# Linking Land Registers and Other Official Registers in the Republic of Croatia based on LADM

**Mario MAĐER, Hrvoje MATIJEVIĆ, Miodrag ROIĆ, Croatia**

## SUMMARY

Weak or not existing linkage of official registers in Republic of Croatia (real estates, rights, persons etc.) and data redundancy as an inevitable outcome of such a state are the cause of various unwanted consequences for the relevant public authorities, but also for citizens and companies as the end-users of such data. Linking the registers, and thereby rationalizing the procedures related to public authorities, would enable significant savings in time, people and resources, and at the same time increase the legal security of registers and the availability of high quality and always up to date data.

In this paper the analysis of relevant registers is done together with the proposed model of their linking. The above mentioned model is developed as an extension of the existing Land Administration Domain Model – LADM. Some parts of this research should serve as a contribution in development of the LADM country profile for the Republic of Croatia.

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## 1. INTRODUCTION

During the recent period in the Republic of Croatia, several components of the Land Administration System were undergoing radical changes that are primarily related to the transition from analogue to electronic data processing. The main subject of the changes were the land registers. Transitioning of analogue registers to electronic form significantly simplifies the maintenance of data, increases their quality, availability and transparency, and enables dissemination of information via network services. Despite these advantages, analogue logic and the way of thinking have been retained in the newly established electronic environment (Mađer 2012). Because of that, all the benefits that the technology surrounding such systems could provide are not fully used. The same premise can also be applied to all other official registers. There are a large number of registers that partially record information about the same features but are not linked. The existence of redundant data in the public authorities, often leads to situations where information about a feature registered in one register does not match the information about identical feature in some other register. The current state of data is the cause of a variety of unwanted consequences burdensome for the relevant public authorities, but also for citizens and companies and other end-users of such data.

In an effort to end the current situation and make things better, idea to use LADM as a core which covers land registers but can be extended to the needs of the whole national system of registers has emerged. The logic and good ideas implemented into LADM could be applied to other fields which are outside the scope of LADM. To achieve this task, an overall analysis of all official registers must be done. In this paper, for the beginning, only some relevant registers were taken into consideration. The goal of the analysis was to determine the general condition of registers and use the resulting conclusions for building a better and sustainable national system of registers. Appropriate linking of registers would eliminate data redundancy and achieve significant savings in time, people and financial resources used for redundant and unnecessary multiple recording of the same data in different registers. This would lead to overall rationalization of the system of registers, enhancement of its legal security and production of high quality and always up to date data.

## 2. OFFICIAL REGISTERS IN REPUBLIC OF CROATIA

Much of the information that public authorities collect, maintain, use and make available to others, refers to the information on persons, property and property rights. This information are maintained in official registers either in analogue form or in electronic form, which is nowadays more often. Registers are systematically organized, maintained and regulated lists of specific legally relevant data, facts or rights. By registering data in official registers, the registered data becomes information based on which public authorities provide various
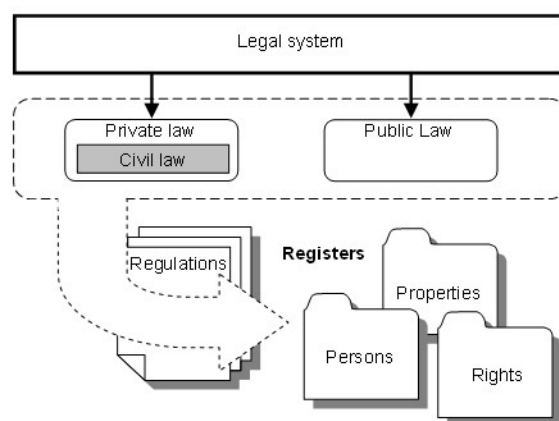
services to citizens, and citizens use that information to exercise their rights. The importance of the registers is reflected in the daily use of the registered data in the business and private lives of most citizens. Every day we come to situations where a certificate from some register is needed in order to prove certain fact, right or legal relationship. Well organised registers are prerequisite for smooth progress of the overall legal transactions. The amount and complexity of information that are maintained by public authorities according to regulations is constantly increasing. This fact is conditioned by the development of technology and is taking place simultaneously with it. A list of possibilities provided by new technologies is constantly increasing. The adoption of technological achievements, especially from the field of ICT and their implementation in the system of registers, has enabled easier maintenance, access and sharing of information. This has opened the possibility of collecting some new, additional information that previously weren't collected because their maintenance was technologically too demanding. A large amount of information and a large number of the registers require constant supervision and great care of data, registers and associated processes. Important role in this have public authorities which have jurisdiction over official registers. They are responsible for avoiding multiple data entry in the registers, proper organization of data, controlled spending of taxpayers' money and a reliable and high quality access to information of public registers.

