Development of Multipurpose Land Administration Systems

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SUMMARY

Today's land administration systems (LAS) efficiently fulfil their primary purpose, the support for land administration processes. Besides that, land administration systems should also facilitate land management as an important instrument for the implementation of land policy contributing to comprehensive land governance. Unfortunately, this is often not the case, or at least not in an efficient manner. A multipurpose land administration system efficiently supports land management processes.

Within the paper we describe the steps leading towards the transformation of a LAS into a MLAS. For the purpose of transformation we propose to improve the two basic aspects of a LAS, its efficiency and its usability, and argue that it should facilitate the transformation. Within the efficiency aspect we focus on increasing the outsourcability of processes and in the usability on finding new usages in the domain of land management. We argue that the project should include two basic components (the conceptual and the technical one) and that it should be executed in three phases (first the definition of concepts, second the physical modelling and pilot and third the testing of outputs and refinement of findings).

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1. INTRODUCTION

The primary purpose of land administration system is the support for processes of recording and disseminating information about the ownership, value and use of land and its associated resources (UNECE 1996). Most of the world's land administration systems (LAS) fulfil their primary purpose adequately.

Besides its primary purpose, a land administration system can also serve as a basis for land management as an important instrument for the implementation of land policy contributing to comprehensive land governance. Different to the land administration, land management is a set of processes ensuring that land is used in an efficient and sustainable manner (Williamson et al 2010). There are two basic prerequisite for meaningful execution of those processes. First, they need to be planed, designed and prepared in a sustainable manner and second it must be possible to efficiently and transparently record their consequences within underlying land administration system. If, besides its primary purpose, a LAS also efficiently supports land management, it becomes a multipurpose land administration system (MLAS).

Most land administration systems can efficiently support the consequences of land management. However, the design and execution of land management procedures is an issue where land administration systems often fail, even in the developed countries (Williamson et al 2010). This usually comes from the fact that when they were originally designed, the three cornerstones of land administration were not considered holistically but rather separately.

To be able to efficiently design and execute the processes of land management, different types of information to that needed for registration, are required and in different forms. This to be achieved, a land administration system needs to evolve according to a set recognized trends (Bennet et al 2010).

Within this paper we consider the strategies for transforming a LAS into a MLAS. We describe a concept of steps necessary to transform an existing LAS into a MLAS.

1.1 The Idea

We feel that in order to facilitate the needed transformation, both of basic functional aspects of a LAS should be improved:

- Efficiency and
- Usability

The primary goal of the improvement should therefore be set to as: to transform a LAS into a MLAS by increasing its efficiency and its usability (Figure 1).

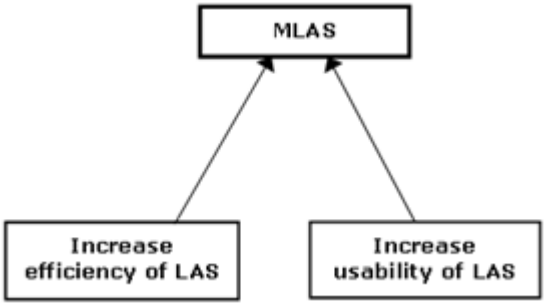

Figure 1: Primary idea for the transformation

The development should be based and build upon the well-known international standard, the Land Administration Domain Model (LADM) (Lemmen and Oosterom 2013), and all the previous theoretical and practical research leading to its creation. The LADM deals primarily with the registration of rights, restrictions and responsibilities (RRR's) to the land and considers the other aspects of land administration to be external. We feel that this concept need not be broken, eventually leading to a monolithic data model. Rather, we aim on a better integration of all three aspects of land administration by providing a framework to efficiently integrate the processes of land administration across separate data models, i.e. information systems. The data models should base on the same data modelling concepts that should be borrowed from the LADM. All this should be facilitated by sophisticated technology the Service Oriented Architecturere - SOA (Onsrud 2012).

