Towards a Standardized Concept of Multipurpose Land Administration

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Key words: Cadastre; Land Management; Marine Cadastre, Multipurpose Land Administration, LADM

SUMMARY

A more extensive use of land administration data began with the development of multipurpose cadastral systems. However, establishing of multipurpose cadastral systems has proven to be a task more demanding than expected, so hardly any country has one that is really efficient. Only with a start of a more extensive introduction of IT technologies have the prerequisites for developing of multipurpose land administration system really been fulfilled. Still, the differences resulting from basic concepts (e.g. deed vs. title registration, fixed vs. general boundaries, institutional and jurisdictional differences) require on a per country approach to be applied when multipurpose land administration systems are to be implemented. LADM can be used as a facilitator for the development of a standardized concept for a multipurpose land administration system, however it first needs to be adjusted to local conditions.
The inclusion of all the involved stakeholders directly into an integrated LAS would not result in an efficient system. The analysis of parts of LAS indicates that the most appropriate solution is a distributed MLAS based on the interoperability of its parts. The analysis focuses on components (registers) to be included in order to satisfy as many users as possible.

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1. INTRODUCTION

A more extensive use of land administration information began with the development of multipurpose cadastres. Their establishment, however, has proven to be quite a demanding task, so it is hard to speak of efficient multipurpose cadastres in any country. It was only the development of information technologies (intranets, databases…) that really opened up the possibilities for development of Multipurpose Land Administration Systems (MLAS). The differences between systems for registering land and systems for registering land tenure do not allow for a unified approach among countries. Title or deed registration, fixed or general boundaries, institutional and organizational issues, jurisdiction and structure of land registers, as well as other differences require a customized approach to the development of a multipurpose land administration system in each country.

The idea of a multipurpose cadastre is mentioned and elaborated particularly frequently in the 1980s in the USA (NRC, 1983). The differences between cadastral systems in individual states and even counties of the USA were identified as a constraining factor in improving the use of the existing information. Cadastres, which sometimes record only titles without specifying the location, and sometimes only the information needed for taxation, are difficult to use in a unified manner in conjunction with other registers in order to establish an integral and homogeneous land information system for the entire country. The significant potential of having officially recorded information spurred reflection and work on a coordinated enhancement of individual systems. Cadastres, as independent registers, have over time been subject to expansions, so instead of having a single purpose (e.g. taxation), today they serve multiple purposes.

Modern thinking in multipurpose cadastral systems is increasingly directed at developing multipurpose land administration systems (MLAS), i.e. building national land information infrastructures (Bennett at al. 2012; Duncan and Rahman 2013). Aside from the cadastre as the fundamental register of land information, many countries have other registers of land and land tenure that need to be combined. One characteristic they have in common is that most information is registered in relation to the basic spatial unit – the cadastral parcel – but also with regard to specific spatial features (e.g. a national park…). If such features are not originally linked to parcels, difficulties in management often arise. This paper provides an overview of the different components

of a land administration system and of the possibilities for increasing its efficiency by combining individual registers.

2. USING LAND INFORMATION

Land information on parcels plays a central role in many administrative and economic activities. It is used by many public administration bodies and private sector in their everyday tasks (Figure 1).