## 2.1 Classification of official registers

Croatian legal system is built on Roman law, common to the countries of Western Europe. It also provides the classification of official registers. According to their content, the registers can be classified into the Registers of persons, Registers of properties and Registers of rights (Figure 1). These registers are governed by numerous regulations that are largely derived from private law. Private law is one of the main branches of law. Majority of theories of the division of the legal system divided it into private and public law. Generally, private law governs relationships between individuals while public law governs relationships between individuals and government and those relationships between individuals which are of direct concern to the society. Private law serves the private interests while the public law serves common interests.



**Figure 1. Position of registers in the legal system**

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The core of private law is civil law, which is defined as a set of legal rules governing the relations of natural and non-natural persons regarding the property and deeds. Natural and non-natural persons are subjects of civil law, while property and deeds are the objects of civil law.

Because of the topic of this paper, the importance of civil law for the land administration systems must be emphasized. Registers that are based on private law i.e. civil law are an essential part of such systems. Through these registers, civil law is built into the foundations of the land administration system (Roić et al 2008).

## 2.2 Key registers

Key registers are primarily those that contain information about people and space and their relationship. This definition can be extended to other registers that meet the requirements and whose data at some point become of key significance to the government. Data registered in such a register must be original and should not be collected and maintained in any other register. Furthermore, key registers must be regulated by law, their content must be well defined and data quality assured. There must be an obligation required by law for public authorities and other users to use the data of the key registers. Also it is important to establish procedures and standards for data sharing (Ellenkamp and Maessen 2009).

Because Croatian official registers don't meet basic requirements for key registers to the full extent, in this paper it will be shown how the LADM could help in fully meeting at least one condition: better linkage of registers modelled by object approach and elimination of data redundancy. Some of those data are already inside the scope of LADM but some are outside and those will be modelled as an extension of current LADM model.

## 3. ANALYSIS OF REGISTERS

Analysis of the possibilities to improve the existing model of linking the registers was extensive and required a suitable methodology. The beginning of the research required a clear definition of the objectives to be achieved. The aims of this research can be summarized as:

- determining the condition of the registered data
- identification of existing deficiencies in registers
- recognizing features which are the subject of registers
- recognizing the relationship between features in different registers
- identifying common attributes of official registers and LADM

Certain deficiencies in registers and poor condition of data were direct result of outdated regulations which have also been the subject of the analysis. Official registers are regulated by different laws and other regulations and sometimes different names were used for same features. It was necessary to recognize all those features and their relationships in different registers and show them correctly in the LADM-based model. LADM has been chosen as a basis for development of model of linking the official registers because it recently became an ISO Standard (Lemmen et al 2013) and because the great part of analysed registers data was also the subject of LADM. Development of the standard based on LADM is confirming its

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significance, and also at the same time justifies the choice of LADM as a basis for the development of a model of linking the official registers.

For the analysis, an RDBMS based application was built and used to describe the LADM and official registers through relational model and later used as a tool for identifying the attributes of the registers and attributes of LADM. This analysis demonstrated to what extent the selected official registers comply with LADM and in which direction to go with its extension. The analysis confirmed some earlier assumptions about the unsatisfactory state of the data, especially about their redundancy, which directly affects the reliability of information that can be gained from official registers.

## 3.1 Analysed registers

Conducted research included the analysis of a group of key registers listed in the following table (Table 1).

Table 1. Registers and jurisdictions

| Num. | Register | Public authority |
|------|----------|------------------|
| 1. | Register of natural persons | Ministry of public administration |
| 2. | Registers of non-natural persons | Judicial authority |
| 3. | Register of personal identification numbers | Tax administration |
| 4. | Land registry | Judicial authority |
| 5. | Cadastre | State Geodetic Administration |
| 6. | Register of spatial units | State Geodetic Administration |
| 7. | Utility cadastre | State Geodetic Administration |

Register of natural persons actually consists of three registers, each governed separately by Ministry of public administration: Register of births, Register of wedded and Register of deceased. Registers of non-natural persons are under the jurisdiction of judicial authority and its purpose is to provide legal personality of non-natural persons such as public authorities, companies, corporations etc. Register of personal identification numbers is governed by tax administration and holds the data about permanent identifier of Croatian citizens, non-natural persons established in the Republic of Croatia, as well as all natural and non-natural persons for whom the need for monitoring on the Croatian territory has emerged. Personal identification numbers can be used for linking the official registers. It was introduced due to general informatization of public administration, better data exchange between public authorities and better control over property of citizens and non-natural persons. Land registry is another register under the jurisdiction of judicial authority. It holds the data about real property rights, restrictions and responsibilities. Last three registers are under the jurisdiction of State Geodetic Administration. Cadastre is the register of real properties. Register of spatial units holds the data about names, territories and boundaries of counties, cities, districts, local self-government units, settlements, cadastral municipalities, statistical and enumeration districts, streets and house numbers. Utility cadastre holds the data about power lines, water systems, sewerage systems, gas pipelines, thermal pipelines and other utilities together with associated facilities.

