen in diagrams 1 and 2.

In the first one, the LA_Party class presents the individual data of the individuals related to a unit of property; in the LA_groupParty class, the groups of individuals connected to the same property are defined; in the LA_PartyMember class, the fraction of each individual of a LA_groupParty is presented; the LA_BAUnit class connects individuals to administrative matters as shown in Figure 1.

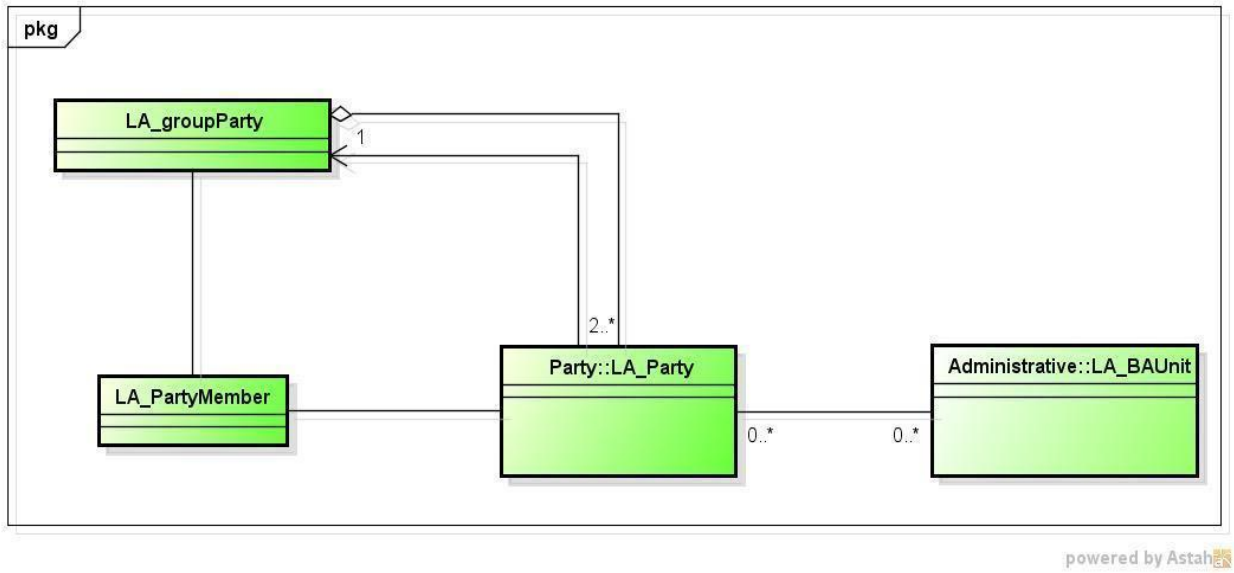

Figure 1: Relationships between individuals connected to the same property
Source: Paiva et al. (2016)

According to Oosteron & Lemmen (2015), one of the great advantages of LADM is to portray the relationship between Earth's administrative issues and the individuals interacting with it. Thus, in the following diagram (Figure 2), the legal-administrative characteristics of the properties are presented. The classes that define the rights, restrictions and responsibilities over a parcel are: LA_Right; LA_Restriction; and LA_Responsibility. The connection between both legal-administrative and owners characteristics is given by the LA_BAUnit class. The relationship between both the legal-administrative and spatial characteristics of the properties occurs through the LA_SpatialUnit class.

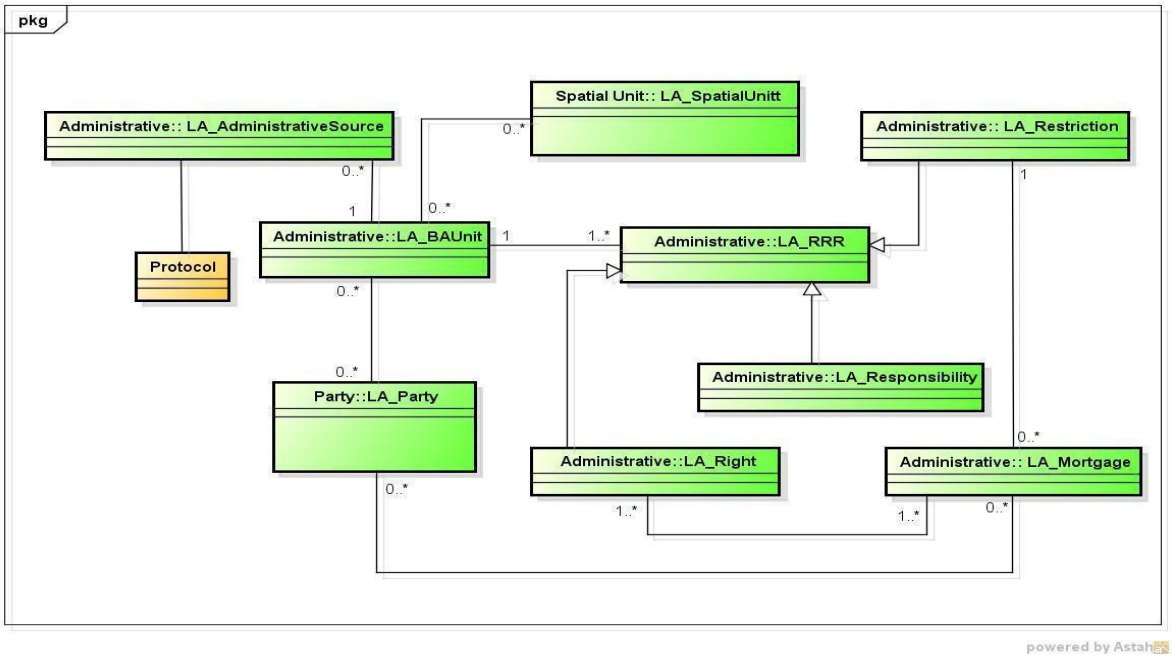

Figure 2: Administrative relationships of a real estate property
Source: Paiva et al. (2016)

2.1 Area of Study

The choice of a case study that presented data from a register in accordance with the guidelines proposed by the Ministerial Order No. 511 of the Ministry of Cities, regarding the implementation of Brazilian cadastres, was necessary in order to allow the scope of the methodology to be extended to other regions with different socioeconomic situations. Based on these conditions, the case study comprises the Parque da Fonte neighborhood, located in the municipality of São José dos Pinhais, in the metropolitan region of Curitiba, state of Paraná, Brazil (Figure 3).

Among the characteristics of the Parque da Fonte neighborhood, the population increase observed by the data from the Census of both 2000 and 2010 stands out; the proximity to the Afonso Pena International Airport and the recent opening of the Extravasor Canal of the Iguaçu River that cuts through the neighborhood are also worth noting. These factors attribute to the properties of the region not only restrictions regarding their use, which should be noted in land registration data, but also the need for constant register updating.