When considering the efficiency, the primary focus of the improvement should be on the techniques and technologies of data updating, closely related or even integrated with data collection process (Janssen et al 2011). As this aspect of functioning of land administration systems is still missing an in depth research, we expect that significant improvements could be done on the topic. Furthermore, we feel that outsourcing of a more significant part of the data updating process to the private sector is a significant step towards the creation of an efficient MLAS. In order to make the updating of the data outsourcable, a comprehensive transaction processing framework as well as various correctness controls (Matijević et al 2008) need to be devised.

When considering usability, the focus should be on analyzing, describing and improving the land management processes. Primarily, this concerns the efficient support for the processes aiming towards increasing the agricultural productivity of the land (Demetriou 2012). Furthermore, as there is a growing need for an efficient system of registration of legal impacts that the utilities have on the land, this issue should receive additional attention (Döner 2008). Reducing the redundancy between the LAS and other correlated registers (Mađer et al 2013) should bring to its usability also.

2. TRANSFORMING LAS TO MLAS

2.1 The transformation methodology

The transformation methodology should base on a set of two interrelated components. The first component (C1) should define the high level requirements expected to increase the efficiency and the usability of the existing LAS. Those requirements are the foundation for defining the core concepts that need to be employed in order to transform a LAS to a MLAS. Additionally, those requirements should form the basis for development of a conceptual model for MLAS.

The second component (C2) should aim on developing the MLAS data and process models. After the core concepts have been established, an investigation of the technically oriented requirements for achieving them should be done. The primary outputs from the second component are the MLAS data and process models. Both the core concepts and the improved data and process models are to direct the actual implementation of the MLAS (Figure 2).

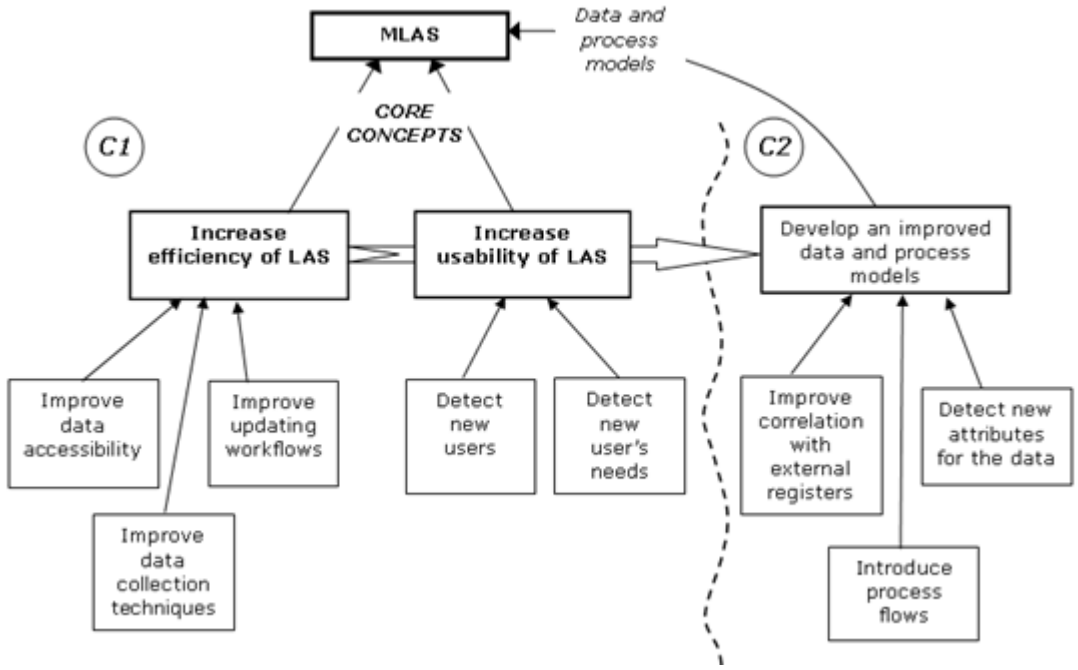

Figure 2: Detailed elaboration of the approach

The described components should be executed sequentially. The first component will ensure that the high level concepts are abstracted from the technological basis to be used for implementation. Following, the second component should try to use the most of the today's technological achievements in order to facilitate the implementation of the concepts from the first component.