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## 3.2 Compliance Analysis

Analysis of official registers data compliance with LADM was based on a comparison with the classes of three packages (Administrative package, Party package, Spatial Unit package) and one subpackage (Surveying and Representation package).

Administrative Package contains 8 classes with the total number of 20 attributes. Figure 2 shows LADM attributes to which corresponding attributes of the official registers were identified. Attributes of Administrative package have been found in analysed registers in large amount. Cases in which a particular attribute of Administrative package is identified with two or more attributes of official registers may indicate the possible redundancy in the official registers.
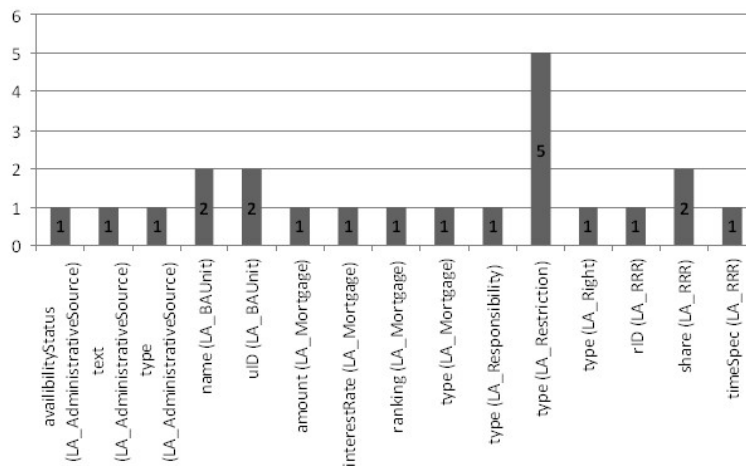


**Figure 2. Attributes of *Administrative* package found in analysed registers**

Party package contains 3 classes with the total number of 8 attributes. Figure 3 shows the results of the comparison that indicates an extremely high level of redundancy in the field of some personal data.
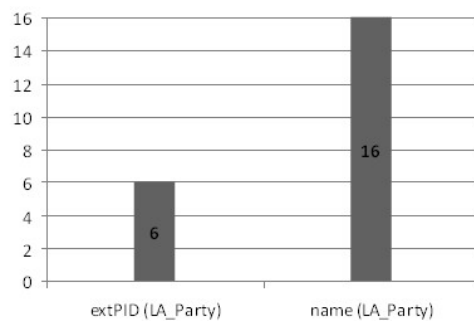


**Figure 3. Attributes of *Party* package found in analysed registers**

Spatial Unit package contains 6 classes with the total number of 24 attributes. Figure 4 shows all identified attributes. A small number of identified attributes points to the fact that spatial

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data in the official registers are not yet at the level assumed by LADM, especially regarding the 3D.
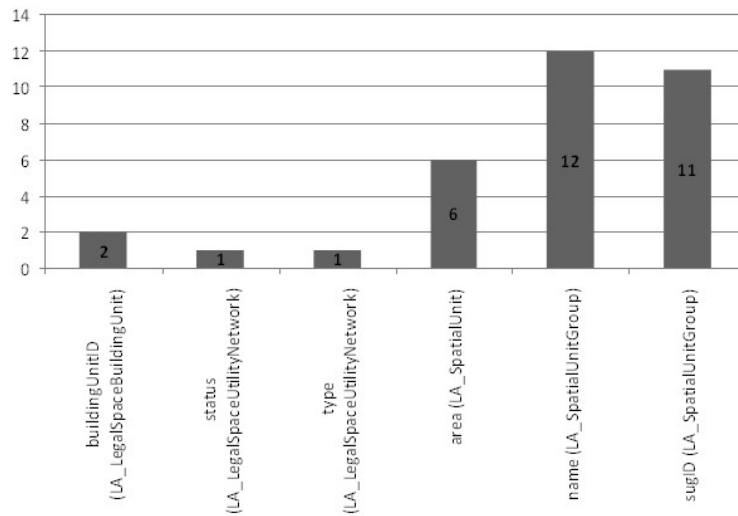