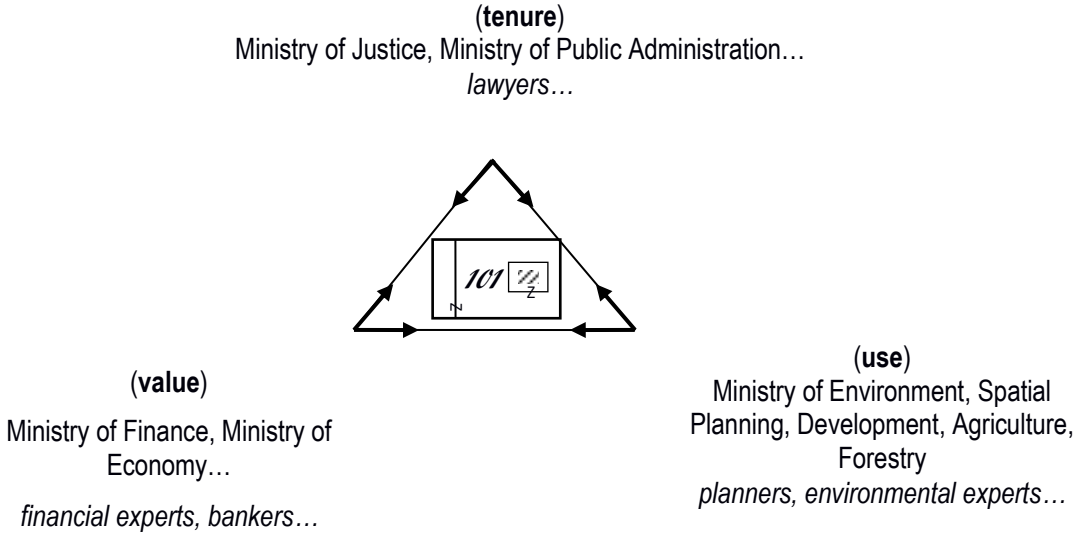

Figure 1. Role of land information (Roić, 2012)

Land information registers keep track of the actual status of land and as such take static care of the environments. Man-made actions constantly change this status. The changes can be arbitrary or prescribed. Population growth and increased pressure on land have lead to a decrease in the range of changes that can be carried out arbitrarily. Spatial planning takes dynamic care of the environments by determining where construction or some other action is allowed. The static status itself does not, therefore, provide complete land information as required for land management and performing desired operations on the land.

Many users at both national and global levels need detailed land information for decision making purposes. Disasters do not stop at city or country boundaries, and land information is commonly spatially segmented and accessible in separate registers. People live in a particular residence; crimes happen at certain addresses. Information exists on both those facts, but it is still difficult to link and analyze it in a holistic manner. There is heterogeneity of land tenure, which also reflects the diversity of institutions and registers in individual countries.

The need for a national/global land information infrastructure is no longer put in question, but the path to achieving that goal is still not clear. Cadastre and cadastral parcel information is recognized as a fundamental and integral part of a geoinformational infrastructure (e.g. INSPIRE). Policies, regulations, institutions and technical support need to be enhanced in order to improve the existing infrastructure and build a more efficient one.

Complete land information must be available to the economy and politicians at decision-making time. Standardized information is a necessity, and users are increasingly aware of this. Key requirements are economic gain and environmental protection. Existing heterogeneous registers are not sufficient to meet user needs and must be unified within a homogeneous land information infrastructure that is efficient and accessible to users.

3. LAND INFORMATION

Cadastres, which feature among the oldest and longest-lasting official registers, were established primarily for the purpose of registering land and/or private rights in it. Public land was originally excluded from cadastres, as it fell under state jurisdiction. For areas under the jurisdiction of public institutions, it has been common to establish special registers managed separately from the cadastre (e.g. Register of State Property, Railroad Register, Forest Cadastre, Utility Cadastre, Building Cadastre, Marine Cadastre, Cadastre of Mining Resources...). Most land information is registered in the cadastre, so all special registers are somehow connected to it. It would be very difficult to establish them without the cadastre, and they are most often established by taking over cadastral information on the land (cadastral parcel) and adding the dataset significant for the resource for which the register is being established. The establishment is most often motivated by immediate needs, which are frequently transient, so such registers sometimes have a very short lifespan. Besides, establishing a register is a demanding and costly affair, and maintenance is the most important success factor. The latter is usually neglected, which guarantees failure.