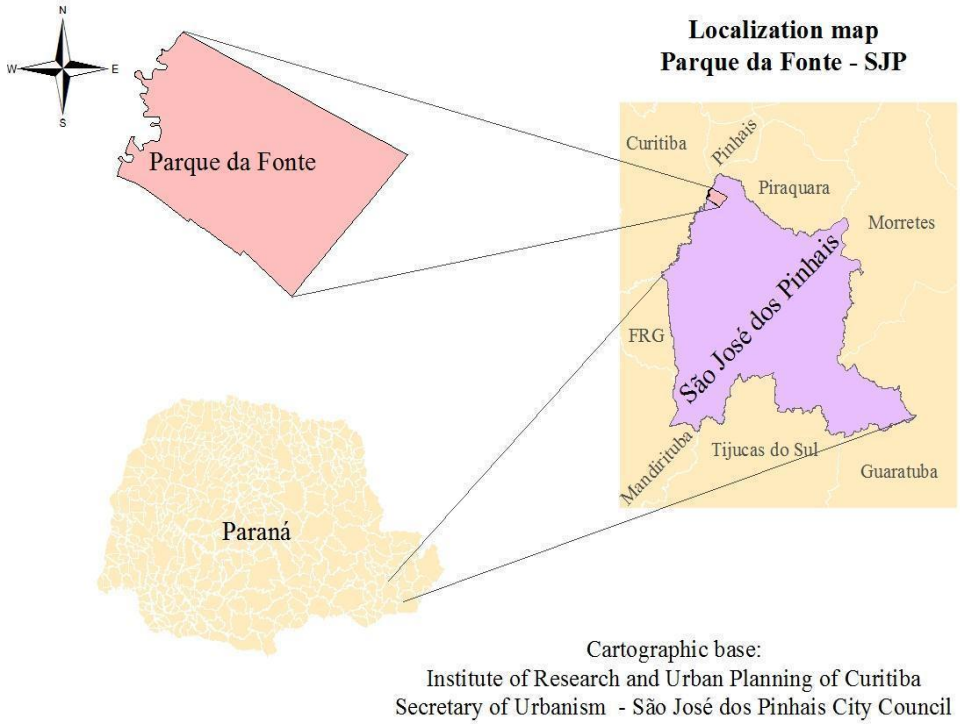

Figure 3: Location of the area of the case study.
Source: The author (2017).

3. Methodology

The methodology described here further deepens the generic proposal of integration defined by Paiva et al. (2016). Its importance is centered in two aspects: the optimization of the

aforementioned conceptual model, which brings together the LADM and ET- EDGVDefesaFT standards, and their application in a specific case study.

The diagram below (Figure 4) shows the methodological sequence performed. The procedures that allowed the creation of the database with information from the Land Registration (LR) and from the Urban Cadastre of São José dos Pinhais, as well as those of designing a prototype of an exchange programme, stand out in comparison to previous developments.

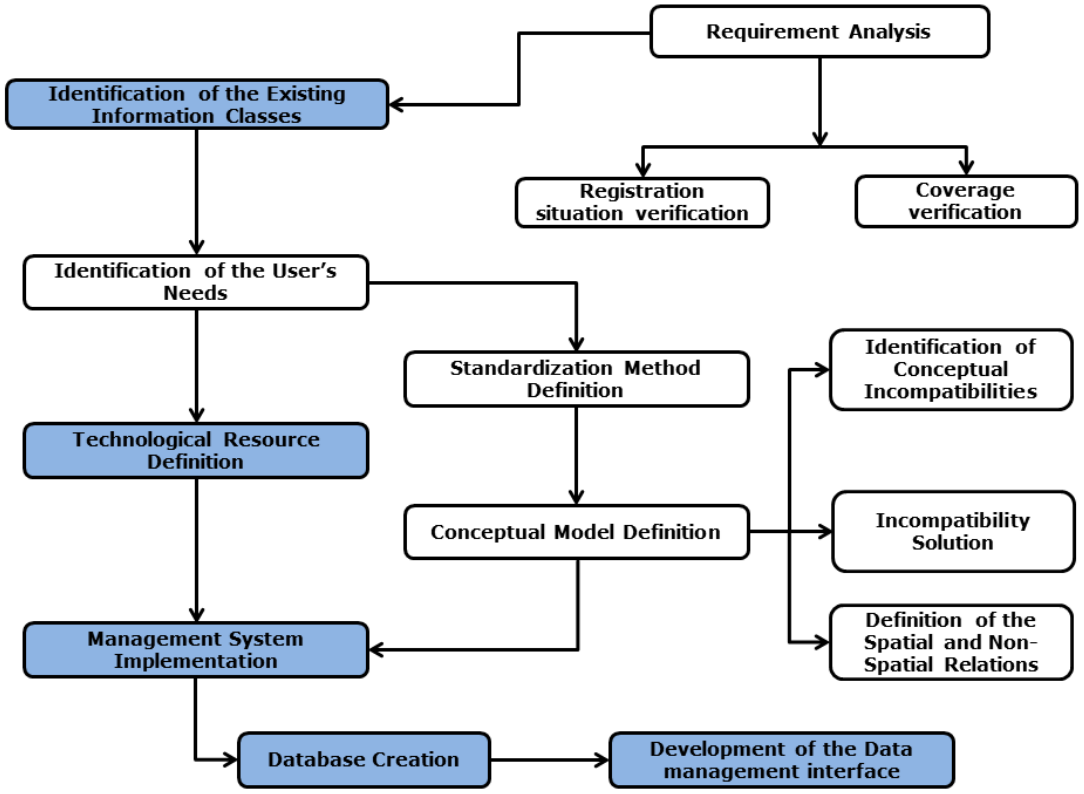

Figure 4: Methodological Flowchart.
Source: Adapted from Paiva et al. (2016)

3.1 Identification of the classes of information in the case study

In the municipality of São José dos Pinhais, the Cadastre is composed of a series of spatial layers and their respective attributes, among them, the vector layer that represents the limits of the parcel. The offices of land registers, in accordance with the Public Registers Law, provide to any interested citizen, upon request, the evidentiary certificates of the real estate legal status. Thus, the main information layers of the Urban Cadastre and of the LR, as well as their attributes, are presented in Tables 1 and 2:

Table 1: Main spatial features in the São José dos Pinhais urban cadastre

Layers and Attributes of the Urban cadastre
Allotment: allotment code; name; issues; date of approval; status (implemented/not implemented); area; perimeter.
Street segment: segment code; type of segment; address; neighborhood; zip code; type of paving; length.
Block: code; status (real or fiscal); block number; area; perimeter.
Neighborhood: neighborhood code; name; area; perimeter.
Lots: fiscal indication; sector; block; lot number; zoning; property number; neighborhood; area; perimeter.
Building lots: fiscal indication; sector; block; lot number; zoning; area; perimeter.
Water bodies: code; type; description; approximate area; approximate perimeter.
High-voltage power line: code; elevation; length.
Municipality: code; name; area; state; initials.
Zoning: code; name; sub-zoning code; approximate area; perimeter.

Table 2: Main administrative and legal information of the properties

Information of the Land Registration
From the Finance Department: parcel code; municipal registry number; address; neighborhood; block; lot; housing complex.
Arbitrated to compose the database: name of the owner(s) or corporate name; nationality; marital status; CPF (an identity number for individuals issued by the Brazilian government) or CNPJ (Brazilian National Registry of Legal Entities); profession or activity; email; phone number.

3.2 Identification of user needs

To integrate the data of the Land Registration and of the Urban Cadastre of São José dos Pinhais, a preliminary investigation was done in order to verify the situation of the municipality in relation to the theme. From technical visits to the city hall, it was noted that approvals of various projects, such as dismemberments, unifications, area corrections, allotment approval, among others, which are necessary both for legal acts practiced by Land Registration and for registration actions of the city hall, require the action of third parties in order to be identified by all entities related to these processes. This creates, for the same parcel, a disparity between the information of the LR and of the Urban Cadastre of the municipality.