**Figure 4. Attributes of *Spatial Unit* package found in analysed registers**

Surveying and Representation package contains 4 classes with the total number of 17 attributes. Figure 5 shows all identified attributes and possible significant redundancy of geometry data.
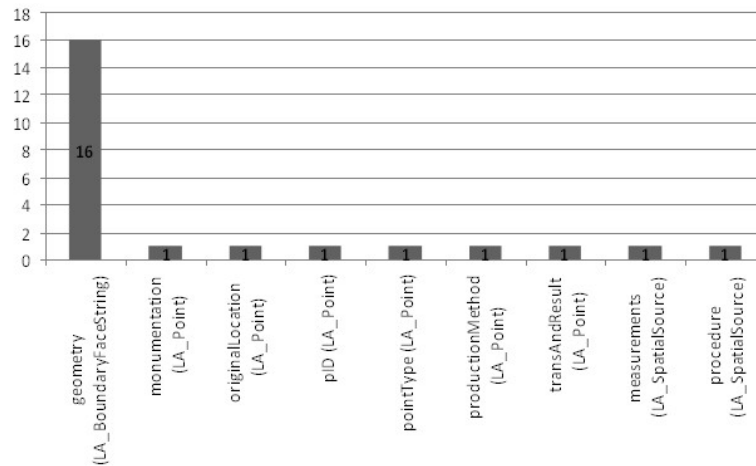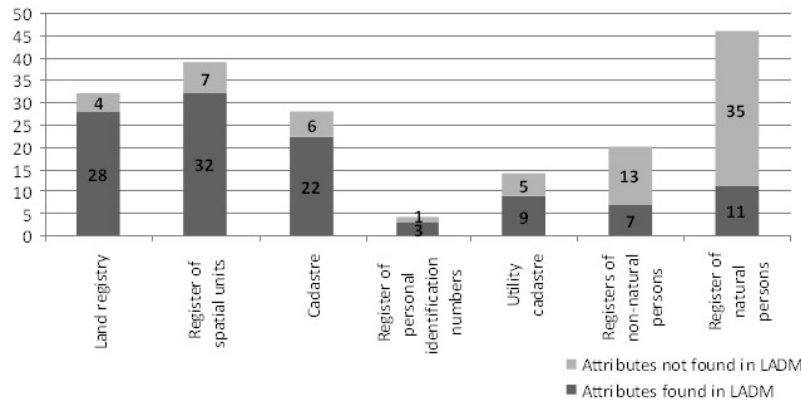


**Figure 5. Attributes of *Surveying and Representation* package found in analysed registers**

### 3.3 The level of compliance between attributes of official registers and LADM

Analysis results (Figure 6) are showing the level of compliance of analysed registers and LADM. For each analysed official register it is shown the ratio of attributes identified with attributes of LADM and attributes which are not found in LADM. High rate of compliance of LADM and official land registers were expected and confirmed and for the rest of official registers some significant extensions will have to be done.

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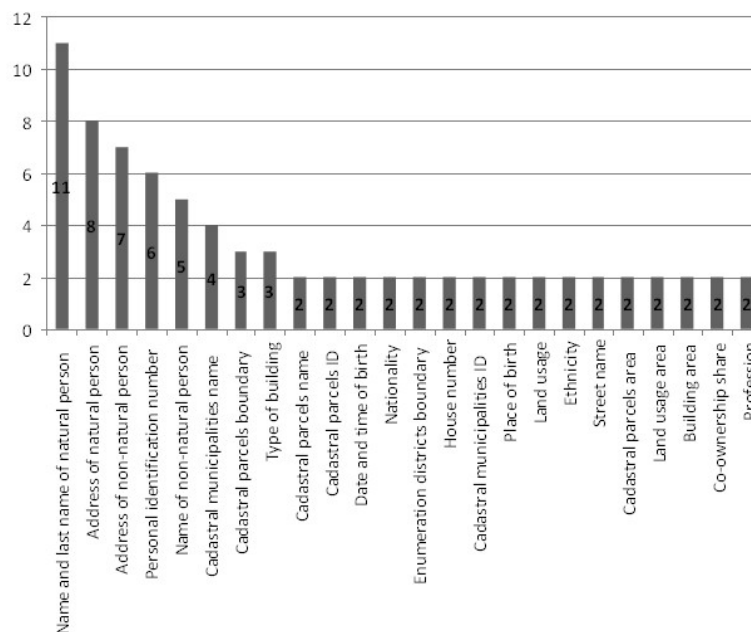
**Figure 6. Compliance of analysed registers with LADM**

Reason for only partial compliance of land registers and LADM lies in the fact that those registers also hold data which are outside the scope of LADM, usually are originally maintained in other registers, and therefore are redundant.

### 3.4 The level of data redundancy

Analysis has confirmed a significant amount of data redundancy in the official registers (Figure 7) which is direct consequence of using analogue technologies for data maintenance up until recently. The largest redundancy was found in data related to natural and non-natural persons. This is not surprising if one takes into account the fact that almost every other register uses those data while there is no systematic solution for linking registers on data level.