Except for land information, which they register and maintain, public authorities are also responsible for many other types of information – they produce and maintain statistical, financial, economic, traffic, legal and numerous other types of official information. Such information can be presented in maps, reports, lists, tables, photos or films; it can be in analogue or electronic format, individual or organized in data warehouses. Some of it is copyright-protected, and some of it is not. All of it represents an enormous potential that can be used to achieve economic progress if it is accessible and reused, which means utilized in new ways, adding new values, combining information from different sources and analyses, and finding new applications. Individuals, non-profit and for-profit organizations can use public sector information to develop the economy and culture and increase efficiency while respecting sustainable development to the benefit of society as a whole.

Reusing public sector information creates new jobs and provides users with a wider range of cheaper services. Such information can also be used by the public administration in making better

political decisions that will make it more efficient and cost-effective. The authorities are aware of this and they try to use the potential of public sector information. Availability of public sector information for reuse depends on technical requirements and rules governing its availability, as well as on the ways in which it may be used. The right to use public sector information depends on whether it comes in the form of copyright-protected works or it is mere information.

The need for multipurpose use of land information and connecting to other data is frequent in all spatial activities. Understanding the content and quality of the cadastral map is important for all users, especially when it comes to connecting it to other sets of spatial information, e.g. topographic and orthophotographic information.

The foundation of an efficient multipurpose land administration system is the establishment of a unified geodetic reference system and basic datasets. A geodetic reference system provides spatial foundation for positional linking of all other multipurpose cadastral information. Basic dataset can contain topographic information that greatly facilitates spatial orientation and determination of basic cadastral features – boundaries. Electronic management of registers allows for physical and logical linking without significant additional costs, while at the same time bringing major benefits to users.

Establishment of a multipurpose land administration system presupposes cooperation among many levels of public administration. Public administration bodies ensure the basic requirements, and the system is built by numerous professionals, such as surveyors, lawyers and planners. Cadastres established for one purpose and subsequently expanded with other land information are one way of establishing multipurpose cadastres. If a cadastre is assigned new purposes without ensuring appropriate material and other support, the efficiency in fulfilling the original purpose can be compromised. Instead of recollecting the information that is already kept in a register, the purpose can be fulfilled by logical linking of register warehouses. This was made possible by the development of information and communication technologies.

The concept of a distributed MLAS development can be further expanded and included in the concept of spatial information infrastructure or geoinformational infrastructure. The cadastral dataset is in such a case the basic layer of information necessary for efficient land administration within the geoinformational infrastructure. The key quality of a distributed MLAS is the fact that the state is responsible for the information, i.e. the information author – or the party responsible for the information in individual registers that make up the MLAS – continues to vouch for the content of the system. Other than basic information registered in the cadastre, the MLAS must also include public rights, public utility infrastructure, complex buildings, maritime areas, and so on.

3.1 Public rights

In order to ensure sustainable development and environmental protection, countries use special regulations to introduce an increasing number of public interests in land. Established rights or

charges can have the effect of right of access, management, usage, utilization or alienation. Establishment of public rights can refer to a maritime domain, water estate, cultural property, strict reserve, national park, special reserve, park of nature, regional park, natural monument, significant landscape, forest park, park architecture monument, protected area, etc.

Spatial planning documents also introduce new rights, restrictions or responsibilities in land. They define a binding purpose of land and must be adhered to, i.e. they have a regulatory effect.

3.2 Public utility infrastructure

Public utility infrastructure objects (utility lines, hydrants, manholes…) are a special type of immovable objects located on, above or below the earth's surface and are permanently connected to it. Due to their importance and influence on the land on which they are located, they can be part of a (land or property) cadastre, or there can be special utility cadastres established by means of regulations in order to record such objects. Public utility infrastructure can include utility lines and the corresponding network objects: electricity, telecommunications, water supply, sewage, heating, gas, oil pipeline etc.

Managing of information on public utility infrastructure is often the responsibility of local authorities. In such cases it is mostly technical information on the infrastructure that is recorded, whereas the legal relations remain unregistered. The relations between land owners and infrastructure are available only if they are also additionally entered into a register recording land rights such as servitude. Recording of such information is rarely done in practice, and even if records do exist, the spatial extent of the right of servitude is usually imprecise. An expedient solution would be supplementing the information already contained in the original cadastre used to manage the cadastral map.

