Topics regarding the joint spatial planning data model

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ABSTRACT:

In modern times, spatial planning activities have been the process of determining projections for future land use. Spatial plans produce decisions about space in many different fields, from construction to transportation and environmental, natural, and cultural protection. The right, restrictions, and responsibilities (RRRs) to use the land pieces whose physical borders and legal status are registered with the cadastral process are determined by the spatial plans in line with the national purposes, public welfare, and healthy urbanization objectives.
Land Administration Domain Model (LADM) is a general-purpose data model introduced in 2012 with International Organization for Standardization (ISO) standards. LADM proposes standards for many data infrastructures and land administration systems. In this context, although it does not have complete recommendations within the scope of spatial planning. It is essential to make additions to version II. As a result of gradual studies, spatial planning processes and decisions can be presented in a data model and the model can be associated with the LADM standard structure and integrated into land registration systems. Since LADM offers a conceptual model, newly created packages must be designed in a conceptual data model. The conceptual model is a product of several stages. This study focuses on how can produce a conceptual model in which countries can share spatial planning data. The requirements of the model that achieves this aim are revealed by considering the conceptual model production stages. By evaluating the findings, how can obtained data which helping to design the classes, class relations, and attributes of the data model were searched. With the conceptual data model to be prepared in line with the requirements, it is thought that land management processes can be strengthened by providing integration with spatial plans in LADM-based land administration systems.

1. INTRODUCTION

Today, lands are too precious assets to be evaluated by arbitrary practices and daily decisions. The social, economic, and cultural effects of the activities taking place on the lands are not only limited to the land itself but also cause effects in certain dimensions. The use of inventories in both physical and virtual environments where people activity together is determined by various decisions. In this way, healthy urbanization, social justice, and sustainability are tried to be achieved. There are documents that determine the type of use of lands on terra, create restrictions on use or define various responsibilities for the land. Documents can be in the form of contracts, laws, or plans. Among these, spatial plans stand out with their spatial characteristics and being the product of many sectoral plans. Spatial planning is a process that starts with the feasibility studies for the preparation of the plan and continues with the surveys, analyses, and opinions, and finally ends with the implementation of the plan. The decisions that emerge as a result of the process include obligations that contain many orientations such as land use types, zoning activities, investments, and protection zones.

Spatial planning processes and produced decisions vary. The same is true for land registration systems. Countries' approaches to the concept of land, past practices, and population density have led to differences in land policy and tools. However, there are standardization studies in the field of land administration that aim to combine different practices at a common point. While the Land Administration Domain Model (LADM), which is widely used among these standards, represents the relationship between the factors that create RRRs in the land and land administration elements, it is limited to land tenure and land registration system data (Indrajit et al., 2020). As it is possible to transform spatial planning processes to an unattached data model, adding them externally to a standardized conceptual model offers opportunities for unity in land administration, integration with land registration systems, and less paperwork.

In the study, the scope of preliminary studies for the production of a spatial planning data model that can be added externally to the LADM standard is handled. Based on the conceptual model design processes, the necessary data to produce the final product and how to obtain it are mentioned. In the second part of the study, land administration systems and their relationship with information systems are explained. Then, the data modelling processes were discussed, and conceptual modelling was emphasized. In the fourth chapter, how the requirements analysis should be for the spatial planning data model is discussed. In the last section, the obtained results are presented.

2. LAND ADMINISTRATION SYSTEMS

With the importance of geographical information, it has become one of the main duties of national or regional governments to create data about land and present it to citizens. Institutions use many methods, including voluntary geographic information formations, to collect and verify data. The accuracy and timeliness of the data are important elements for well-functioning land management systems. Land administration is the notion given to the process of obtaining and evaluating the ownership, use, and value data of the land in the land management process. The necessity of managing, processing, storing, and temporally recording a large amount of data on land administration transactions has created an environment for the development of Land Administration Systems (LAS). The cadastre, which is one of the processes covered under the title of land administration, has key importance as it forms the basis for many land information systems. Land administration systems are part of the infrastructure that supports good land

management. It should not be judged as an end in itself, but as a means to an end (UNECE, 2005).

Land administration is not always inclusive only within the political boundaries of countries. States should have a joint standard of administration in order to prevent hazards such as water and air pollution, to ensure efficient use of natural resources, and to build large engineering structures. At the end of the 20th century in the globalizing world, standard development studies started in order to solve the negative impact of countries having different land administration systems on interoperability and the lack of an accepted standard model. LADM, which has been standardized by ISO, is one of the published standards to ensure interoperability in data exchange and land information system design. Since the beginning of the development works, it has found application in various fields and countries on behalf of the land administration.