**Figure 7. Redundant data in the official registers**

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More surprising is the fact that a certain degree of redundancy exists if we look at it at the level of individual public authorities responsible for governing multiple registers. Especially situations like this shouldn't happen because public authority responsible for more than one register has unrestricted access to whole data, is fully familiar with data models and thereby should be able to find simpler solutions for data sharing than those when data is jealously kept under different jurisdictions. This type of redundancy also originates from analogue era but nowadays there should be no technical or administrative reasons for its existence. This primarily refers to the data which are maintained originally.

## 4. MODEL OF LINKING THE ANALYSED REGISTERS

Model of linking the official registers was done using the standard UML diagrams. It has been done by extending LADM in parts which are outside its scope. Parts of each diagram bounded by dashed lines are the ones that can be recognized as parts of current official registers. First diagram shows the extension of LADM regarding the natural and non-natural persons (Figure 8).



**Figure 8. Natural and non-natural persons**

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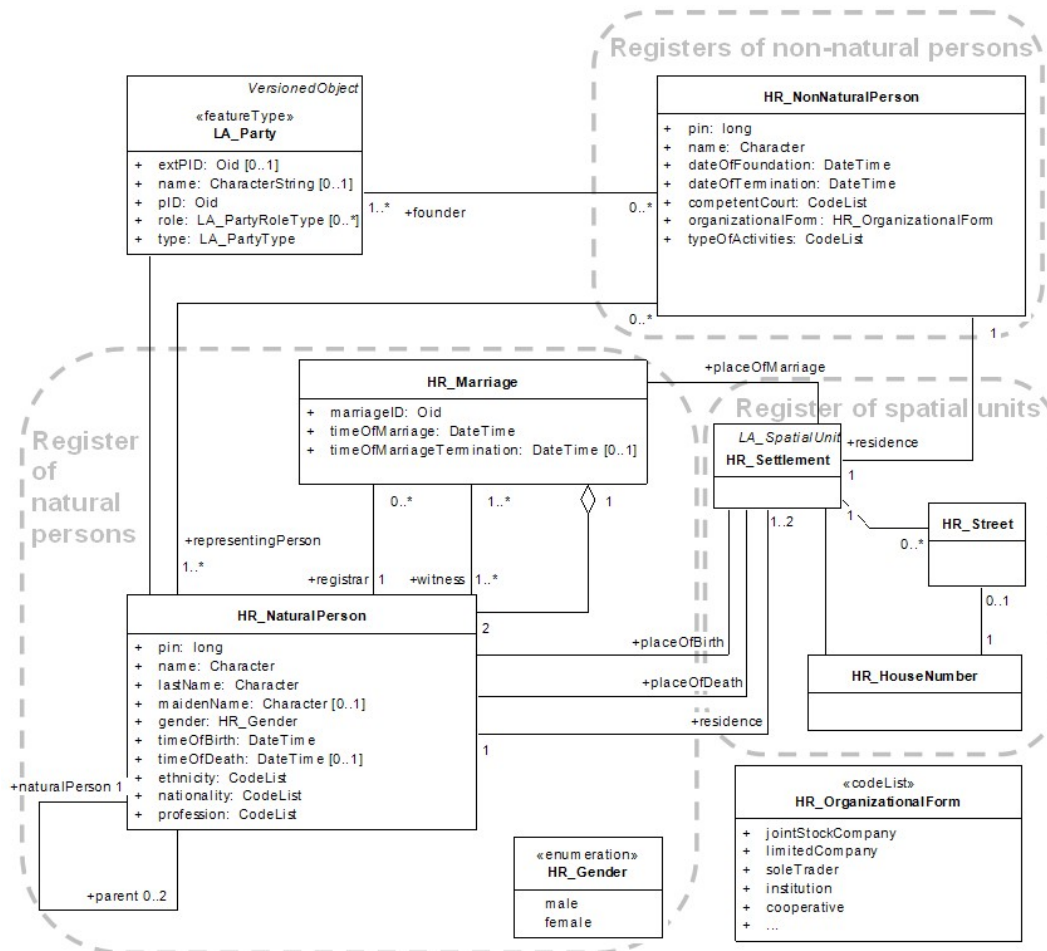International FIG workshop on the Land Administration Domain Model
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Detailed information on persons are outside the scope of LADM so an extension has been made by classes HR_NaturalPerson and HR_ NonNaturalPerson, which are included into model by associating them with class LA_Party. By separating natural and non-natural persons into two separate specialisation classes, their specific attributes were also separated. Such separation is in accordance with the divided jurisdiction over the persons data. Class HR_NaturalPerson together with the class HR_Marriage represents Register of births, Register of wedded and Register of deceased, which are all parts of one Register of natural persons.