2.2 Efficiency

In our approach, the efficiency of a LAS is considered to be measurable through two aspects:

- the overall time needed to execute land administration and land management processes and

- the accessibility and availability of the services that the system exposes to its users.

In order to increase the efficiency, we propose to undertake the following steps. First, to design (or rather redesign) the land administration and land management processes in order to make them outsourcable to a highest possible level. The redesign should include all the segments of those processes, starting from field data collection to the actual execution of

updates to the system's data. Once a more significant part of the processes can be outsourced to the system's external actors (private surveying companies and notaries or lawyers), the time needed to execute those processes will be decreased, leading to an improvement to the systems efficiency. This in turn should lead to the overall reduction of costs of real estate transaction (Zevenbergen and Stubkjær 2005), as well as other components of land administration.

As besides the recording of the information regarding its three domains, the purpose of the LAS is to provide information on the facts recorded, the overall accessibility of the data should be increased. Today's technology is more than capable of supporting such an undertaking so it can be done as soon as the concepts of the MLAS become available.

2.3 Usability

The usability segment of our approach focuses on the integration of the RRR aspect of the LAS with its land valuation and land use component in order to improve the most important land administration processes:

- Fair and efficient mass land valuation
- Increasing the agricultural productivity of the land
- Sustainable urban and rural planning.

By achieving a better integration between the three components, the increased usability of the LAS should be reflected by increased efficiency in supporting of a variety of different land management processes. In rural areas in the land consolidation procedures and in urban areas in urban land readjustment. The MLAS should enable Multi Criteria Decision Analysis and Expert-Based System leading to development of a Land Management Decision Support System.

MLAS should enable an easy and transparent application of automatic procedures of land valuation in rural land consolidation procedures, which in turn should increase the perception of fairness and should enable simpler and fairer allocation of land parcels. When valuating land parcels, along with the valuated units as the element of reducing all properties under the same joint denominator - depending on the land and culture capability, it should be possible to determine many other influences which can significantly improve the value of land.

For instance, since the shape of a parcel greatly influences the agricultural productivity, by including the additional information (e.g. the length of the parcel's sides, angle values between subsequent sides and the number of boundaries points) to the automatic valuation procedures (Demetriou 2012) a better total measure of value could be achieved.

MLAS should be used to determine the market values of all the real estates affected by an urban land readjustment. By a-priori determining the values of real estates that are to be the product of an urban readjustment, the process itself could be fine-tuned in order to produce real estates of an increased value. An even wider inclusion of all the relevant policies and zoning regulations into MLAS would form a comprehensive planning system (a dynamic urban plan) (Enemark 2007), covering all the factors involved in the decision making process.

2.4 Improved data and process models

The concepts developed within the first component should be moulded into the improved data and process models, supported by the modern technological achievements. The primary objective of the component two would be to transform the data and process models in order to support the land management processes. This would be achieved by introducing the additional attributes or additional feature classes to the existing data models. The existing process models would also be adjusted and the needed new ones created. There are however some additional goals, that should be achieved within this component.

While redesigning the data model, the overall redundancy between the LAS (and subsequently the MLAS) and the other land related information systems could also be dealt with. One of the approaches to detecting redundancy within the LAS is described by Mađer et al (2013). Appropriate linking of land and other official 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.

Furthermore, a clear trend of increasing the interest for data on utilities can be detected in many of the world's land administration systems (Williamson et al 2010; Doner et al 2008). The LADM defines that only the legal space caused by the existence of utilities (which usually does not correspond to the actual physical utility itself) is registered in a land administration system. Whilst keeping this premise in mind, an investigation of the options of tighter integration between both legal and physical components of the utilities should be done while redesigning the data model.

During the redesign of the LAS data model, also the trans-national initiatives should be looked into. For many of the European countries this primarily relates to the INSPIRE initiative (Martin-Vares and Salzmann 2009).

Last but not least, the topic of introducing the third dimension into the land administration, more specifically the 3D cadastre should be considered while redesigning the data model of a LAS. The 3D data should carefully be integrated into the LAS data model by integrating the 3D legal objects with their physical counterparts as well as the underlying semantics (Aien et al 2013, Döner et al 2008).