At the point where the cadastre has arrived today, land registration not only focuses on property registration, but also serves the tasks of land development, urban planning, land management and environmental monitoring performed by the private, and public sectors (FIG, 1995). Considering the task undertaken by the cadastre and modern trends such as 3-dimensional cadastre and holistic land management, LASs should be expanded to include real estate value and land use data, rather than just systems that determine and secure property boundaries (Çete & İnan, 2013). LASs mainly involve the characterization of relations between people and land in relation to rights (use or ownership) and are influenced by developments in Information and Communication Technology (ICT) (UN-GGIM, 2019). Since land value, land use and land development processes also cause relations between the parties and the land, the management of the produced information in relation to the land registration systems is important in terms of holistic land management. It also provides the ownership infrastructure to the mentioned transactions. For sustainable development and effective land management, information about the four functions of land administration, tenure, value, use and development should be collected in an institutional framework and land policies should be developed. This development could be realized by using internationally accepted land administration standards.

3. DATA MODELING

Today, the concept of data refers to a very wide cluster. Individuals and technological devices are in the process of constantly generating and using data. Only the data needed can be turned into information when it is obtained and used from the existing data stack. Information gives users the power to make inferences and take action. Databases are generally used to store data. The applications that create, organize, and manage the database are called Database Management Systems (DBMS). DBMSs allow data to be categorized, stored, and used effectively. DBMSs are the component that most programs need to run. The design process of the data to be obtained and the relationships between the data in accordance with the database is handled as data modelling.

LADM deals with providing a conceptual model of the rights, restrictions and responsibilities affecting land (or water) and their geometric components. It aims to serve two main purposes: the first is to establish an ontology between countries in the field of land administration, and the other is to lay the foundation for the development of efficient land administration systems based on Model Driven Architecture (MDA) (ISO, 2012). LADM purpose is to represent land administration data with common model elements independent of any software environment. This representation is also the first stage of modelling physical data that would form the basis for software and applications. Conceptually, a conceptual schematic language is needed to describe a model. LADM uses Unified Modelling Language (UML) diagrams to establish the relationship between people and land through RRRs (Thuy et al., 2012). At the stage defined as conceptual modelling, the model is designed, checked for its deficiencies and accuracy, edited, and approved.

3.1 Data Modelling Stages

Databases consist of entities, properties that specify properties about entities, constraints of data, and relationships between entities. The database designer generates the database model which is a high-level description of the real world using the necessary dictionary and schema rules so that other users can perceive it. The database design process consists of 3 stages: conceptual model, logical model and physical model (Aydınoğlu, 2009).

A conceptual data model represents the overall structure of the data that is required to support business requirements, regardless of any software or data storage structure (Sebastian-Coleman, 2013). The conceptual model is a model structure used to represent entities whose attributes and relationships are represented in the database. Because assets are represented independently of software, objects are presented in a common structure. LADM presents the basic components of land administration in a joint model structure and predicts that this model would differ according to the land administration approach of countries. For this, as in many other standards, it covers the conceptual modelling step of data modelling.

Attributes and key attributes are determined for each entity in the logical modelling process. With this modelling process, the conceptual model is made suitable for a DBMS even though it is still independent of a program. A physical data model represents how data is physically stored in a database. It contains the actual structure of database tables and columns or messages sent between computer processes. (West, 2011).

4. REQUIREMENTS FOR SPATIAL PLANNING DATA MODEL

An object-oriented approach based on model-driven architectures is required for LADM. This is possible with the UML standard combined with LADM (Jeong et al., 2012). Object refers to entities that exist physically in the real world. The emergence of the object-oriented design concept is the idea that the world consists of interacting objects (Döner, 2010). Objects that share the same attributes, relationships, and semantics in UML are represented as a class (ISO, 2014). The properties of physical objects are expressed in terms of attributes data, while the relationships between them are represented by the relationship structures that the UML language provides. The most important advantage of modelling in UML is that it allows to create a standardized exchange format for data. (van Oosterom et al., 2006).

The conceptual data model design process consists of the data model design stages, which includes the requirements analysis in which the data to be used in the model are determined, and the creation of the conceptual model according to the

requirements. The integration of the externally created data model into the land administration systems by associating it with the LADM standard is carried out by establishing its relationship with the LADM classes.

In order to produce a data model structure in which the spatial planning data can be represented jointly by the countries, the common points of the spatial planning processes and the conceptual data model production steps should be considered together. Spatial planning data model production should be examined within the conceptual modelling technique. Conceptual model generation begins with the requirements analysis step. In the requirements analysis phase, the classes to be used in the model, the properties of the classes and the data types that the properties can be represented are determined. In order to design a data model that can be adapted to the spatial planning systems of countries, the planning systems of a satisfactory number of countries with different governance forms should be examined. These investigations can be discussed on several topics and sufficient data can be obtained for model design. Figure 1 shows the work that can be done to determine data, relationships between data, and data types.