Register of spatial units holds data about spatial units shown below (Figure 9). Those data can be easily integrated with LADM by associating them to the two basic classes of Spatial Unit package: LA_SpatialUnit and LA_SpatialUnitGroup. Relationships of classes that represent spatial units are mostly the aggregation series which is the result of their positional and hierarchical relationship in nature.
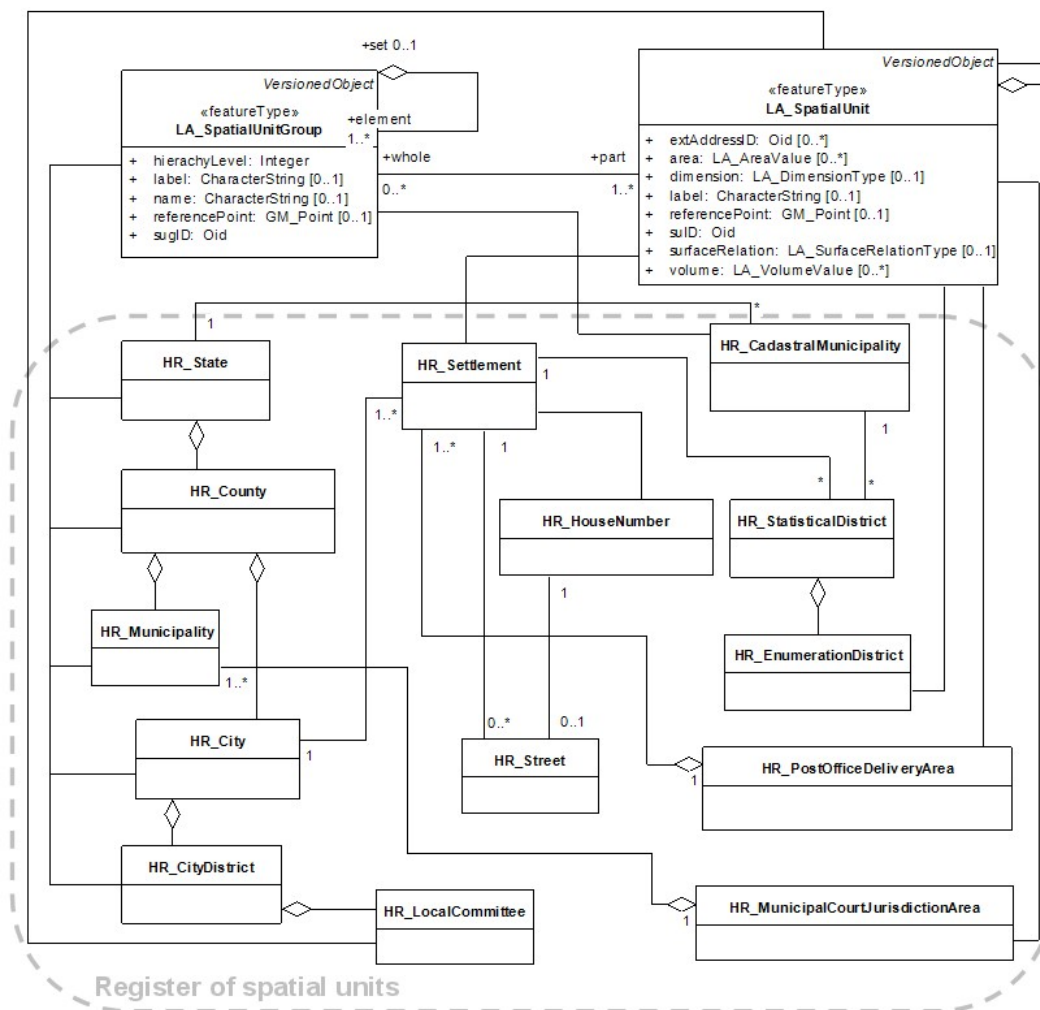