As this is one of the main functions of an integration system, an important contribution to the data integration system for the urban area under study was the presentation of protocols related to several projects. An overview of the role of each user in the proposed system, according to the needs observed for the municipality, is shown in Figure 5.

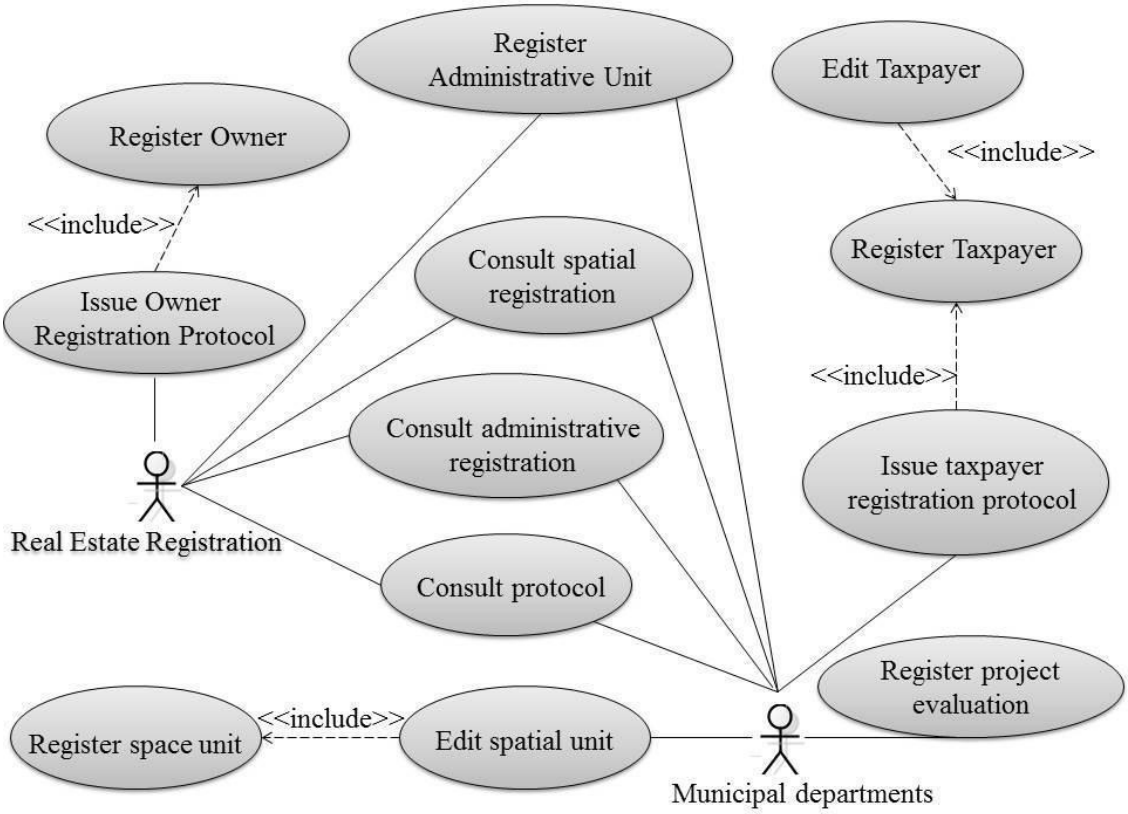

Figure 5: Role of users in the proposed system
Source: Author (2017)

Basically, two actors are involved: LR is responsible for issuing owner registration protocols for the knowledge of the municipality. In addition to this action, it may also conduct various consultations and register some information regarding the real estate portion treated as an administrative unit. The municipality, from its offices, can issue registering protocols and editing ones to update taxpayers' information; can carry out consultations, both on spatial and administrative data of buildings; register and edit spatial units; register project reports; and conduct varied queries.

3.3 Optimization of the conceptual model

The standardization method defined by Paiva et. al. (2016) sought to systematize data integration by adopting the standardization concepts defined by ISO 19.152 and ET-EDGVDefesaFT. Knowing that both the LADM and the ET-EDGVDefesaFT normalize the set of information regarding territorial issues and issues of cartographic representation of the urban topography, respectively, and that the two standards are documented from classes and categories of information based on an object-oriented language, UML (Unified Modeling Linguage) was used as a language for the design of the conceptual model, implicit in both.

As ET- EDGVDefesaFT is a standard created to meet the needs of topographic mapping in large scales, bringing in its documentation only an indicative modeling of the Urban Cadastre,

adaptations were necessary for its junction with the LADM. In answer to the paradigms of object orientation proposed by Borges (1997), referring to the model OMT-G, the connection of the categories of information of the register of São José dos Pinhais was performed, modeled by the Brazilian standard. The rest of the spatial and land registration data of the municipality were not modeled by said document. These non-modeled classes refer to zoning layers, building lots, and allotment.

In the Figure 6 is presents in green the information classes modeled by the ISO standard and present in São José dos Pinhais; in blue are the categories of information documented by the DSG specification and also present in the municipality of São José dos Pinhais; and in orange are the information classes exclusively of São José dos Pinhais and not modeled by any of the standar
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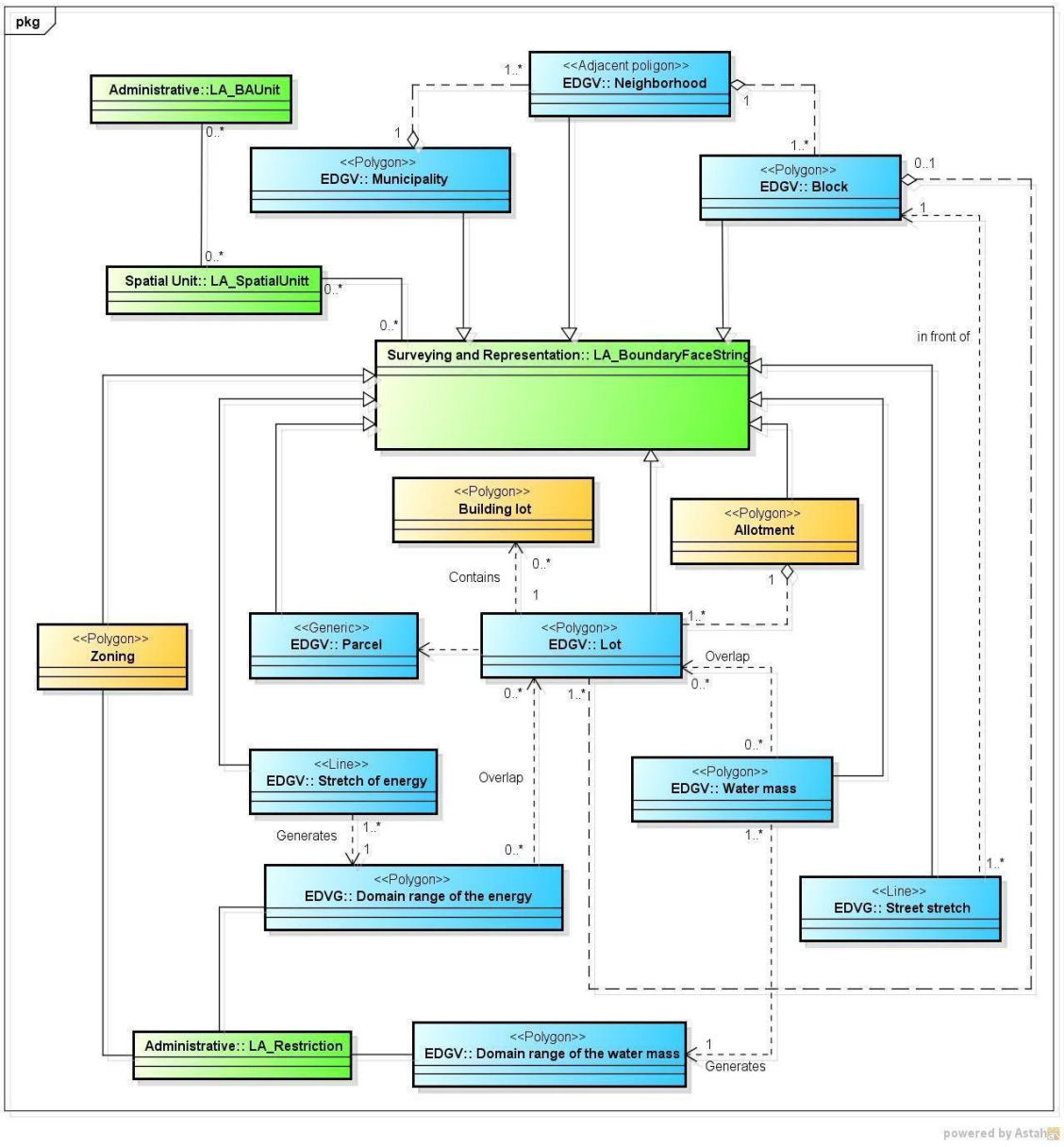