3.3 Complex constructions – separate property parts

The pressure to erect buildings, especially in city centres, has lead to a dense concentration of complex buildings. Relations in such buildings are intertwined. Normally, it is possible to register rights in parts of such buildings. A spatial representation of rights, however, usually does not exist, or it is made possible through multilayer two-dimensional representations.
Traditional cadastres, based on representing land properties in a two-dimensional cadastral map, provide only the footprint of buildings. Legal relations in the third dimension are recorded descriptively, making spatial extent unreliable.

Reliability of registration of complex buildings – or parts thereof – demands that the cadastral map data model be enhanced in relation to the third dimension. Introduction of technical capabilities for 3D representation on the cadastral map would enable further development of 3D cadastre towards supporting the registration of legal relations above and below the surface.

3.4 Maritime areas

At the time when land cadastres were being established, maritime areas were not a matter of interest and they were mostly excluded. Today, maritime areas must not be ignored. Aside from its importance as a natural resource, marine environment and its utilization are inherently three-dimensional and encompass usage rights related to the surface, water column, seabed and marine subsoil. There are many interests in maritime areas. Some of them do not have a pronounced spatial characteristic, or they include the entire extent of a country's maritime area. Maritime area administration by means of only allocating the right to carry out such an activity, without a spatial definition of the position and form of the area in which it is carried out, creates numerous difficulties. Efficient registration of interests in maritime areas requires full use of FIG's definition of cadastre. In this definition the Earth's surface does not end at the boundary of land and sea, but stretches out across the entire Earth, regardless of whether the area is sea or mainland.

Due to their natural characteristics, maritime areas can be recorded in different registers, but all of them must be a part of a distributed MLAS.

3.5 Other information

Beside the special datasets explicitly listed above, there is other important information. State-owned land/property is often treated as a separate dataset and special registers are established to record it, despite the fact that such land can be efficiently recorded in the basic cadastre together with other types of land. The same is true of railroad land/property, forests and forest land, as well as mineral resources.

4. USING THE REGISTERS

All registers in a given country are governed by regulations, and their management and maintenance are entrusted to a public administration body. This body must maintain the register in keeping with regulations and guarantee the integrity of the information recorded in it. For every register, a purpose(s) for which it is established is defined at establishment. Key components of a multipurpose land administration system are registers of land information and land tenure.

4.1 Registers

Key land registers contain original information about the land, buildings, rights and values. Besides these, original official information is also kept in other registers about persons, revenues and assets, valuable movables, soil and mineral resources, etc. Such registers are kept by various institutions, depending on a country's tradition. These institutions' jurisdiction can extend to the entire country, or they can have regional jurisdiction. Some registers are also kept for areas under the jurisdiction of local administrative units.

Each administrative area has developed its own processes and translated the information into an electronic format that suits its needs. Such systems are difficult to access and use for global and national purposes. The difficulties are political, administrative and technical in nature. The goal is to integrate the information at technical and other levels.

Separate establishment of registers, usually each of them for a single purpose, has lead to multiple recording of the same information. Many pieces of information that are original to one register are entered (copied) in another, thus creating redundancies in the land administration system (Figure 2).

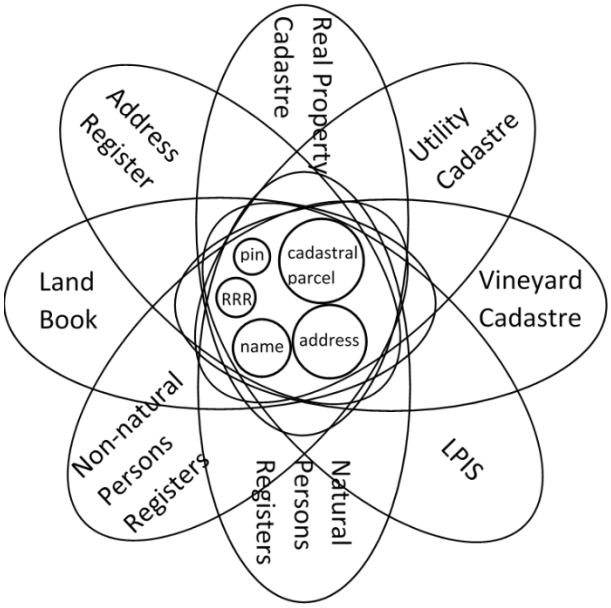

Figure 2. Registers and shared (redundant) information (Mađer, 2012)