**Figure 9. Spatial units in Republic of Croatia**

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The basic registration unit of Cadastre is cadastral parcel. Its spatial component is represented by class HR_SpatialUnit (Figure 10). Although it is a basic unit of registration, cadastral parcel can consist of even smaller parts which are differentiated according to the way they are used and cannot be registered alone but only as a part of basic registration unit. Those parts are represented by class HR_CadastralParcelPart which may refer to land or building (land beneath the building). Land use types and building types are presented by appropriate codelists. HR_SpatialUnit class is a specialisation of LA_SpatialUnit which represents spatial component of all spatial units in LADM. Its specialisation HR_LegalSpaceUtilityNetwork is associated to class HR_UtilityLine which is a class for utility data registration. Boundaries of spatial objects are defined by points measured in the field and are represented by class HR_Point.
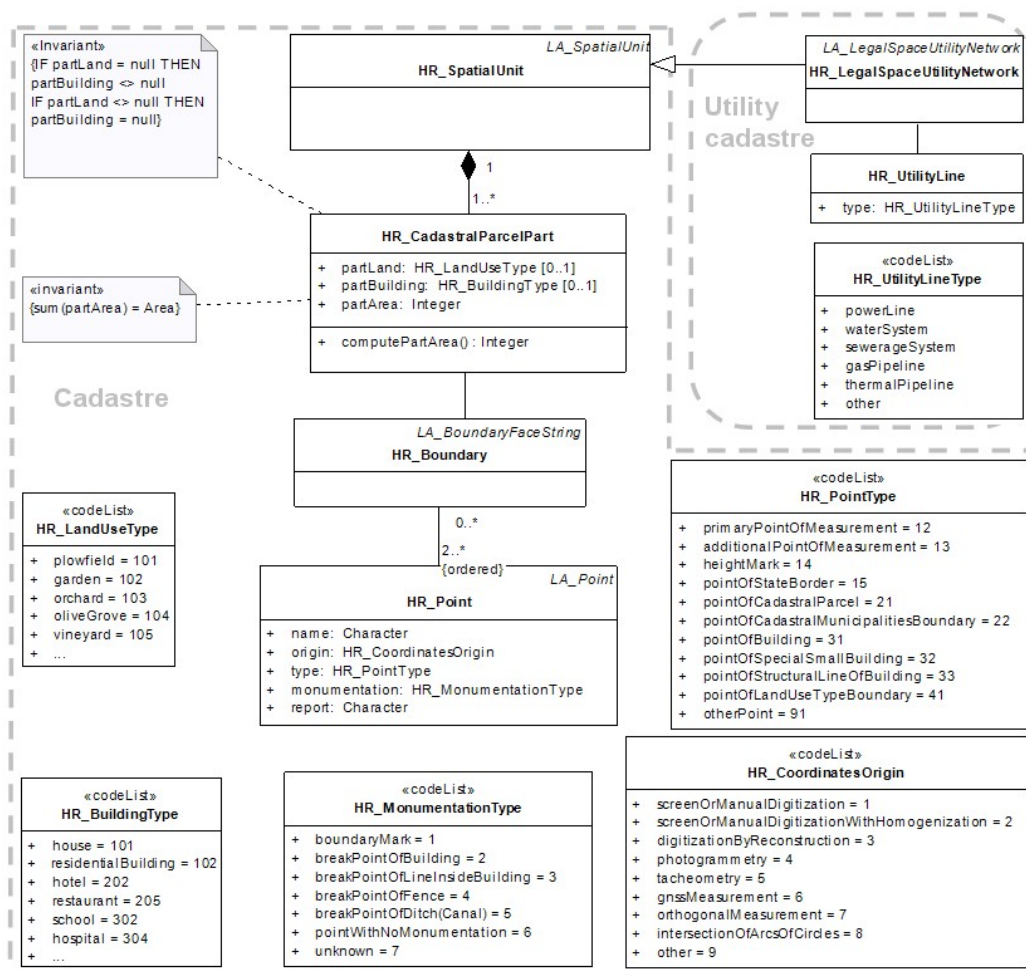


**Figure 10. Cadastral parcels and utilities**

Interests that can be established on the real properties are subjects of the Land registry. Based on registration in Land registry those interests can be gained, lost or transferred between different persons. Registration of interests is entirely within the scope of LADM and is