Figure 6: Diagram of spatial relations
Source: Author (2017)

3.4 Definition of computational resources

After identifying and collecting spatial and tabular data from the study area and identifying users' needs, a preliminary architecture was set up for the system to be conceived. At this stage, the search for the best computational solutions for conceptual modeling and prototype design in a GIS environment focused on the social precepts of free technologies application. Since the development of solutions from this type of technology allows the developers to customize the solutions according to their needs, in addition to granting financial autonomy when evaluating their use by the end user, OpenSource or free license programs were chosen. This facilitates the replicability of computational solutions to other municipalities.

The architecture depicting the mentioned is presented in Figure 7. The system is composed by a software GIS software named QGIS; a database manager, PostgreSQL; PostGIS, which is a converter to integrate information to the database; an administrator directly connected to the data (information); and users, represented by the Land Registrations and Municipal Offices.

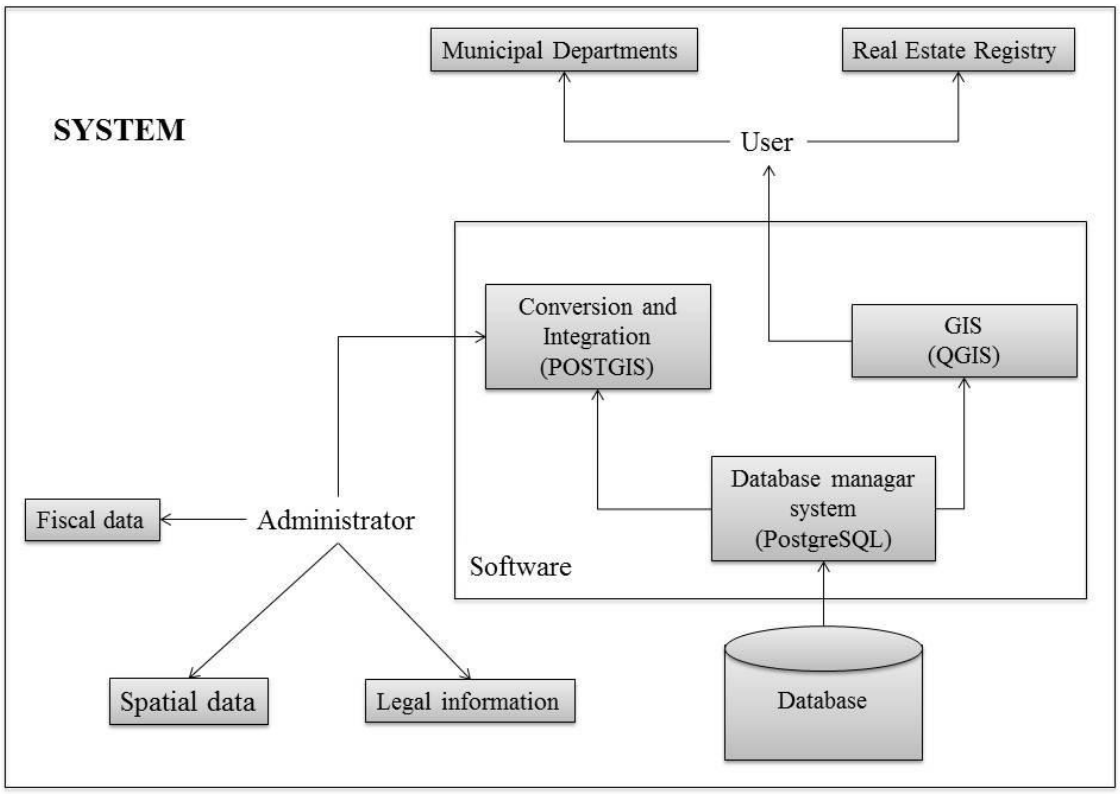

Figure 7: Architecture of the system
Source: Author (2017)

3.5 Implementation of the database

The organization of an object-relational database interoperable and with information pertinent to each entity, was one of the main results sought for the integrating of system. It was intended to offer users operational advantages of time and personal resources in the identification of situations of interest. Among these conversion of vector files, such as shapefiles and CAD, commonly used in Brazilian municipalities for the Database Manager System. In this database each table presents the data regarding the classes of information elucidated by the diagrams 1, 2 and 3. The correspondence between the pieces of information is ensured by binding keys, in which an unambiguous identifier is assigned to each feature, be it spatial or not. Figure 8 exemplifies the correspondence of information in the database according to the diagrams presented.