3. PROJECT FLOW AND ORGANIZATION

3.1 Project phases

The actual transformation project should be divided into three phases:

1. Theoretical research, definition of high level concepts and conceptual data model
2. Investigation of best practices in physical modelling and the pilot implementation
3. Testing of outputs and refinement of findings on the pilot

In the first phase an extensive analysis of the possibilities of extending or improving the LAS, in order to transform it to a MLAS, would be done. As a result of this phase a conceptual data model for a multipurpose land administration system, including options expected to enable efficient land management and the definition of the data collection and updating procedures, would be created.

In the second phase the results from the first phase would be used to develop the logical data model and to do a pilot implementation, having novel technological trends in mind. Within this phase also the procedures for migration of the existing data into the new data model would need to be devised. While implementing the pilot, both the efficiency requirements and potential new usages, as devised in the first phase must be kept in focus. Following the technological trends, the system should be developed as a Web GIS application, potentially based exclusively on available open source technologies (Steudler et al 2010). The system should be based on a set of loosely coupled independent subsystems, communicating based on the SOA concepts.

Within the third phase the focus should be shifted on analyzing of the results from the second phase and on finding other possible improvements thereof. In this phase we expect that it would be possible to further refine the concepts from the first phase, and to do the formalization thereof.

3.2 Participants and roles

In order to be able to efficiently execute such a complex and interdisciplinary project, a wide team of experts should be involved. Furthermore, we feel that the project would benefit by mixing both the scientific and professional experts. The scientists would define the theoretical basis for various improvements while the professionals would provide valuable real world inputs.

The team should include the experts in the fields of land administration, focusing on the cadastre, i.e. its spatial component, but not neglecting the valuation. Furthermore, there should be experts from the field of land management, more specifically from the field of land redistribution for the purpose of increasing agricultural productivity and the urban planning experts. Finally, there should also be a group of land surveying experts and spatial database experts.

Furthermore, in order to create smaller and more compact groups, the participants should be divided into four groups:

-Land administration experts (LA)

-Land management experts (LM)

-Data and technology experts (DT)

-End users (EU)

The LA group together with the LM group and facilitated by the EU group should mostly be involved in the component 1. The DT group should take over the responsibility for component two. In the third phase, the EU group would critically analyse the result using the pilot implementation and provide the valuable feedback regarding the outputs of the project. The feedback could either be used for additional improvements or for later subsequent projects.

4. CONCLUSION

The development of multipurpose land administration systems (MLAS) is a complex task. Unlike with other kinds of spatial data management systems, while doing it, one must consider the legal and institutional frameworks defining the manners how such a system must function as well as the quality of its data.

Within the paper we have proposed an approach to transformation of LAS to MLAS by improving its usability and its efficiency. The improved usability is reflected by introducing the support for land management processes. The improved efficiency reflects itself through two aspects. The introduction of outsourcability opens the opportunity to decrease the time needed to complete the processes of both land administration and land management. The introduction of new technological achievement into the systems is expected to improve the overall accessibility of various services provided by the MLAS and to decrease its overall cost of maintenance.

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BIOGRAPHICAL NOTES

Hrvoje Matijević is currently Project Manager at IGEA L.L.C. Prior to this Hrvoje has worked in Geofoto L.L.C. as Senior Consultant and at the Faculty of Geodesy in Zagreb as University Assistant. He received M.Sc. in 2004 with thesis "Cadastral Data Modeling" and in 2006 he defended his Ph.D. thesis "Modeling Changes in Cadastre" at same university. His main research 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.

Hrvoje Tomić works as a university assistant at the Chair of Spatial Information at the Faculty of Geodesy in Zagreb. In 2010 he defended his Ph.D. thesis at same University, with thesis: “Geospatial Data Analysis in Purpose of Real Estate Valuation in Urban Areas”. His main research interests are GIS and DBMS technology in spatial data handling. Hrvoje Tomić has participated on several projects and has published several papers.

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