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represented by one of the main classes of Administration package, LA_RRR, i.e. its specialisation HR_RRR (Figure 11). It is an abstract class so it gives no instances. Instances of its subclasses represent interests and can be recognized as real property rights, restrictions and responsibilities defined by civil law and incorporated as the most important part of Land registry.
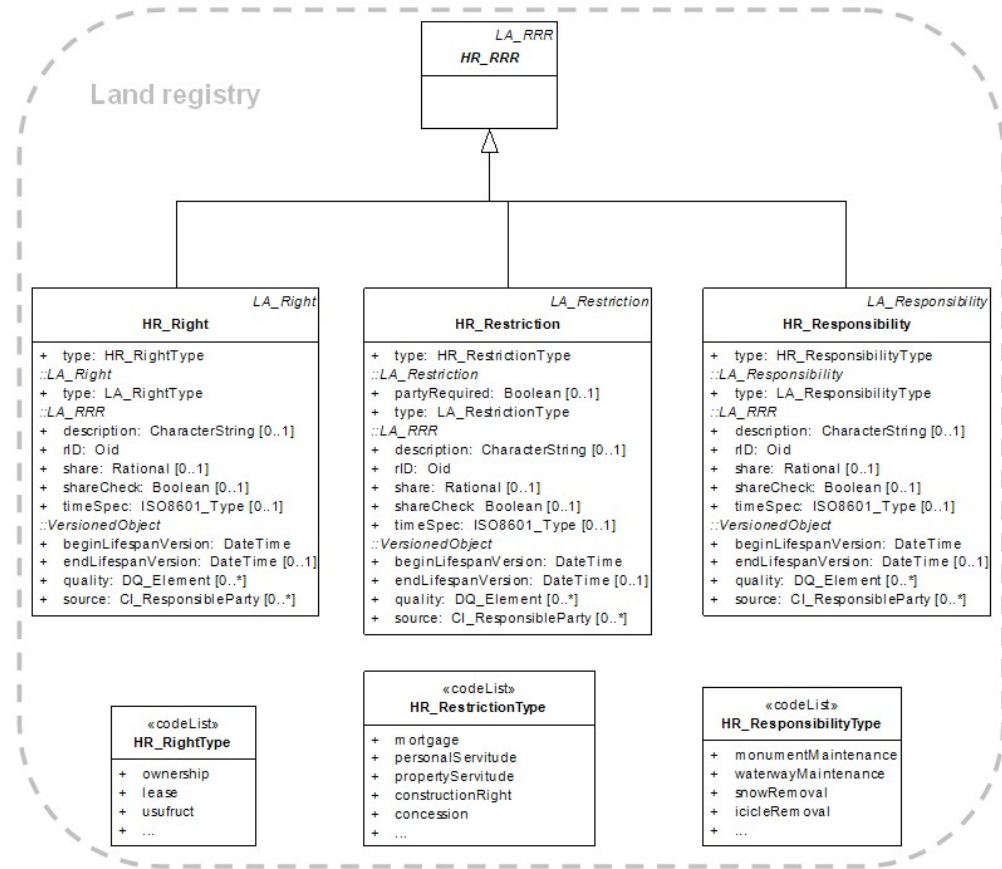


**Figure 11. Interests over the real properties**

## 5. CONCLUSION

The goals of the research presented in this paper are aimed towards providing the conditions for the remodelling of the existing system of registers in order to achieve a better linkage of official registers in The Republic of Croatia and their adjustment to the electronic data processing. Analysis of the possibilities to improve the existing model of system of registers, considering its complexity and extensiveness, is very complex and it was necessary to use appropriate methodology. The research included analysis of the overall condition of land and other official registers, analysis of their linkage, identification of features to be recorded in the registers and identification of their interrelationship. Through the conducted research the deficiencies in the official registers and the basic assumptions for their removal, have been detected. Thereby, all the possible improvements of the current condition have been investigated. The analysis confirmed a high level of data redundancy in official registers even

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when they are under the jurisdiction of the same authority, which raises the question of efficiency of administrating the registers by various authorities. Within the research a comparison of attributes of official registers and attributes of Land Administration Domain Model (LADM) has been conducted. Despite the detected data redundancy in official registers, some level of compliance with LADM has been confirmed.

The conducted research is a prerequisite for the improvement of the national system of registers. In its further development it should follow the example of LADM which has shown how to handle land administration data in the best possible manner. Based on the conducted research and the results of the analysis, taking into consideration the LADM concept, the prototype of the model of linking the official registers has been developed. Some parts of this model should also serve as a contribution in development of the LADM country profile for the Republic of Croatia. Any implementation based on a knowledge represented by this model would provide flexible, sustainable and efficient system. Electronic managing of data structured according to the above model would improve data quality and enable better data exchange among different parts of system.

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Mario Mađer graduated in Geodesy from the University of Zagreb, Faculty of Geodesy. In 2012, he received a PhD from the same University for the thesis "Model of linking cadastre with related registers". The topics that he specializes in are land administration systems, cadastres and geoinformatics. He is a member of Croatian Geodetic Society and member of TC211 at Croatian Standards Institute.

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interests were and still are GIS and Spatial DBMS technology in service of cadastral data management.

Miodrag Roić graduated in Geodesy from the University of Zagreb, Faculty of Geodesy. In 1994, he received a PhD from the Technical University Vienna for the thesis "Surveying of Natural 3D-Structures with Video-theodolites". Since 1996, he is a professor at the University of Zagreb, Faculty of Geodesy. He was Vice Dean of the Faculty, Head of the Chair of Spatial Information Management and the Institute of Engineering Geodesy, and he is appointed as Dean for 2011-2015. The topics that he specializes in are land administration systems, engineering geodesy, cadastres and geoinformatics. He was an editor-in-chief of "Geodetski list", an internationally recognized Croatian scientific geodetic journal. He is a corresponding member of the German Geodetic Commission (DGK) and many other national and international scientific and professional institutions.

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