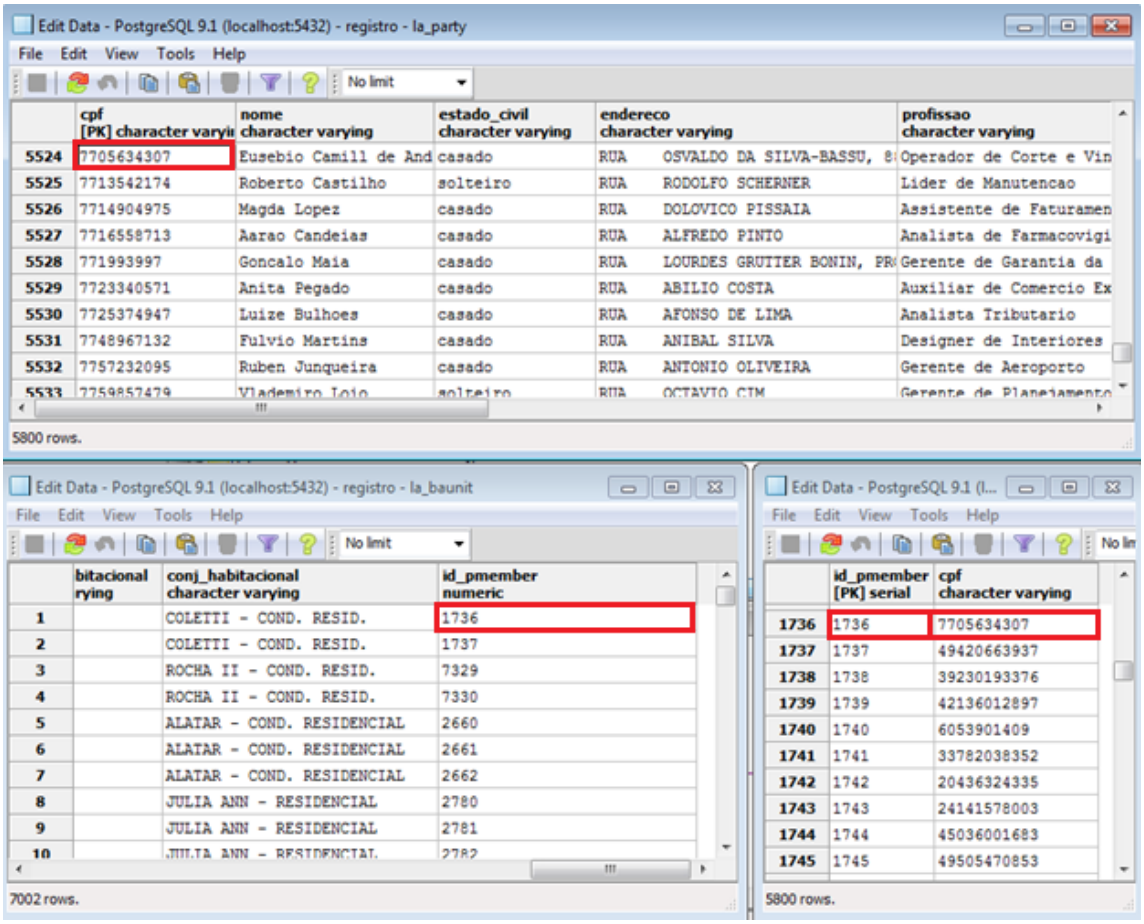

Figure 8: Example of matching information in the database

3.6 Creation of the communication interface

The algorithm that allows the presentation of Urban Cadastre and Land Registration data from a communication interface is based on two programming languages: SQL, which focuses on query of information in the database; and Python, which concentrates on the development of applications in a GIS environment.

The communication initially occurs with the insertion by the user of the data referring to the registration and legal number or fiscal indication of the realty. Following this, all individuals related to a land are presented according to the SSN field contained in both LA_BAUnit and LA Party tables. Once this presentation is made, the user is allowed to choose one of the parties, so that this action returns the data of the parcel and its owner. Yet at this moment, it is possible to select for the spatial visualization of the parcel, in case there is a spatial register. The diagram below (Figure 9) shows the sequence of the process described above.

In addition, the spatial data available in the database, when presented in a visualization interface, allows identification of the direct confronters of an appraised property, due to the attributes of a spatial unit. In addition, the spatial data available in the database, when displayed on a display interface, allow to identify, from the attributes of a spatial unit, which are the neighboring direct a parcel valued. According to the Public Records Law, this report is mandatory for several legal acts involving property. The query sequence on the database through the communication interface is elucidated in the figure below.

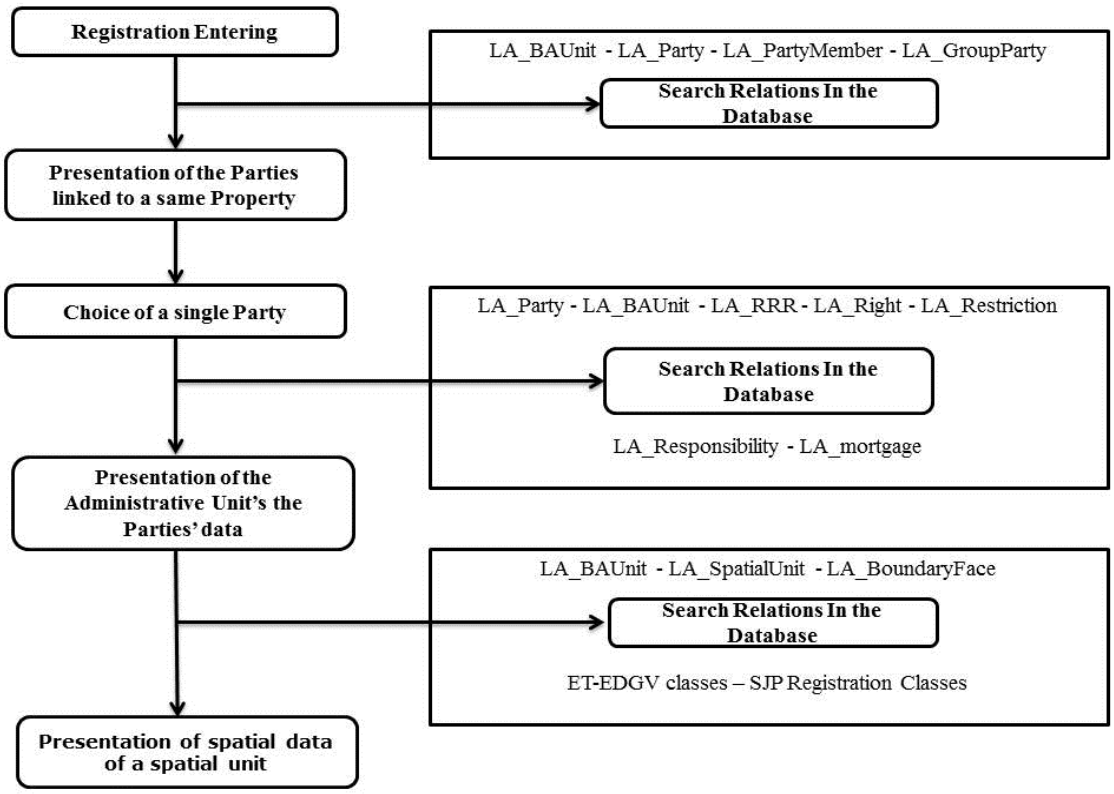

Figure 9: Query sequence on the database from the Interface
Source: Author (2017)

4 Results

Adequacy of the conceptual model addressed to the case study resulted in the definition of the object-relation database, as well as subsequent implementation of a communication prototype of the data concerning Urban Cadastre and Land Registration from the municipality of São José dos Pinhais. In accordance with that presented in item 3.5, Figures 10; 11; 12 and 13 bring the results of the queries allowed by the relationships defined by the adapted conceptual model.

4.1 Registration data query interface

In Figures 10 and 11 show the personal and administrative data query interfaces of the real estate parcels, as well as the spatial unit visualization interface. The personal data of the owners (C) are listed, based on the user's choice of the office in which the property is registered (A), as well as entering the property registration number (B). In addition, restrictions, rights and legal administrative responsibilities both present in the database and coming from Land Registration (E) are listed, along with the (fiscal) information from the urban cadaster (D).