For land registers, spatial part of recorded information is paramount. For other registers this is less important, although each of them has a certain spatial component. The cadastral map, as the most detailed spatial representation of land features, emerges as the basic layer for common spatial reference system. Most other information can be interlinked by coordinates or addresses that are recorded in many registers. The address system included in the cadastral map will make it possible to conduct spatial analyses of many types of information.

A comprehensive analysis of the efficiency in register management must be conducted taking into account optimal jurisdiction of public authorities, determining which piece of information is original to which register and harmonizing terminology between registers. Establishment of a meta-register containing important information about existing registers can aid in a clearer redistribution of contents of individual registers and better cooperation of responsible institutions. It should contain general information about, for example, the responsible body, original information kept in a register, data model, accessibility via various services, etc.

4.2 The need to combine

Registers must not be an end in themselves. They are not established for the benefit of the institutions that keep them nor for the benefit of the experts who contribute to their creation and maintenance, but for the benefit of their users. Today, user requirements when it comes to land information are such that they are unlikely to be met by information from a single register. Usually, information from several registers must be combined in order to achieve the user's objective.

Construction is planned in spatial plans that establish conditions for construction applicable to large areas. Permits are issued for a specific parcel of land owned by a specific person. In order to issue an appropriate construction permit, the required conditions must be clearly determined for each parcel, and this is achieved by combining information from the cadastral map and the spatial plan.

Management of complex buildings is based on a proportional participation of co-owners in the cost of maintaining the parts in joint ownership. In order to determine each co-owner's share, it is necessary to know the spatial relations and the size of each individual part of the building.

Environmental protection is carried out by means of measures adopted for a given area. Boundaries of such areas are established descriptively or on maps. The protection, however, applies to specific cadastral parcels or parts thereof. It is necessary to combine the information on the boundaries of the protected area and the cadastral map in order for the owner of the land to know the conditions that apply to their land.

Local taxes are collected by local administrative units for areas under their jurisdiction. If the cadastral map and information on boundaries of the local administrative units are kept separately, problems arise. Combining the cadastral map and the register of spatial units (Figure 3) does not give unambiguous information on where a given property belongs. The local administrative unit boundary, which cuts across properties in Figure 3, implies that the taxes for a single property must be divided between the two neighbouring local administrative units, which is certainly not the case in practice.

Property value depends, among other things, on the property being serviced by the public utility infrastructure. Consulting the cadastral map can lead to the conclusion that the land in question does not have access to the water supply system. In reality this is not the case because information on the public utility infrastructure is located in another register. It is only by combining the information from the public utility infrastructure register (red dashed line) and the cadastral map that the user obtains complete information on availability of the public utility infrastructure (Figure 4).

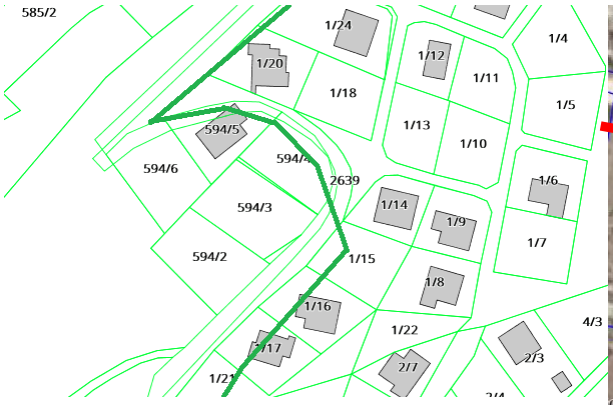

Figure 3. Cadastral map and administrative boundaries (URL 1)

Figure 4. No public utility infrastructure registered in cadastre

In order to have access to agricultural aids, farmers must prove that they have a legal right to the land they farm (ownership or lease). The agricultural parcel register does not include such information. It is only in combination with the cadastral map (Figure 5) and the land register that complete information can be obtained.