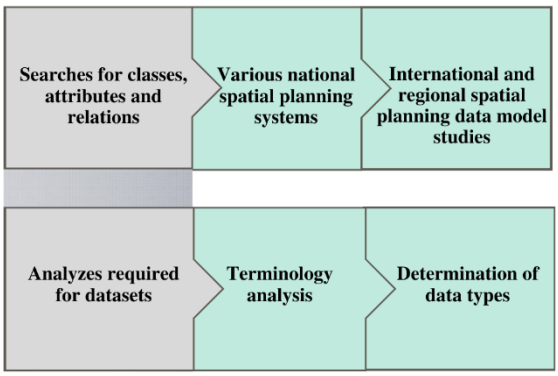

Figure 1. Preparations before conceptual model design

4.1 Spatial Planning System Requirements

When spatial planning is considered as a system, the relationship between the legal and procedural processes that guide the planning activities and the spatial planning processes should be considered holistically. The procedures determined for spatial planning include the hierarchy between the plans, the scope, content, purpose, representation of the plans, the supplement parts of the plan whole, and the responsibility of the parties to the plans, etc. The stages and effects of the plan prepared for the plan region, from the preparation phase to the implementation phase, are determined within the planning system.

Planning processes, the relationship between plans and the documents guiding the plan are as important as plan decisions to represent spatial plans in the data model. Designing the representation of the plans in the data model without knowing the effect of the plans on each other and in the planning region could not reflect the representation of the planning as a system, it could only include the plan decisions. Therefore, the relationship between the plans and the guiding factors should be considered in the design.

4.2 Spatial Plan Decisions and Components

The main benefit from the land administration window in designing spatial planning as a data model and associating with LADM is to give a standard structure to spatial plan decisions and to match the RRRs it produces with the elements in the land administration system. Thus, it is aimed to ensure holistic and effective land administration and to implement land policies more easily. The assets of spatial plan decisions and their representation are also research part of the requirements analysis for the conceptual data model. In addition, representations of spatial plans that include cartographic and written plan decisions, which are the final product of planning processes, should be included in the model for plan definition.

Spatial plans in general make the presentation of decisions with various markings on the relevant plan area through cartographic representations. The representation of the physical information of the plans to which the decisions that have an impact on the land belong are important for establishing the relationship of the plan with other plans and authorized administrations. It is also necessary for the schematic modelling of the plan in the data theme, which components the plan consists of, which maps can be used as a base, which cartographic signs make what kind of decisions.

4.3 Terminology Analysis

In order to ensure the availability of the created data model within the country and by other countries, it is important to include the exact equivalents of the concepts in the planning system in the model. In planning systems, many concepts are used to express both the plan data and the relationship between the plans and the relationship of the parties with the plan. Plan levels, planning authority and planning zone may differ from country to country. In order for different applications to be represented in the joint model, these differences should also be identified as concepts. Thus, the terms used for data model elements can become inclusive for other systems. Semantic studies on spatial planning processes should be carried out to ensure conceptual unity.

As a result of the topics discussed above, which terms can be used in the data model that will represent the spatial plans, data can be represented by which data types, and the relationship between the objects can be determined. Based on these requirements, the data model can be created at the designer's initiative. As a result of the requirements researches Table 1 provides an example of the conceptual model entities that guide the modelling. Table include data characteristics to be used for these entities.

Term used for data	**Data type and classes**	**UML object type**
Spatial plan	featureType	Class
Plan id information	Object IDentificator	Attribute
Time information on the validity of the spatial plan	beginLifeSpanVersion & endLifeSpanVersion	Attribute
Background maps type	Codelist	Class
Institutions	Enumeration	Class
Land cover and use information decision	Codelist	Class

Garden spacing	Decimal	Attribute

Table 1. Requirement analysis for joint spatial planning data model

5. CONCLUSION

Spatial plans are the product of many social and technical processes aimed at ensuring the planned use of land parts. Throughout the planning process, various data collection, data analysis and application steps are followed. Spatial plans define RRRs on lands to ensure the conservation-use balance of land and natural and artificial elements associated with the land. These RRRs prevent individuals and administrations from having arbitrary behaviour in land use. It also provides liveable and functional environments.

In this study, it is discussed how to create a data model at the point of standardization of spatial planning data and integration with land registration systems. The steps and analyses that the designer should follow when creating a joint spatial planning conceptual model are mentioned. With the spatial planning data model to be created by following the instructions, the objectives of participatory planning, holistic land administration and securing RRRs can be achieved. In addition, many RRRs formed by spatial plans above and below ground could contribute to the integration of legal spaces with physical spaces.

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