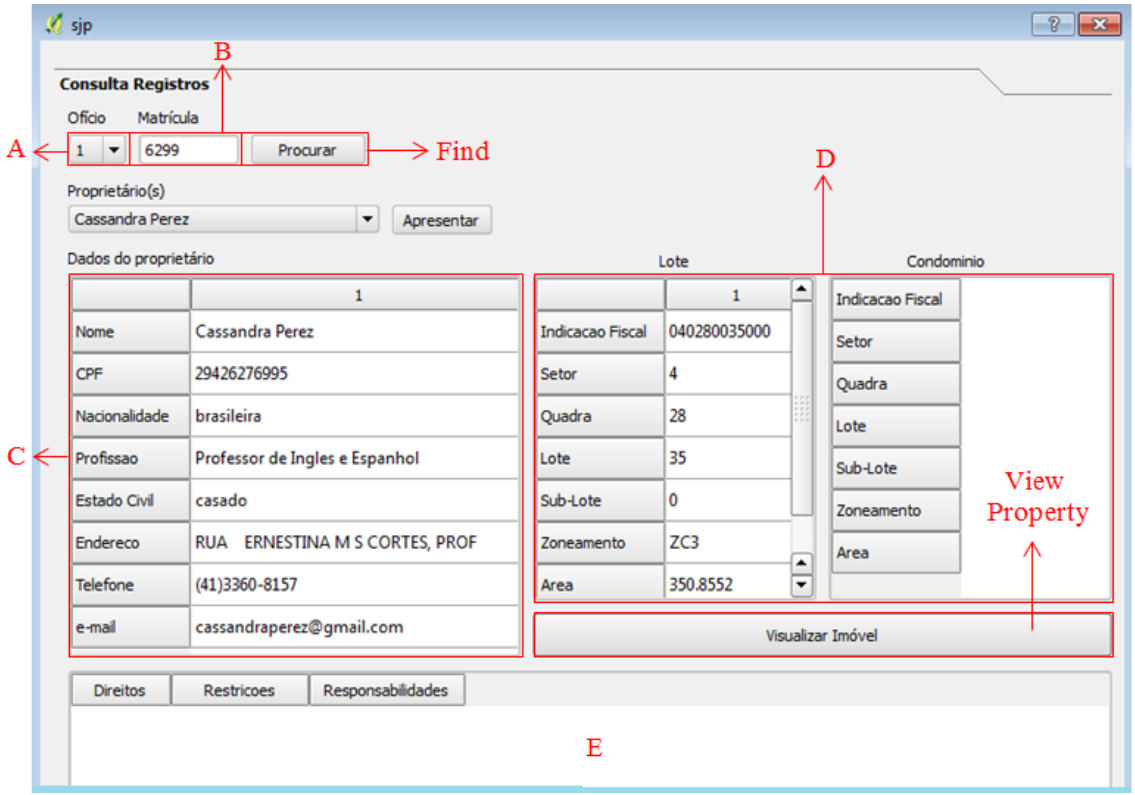

Figure 10: Query interface of the registration data of the parties and the administrative unit
Source: Author (2017)

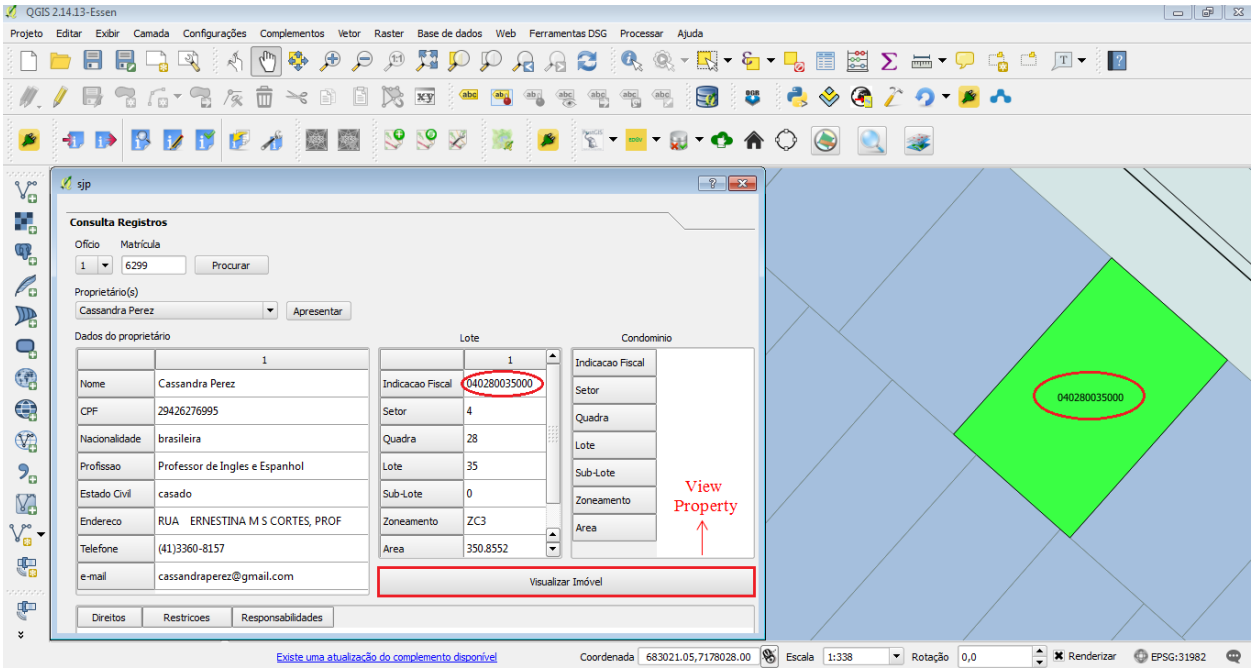

Figure 11: Spatial unit query interface
Source: Author (2017)

4.2 Interface for recording and editing data

Concerning the registration and editing of data, changes in the personal data of the individuals registered as taxpayers or with rights over the real estate property are allowed. This action can be carried out by the municipal offices or by the Land Registration. The search sequence of an individual performed by the algorithm is similar to that performed for consultation. However, the initial entry data is the fiscal indication of the parcel (A). This is due to the fact that a lot may own more than one real estate installment. When entering a fiscal indication, all the portions related to this cod parcel (B) are listed. Once the portion has been selected, the data of the correlated part (C) are presented for editing.

The change of the data of a taxpayer does not interfere with the right of ownership, even if, when this action is carried out, an amendment protocol is sent to the Land Registration.