Spatial extent of concessions on public land is often described without referring to the cadastral map, by means of coordinates only. The staking out of boundaries of the allocated land and subsequent recording of the parcel in the cadastral map using such coordinates can also result in entries that do not correspond to reality (Figure 6). In this context, maritime areas pose particular risks, as they are usually not recorded in the cadastral map, and the marking of parcel boundaries is more complicated than on land.

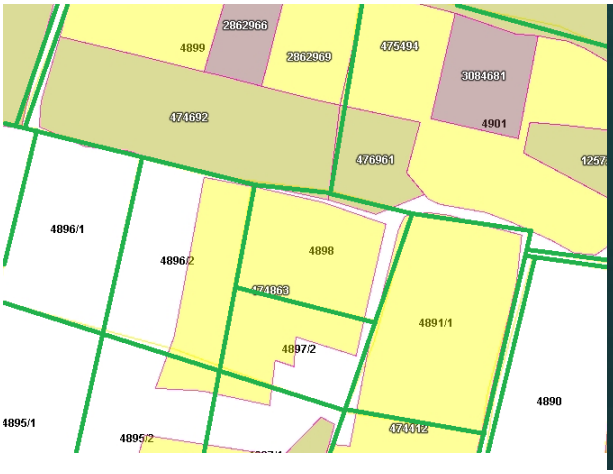

Figure 5. Cadastral and agricultural parcels (URL 2)

Figure 6. Cadastral parcel in a maritime area

The examples above are only the most common instances of the need to combine information. Many other needs arise in practice, and after the establishment of MLAS, possibilities for new combinations will enable users to accomplish tasks that were previously not possible.

5. CONCLUSION AND RECOMMENDATIONS

The beginnings of land administration systems are buried deep in the past, and parts of such systems have been established gradually, by regulations, in different time periods. In parallel to them, registers of persons and valuable movables have also been established using similar methods. Such registers, however, have often been established independently and without coordination, so there are numerous overlaps.

A step towards standardizing land administration systems was made with the introduction of LADM. LADM defines information well, but organizational frameworks in certain countries make its implementation difficult. Implementation can vary significantly in any given administrative area depending on the traditionally used registers. Further research should be directed towards elaborating national LADM profiles and implementation concepts that should be included in all official registers of a given country, and not just those dealing with land. MLAS must ensure semantic and technical interoperability and interoperability of regulations and institutions. Creation of an integral data- and service-oriented concept will allow for the establishment of a homogeneous multipurpose land administration system that will be able to meet most user needs.

The tendency for uncoordinated establishment of multiple registers is also present in countries that do not have a full cadastral map. For them it is recommended to elaborate a strategy for modular implementation of interoperable registers. In this context, it can be of use to draw on the experience of developed countries that have established registers, but now face difficulties due to heterogeneity and inability to combine information.

ACKNOWLEDGEMENT

This research was supported by the Croatian Science Foundation (HRZZ) under the grant I-2485-2014; the DEMLAS project.

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BIOGRAPHICAL NOTES

Miodrag Roić graduated in Geodesy from the University of Zagreb, Faculty of Geodesy. In 1994, he received a PhD from the Technical University Vienna. Since 1996, he is a professor at the University of Zagreb, Faculty of Geodesy. He was Dean of the Faculty 2011-2015. The topics that he specializes in are Cadastre, Land Administration Systems, Engineering Geodesy and Geoinformatics. He was an editor-in-chief of Geodetski list. 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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