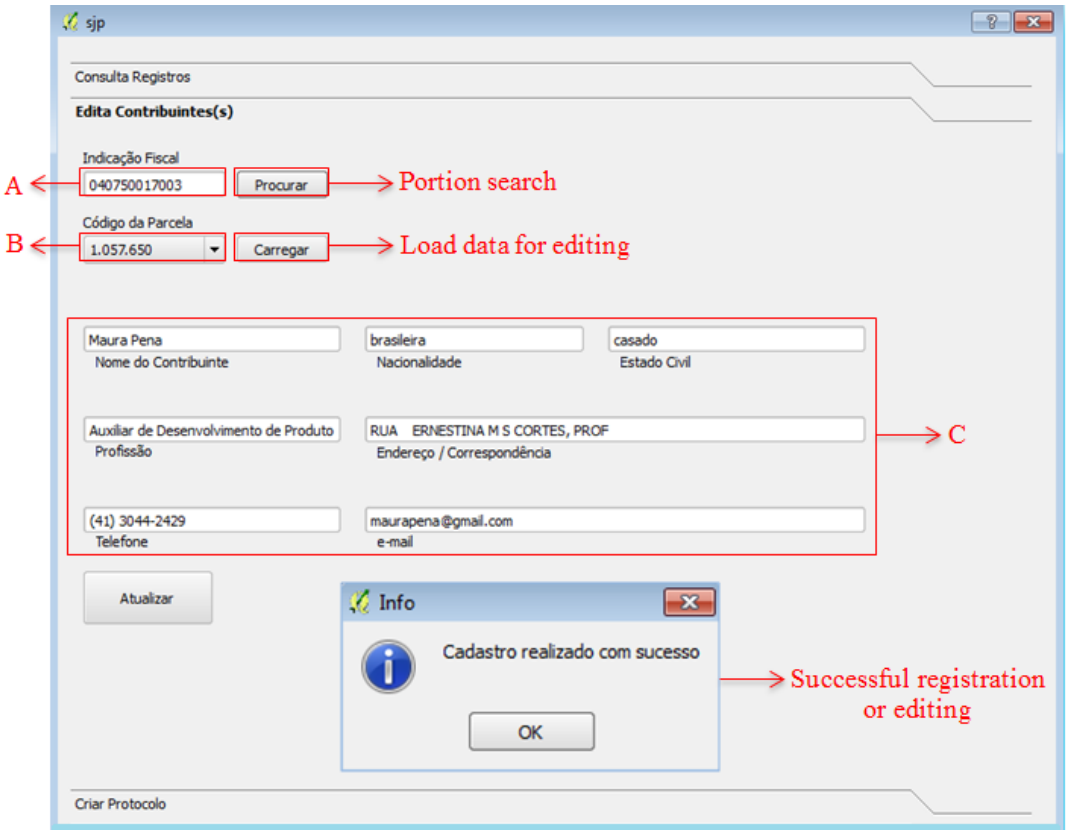

Figure 12: Registration interface and edition of the taxpayers' registration data
Source: Author (2017)

4.3 Communication interface among sectors

The generation of protocols that correspond to the exchange of requested information is displayed in the image below (Figure 13). In this tab, the entity generating the protocol (A) creates a protocol, indicating the respective subject (B), the situation regarding the ongoing process (C) and sends the recommendations so that the receiving entity (D) becomes aware and takes any necessary action. The input needed to generate the protocol is the tax statement of the parcel, as shown in Figure 13.

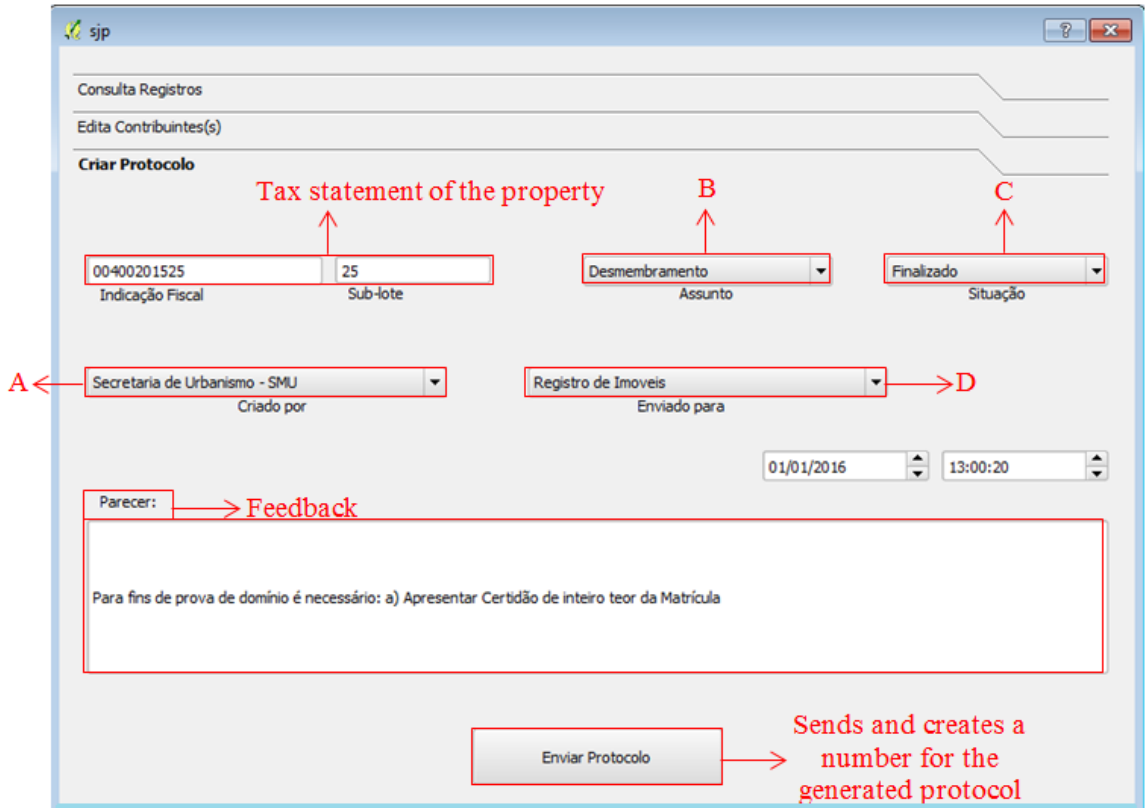

Figure 13: Protocol creation interface
Source: Author (2017)

4.4 Protocol Query Interface

With respect to the query of the protocols generated by the previous process, the following tab presents the processes, thus enabling taking the necessary actions to update the system. From the insertion of the protocol number and year (A), the characteristics and situation of a process (B) are presented.

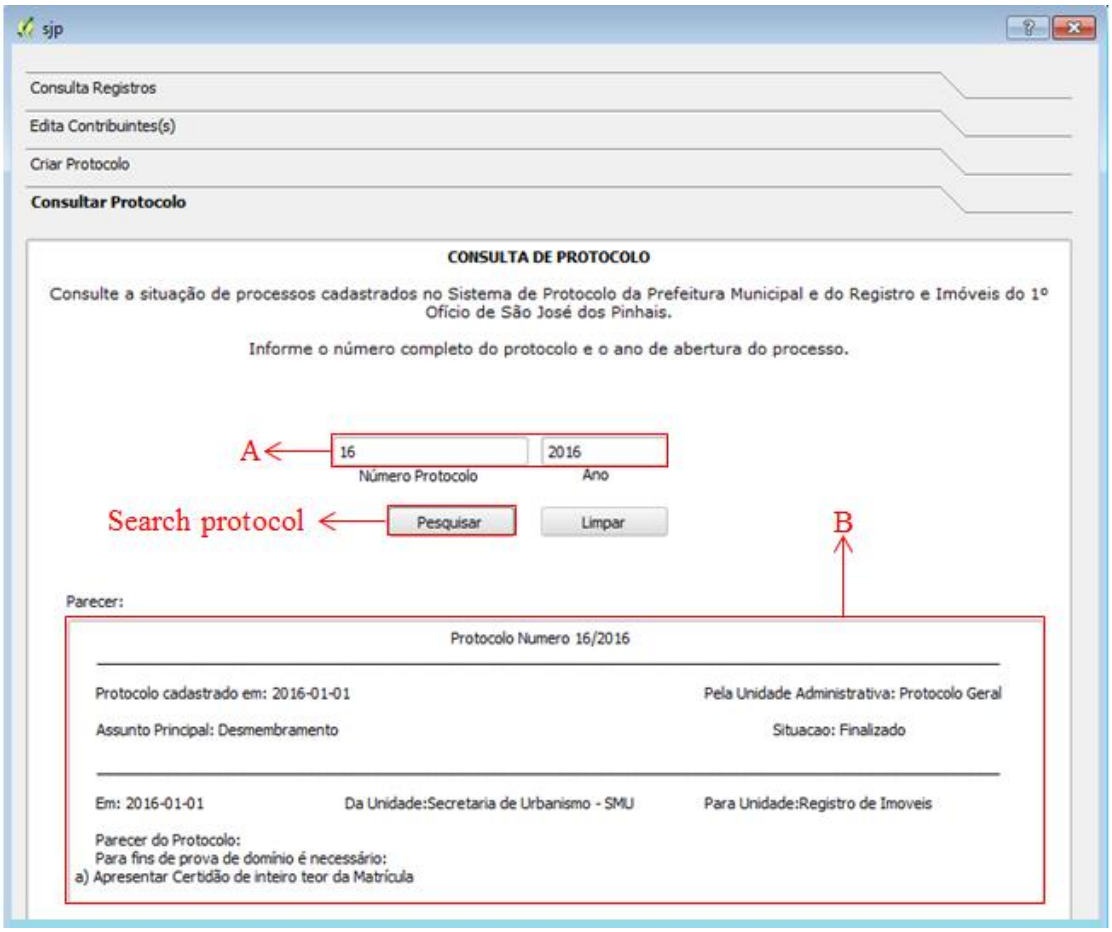

Figure 14: Protocol Query Interface
Source: Author, 2017

4 Conclusion

The intensive urban growth of cities require municipalities to model new management models Averbeck (2005). Since such issues are directly related to the unequivocal identification of ownership boundaries, the integration between IR and CIU has as its primary objective the identification of situations regarding rights, duties and responsibilities over property and ensures land tenure.

In order to achieve these objectives, the main results of the study, the design of the object-relational database and creation of the communication prototype for data regarding Land Registration and Urban Cadastre, stand out. Both had their development possible after optimization, directed to a specific case, of the conceptual model proposed by Paiva et al. (2016).

Another objective reached, concerning repetitive efforts due to lack of data sharing, was the structuring of the aforementioned database from a functional information store. In this, each institution from the interface with the user can change the bank according to their institutional designations. For Land Registration, the compatibility of the information in a single platform reduces the waiting time for records referring to projects, since at times registrations require the

owners of municipal authorization protocols for certain types of processes. Once these protocols are stored in the database, a number of institutions can access them.

For Urban Cadastre, using the reports from the Land Registration becomes an important tool, with respect to collection of taxes, the identification of the data of the owners and legal and administrative situation of the properties. As for the urban planning, it has a history of real estate in accordance with the legal situation of real property, which prevents the actions of political-administrative to be performed without legal support.

Finally, as an indication of feasibility of using the proposal to other Brazilian municipalities, it is observed that the two standards used as reference for the study are modeled based on an object-oriented language, the UML. This fact facilitates adaptations for the conception of conceptual models for specific cases, since, as shown, the information and data in the municipal registers are always not fully documented in the LADM and ET-EDVGDefesaFT standards.

References

AUGUSTO, E. A. A. *Registro de Imóveis retificação de Registro e Georreferenciamento: Fundamento e Prática*. Editora Saraiva, 2013.

AVERBECK, C. E. O Cadastro Como Instrumento De Política Fiscal. In. *Seminário de Cadastro Territorial Multifinalitário*. Ministério das Cidades, Brasília, 2005.

BORGES, K. A. de V. *Modelagem de dados geográficos: uma extensão do modelo OMT para aplicações geográficas*. Dissertação de Mestrado em Administração Pública. Fundação João Pinheiro, Belo Horizonte. 1997

BRASIL. *Decreto 8764*, de 10 de maio de 2016. Disponível em <http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2016/decreto/D8764.htm> Acesso em 10 de dezembro de 2016.

BRASIL. *Lei 10.267*, de 5 de dezembro de 2001. Disponível em <http://www.planalto.gov.br/ccivil_03/leis/LEIS_2001/L10267.htm> Acesso em 20 dezembro de 2016.

BRASIL. *Lei 6.015*, de 31 de dezembro de 1973. Disponível em <http://www.planalto.gov.br/ccivil_03/leis/L6015original.htm> Acesso em 30 março 2016.

BRASIL. *Decreto 6.666*, de 27 de novembro de 2008. Disponível em <http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/decreto/d6666.htm> Acesso em 15 de abril de 2016.

BLACHUT, T. *et al*. *Cadastre as a basis of a general land inventory of the country*. In: Cadastre: various functions characteristics techniques and the planning of land record system. National Council, 1974.

CARNEIRO, A.F.T. *CADASTRO IMOBILIÁRIO E REGISTRO DE IMÓVEIS*. Instituto de Registro Imobiliário do Brasil, Sergio Antonio Fabris Editor, Porto Alegre, 2003.

CARNEIRO, A.F.T. Integração entre Cadastro Imobiliário e Registro de Imóveis. *In*: *Seminário de Cadastro Territorial Multifinalitário*. Ministério das Cidades. Brasília, 2005.

FEDERAÇÃO INTERNACIONAL DE GEÔMETRAS - FIG. *Statement on the Cadastre*. Disponível em: <http://www.fig.net/commission7/reports/cadastre/ statement_on_cadastre.html>. Acesso em: 12 jul. 2016.
ISO. (2012). ISO 19152:2012. Geographic information - *Land Administration Domain Model (LADM)*, Geneva, International Organization for Standardization. 2012.

LEMMEN, C.H.J., P.J.M. VAN OOSTEROM, C. EISENHUT AND H.T. UITERMARK. The modelling of Rights, Restrictions and Responsibilities (RRR) in the Land Administration Domain Model (LADM). In: *Proceedings of the FIG Conference***.** Sydney, Australia. 2010.

OLIANE, L. O. *NOÇÕES DE CADASTRO TERRITORIAL MULTIFINALITÁRIO – CTM*. Série de Cadernos Técnicos da Agenda Parlamentar - CREA PR, 2015.

OOSTEROM, P. V., LEMMEN, C.H.J. *The Land Administration Domain Model (LADM): Motivation, standardisation, application and further development*. Land Use Policy, Volume 49, December 2015, Pages 527-534

PASCOAL, A. P., CARVALHO, R. B., XAVIER, E. M. A. Materialização do Perfil de Metadados Geoespaciais do Brasil em esquema XML derivado da ISO 19139. Anais XVI *Simpósio Brasileiro de Sensoriamento Remoto - SBSR*, Foz do Iguaçu, PR, Brasil, 13 a 18 de abril de 2013, INPE.

PAIVA, C. A.; ANTUNES, A. F. B.; CAMBOIM, S. Proposta de Modelagem dos dados do Registro e Imóveis e do Cadastro Imobiliário Urbano. In: *Congresso de Cadastro Técnico Multifinalitário e Gestão Territorial - COBRAC***.** Florianópois, 20016.