Design and Determine the LADM Infrastructure for Turkey Country Profile

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SUMMARY

Nowadays Land Administration Domain Model (LADM) is a very important component for Cadastral Systems and e-government database framework all over the world. In that case, design and develop LADM for using the cadastral data specific issue for every country. When the past or present cadastral systems are examined, it is seen that the cadastral systems have different purpose, content, scope and administrative structure in different countries. However, all of these systems are generally based on the same logical basis. This basis is the relationship arrangement between people and land through the rights of the cadastre on real property. Internationally, the demand for a widely accepted standardised domain model in land administration emerged in the early 2000s, partly as a result of Cadastre 2014. An effort to standardise cadastral systems started in 2002 by Lemmen and van Oosterom, who had the vision of the Core Cadastral Domain Model. Since then, the model has evolved into the international standard Land Administration Domain Model (ISO 19152). The LADM provides an abstract, conceptual model and is organised into three packages and one sub-package. The main class of the party package of LADM is class LA_Party with its specialisation LA_GroupParty. For these reasons, finally in this study design and develop general declaration and standards for Turkish cadastral and land title systems also e-government case.

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1. INTRODUCTION

Cadastral data are essential in managing land resources all over the world for the countries cadastral systems. For this reason, land registration and cadastre together play an important role in society (Alkan and Polat, 2017, Polat et al. 2018, Liang 2008). Land data are very dynamic for the cadastral systems (Leksono et al. 2011). Data are continuously changing because of changes in people to land relationships as a consequence of the increasing complexity and flexibility of modern land use (Alkan and Polat, 2017, Polat et al. 2018, Kalantari et al. 2008). Economic activities such as area development and settlement need cause changes in the shape of parcels, changes in the ownership and changes in the use of parcels (Ning 2006). Changing related to real property (e.g. land parcels) effects changing in land registration data where it could be categorized into two types: spatial changing (geometric data) and attribute changing (juridical data) of a land parcel (Zevenbergen 2002, Liang, 2008, Zhang and Tuladhar 2006, Leksono et al. 2011). Zevenbergen (2002) explains three main things of land registration concerning the dynamics of land registration system: (1) initial land registration, (2) transfer of land rights (the whole land parcel) and (3) parcel mutation/splitting due to a partial transfer of land rights.

In recent years Land Administration Domain Model (LADM) is an essential component for Cadastral Systems and e-government database framework all over the world. In that case countries, cadastral offices and academic staffs are heavily studies with LADM together with cadastral systems and National Spatial Data Infrastructures.

According to Tjia and Coetzee (2012), "in the land administration domain, one of the key challenges is that cadastral systems differ between countries and generate varied data models, which are often not compatible with one another. Some countries use cadastral systems that are based on land title registration while others use deeds registration. In some countries, these systems are centralised, in others not. Furthermore, in some countries, the principle of general boundaries is applied while in others fixed boundaries are used. In certain countries, cadastral systems are designed for financial purposes and others for legal purposes or a combination of both. These variations often lead to different concepts and incompatible data models. Worldwide, initiatives that attempt to improve the cadastral system issues are growing. The Land Administration Domain Model (LADM) is the most outstanding effort in the area of spatial and cadastral domain modelling (van Oosterom et al., 2006). The goal behind the model is to improve communication between and amongst these cadastral systems. The LADM is an international standard data model being developed by the International Standardization Organization (ISO) under Technical Committee 211 for Geographic information/Geomatics (Van Oosterom et al., 2006). This spatial domain model aims to improve communication through introducing standard concepts or vocabulary in the land administration domain (Alkan and Polat, 2017, Polat et. all, 2018, Tjia and Coetzee, 2013; Alien et al., 2013). This is aimed at improving interoperability between cadastral or related

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information systems, thus improving exchange of land information between local, national, and international organizations (both private and public) and information society at large (Tjia and Coetzee, 2012; Elia et al., 2013; Aien et al., 2013; Gozdz and Van Oosterom, 2015).

In Turkey, there are also attempts to achieve standardisation in the area of cadastral and land-related data. One of them is the Land Registry and Cadastre Information System (TAKBIS in Turkish) which is mainly aiming at providing reliable and up-to-date land information required for all land and land-related activities. These are transforming cadastral data to a multipurpose land information system, accomplishing cadastral services within the scope of information technologies and providing standardisation in cadastral services (Cete et al., 2010; Cete and Yomralioglu, 2013; Doner and Biyik, 2013; Aydinoglu and Inan, 2014). TAKBIS could not exactly reach its goals because of some deficiencies in monitoring and modelling temporal changes of spatial data. In Turkey, an investigation dealing with the application of the LADM relevant to its' unique situation is solely lacking. The purpose of this paper is to develop a country-specific profile of LADM for Turkey. In this way, the relation of the Turkish land administration system model and LADM is examined, and the migration of TLIS basic entities to LADM classes is proposed. The other is World Cadastre Summit 2015 that organised in Istanbul. During the scientific sessions, all of the aspects of Cadastre were tackled by theoretical and administrative practices, and notably different systems and technical works of countries were shared with the participants. The past, present and future of Cadastre were discussed in all dimensions (Rajabifard, 2015) in technical presentations.

As is known, Turkey is a candidate country to join the EU. Between Turkey and the EU coordination of structural instruments, policies and regulations related negotiations are essential for the candidature process. For this reason, LADM, INSPIRE directive, and ISO standards not only for Turkey's EU membership but also to accelerate the country's public services it should be considered (Alkan and Polat, 2017, Polat and Alkan, 2018, Coruhlu et al., 2015). The Turkey model will be designed model inspired by LADM and INSPIRE directives that provided to be understood in the international arena (Coruhlu et al., 2015).

In this study aims to design and develop general declaration and standards for Turkish cadastral and land title systems also e-government case. This paper investigates of the Land Administration Domain Model (LADM, ISO 2012) associated with rights, restrictions and responsibilities (RRR) situations within Turkish cadastral registration system. For this purpose, the main components of LADM which are related within the Turkish land registry and cadastral system have been analysed regarding country profile aspect and have been designed a conceptual model under the legal-administrative components (RRR) of the standard LADM.

This paper is structured as follows: the cadastral system in Turkey (including cadastral system structure and cadastral activities) is introduced in section 2; a brief land administration domain model 3; The Turkey Country LADM Profile Based on International Standards is given in section 4; and finally in section 6 discussion and conclusions is provided.

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2. THE CADASTRAL SYSTEMS IN TURKEY RELATED WITH COUNTRY PROFILE

The Cadastral system in Turkey comprises of cadaster and land registry components (Alkan and Polat, 2018, Alkan 2005, Alkan and Comert 2010). The basic unit is a 2-Dimensioned parcel (Alkan and Polat, 2017). While land registry and cadastral work are done under the control of General Directorate of Land Registry and Cadastre (GDLRC) (Alkan 2005), rights of property are under state guarantee. Cadastral works in Turkey started in Ottoman Empire period in 1912 but were left unfinished due to the war and were started again with Law No 658 in 1925 after the foundation of Turkish Republic (Alkan and Polat, 2017). Cadastral works made until 1950 were mostly limited to urban areas (Alkan, 2005). After World War II, there was a need for determining and registering agricultural areas and cadastral works covered all urban and rural areas (Alkan 2005). Works in this period were according to Land Registry Law No 5602 (Alkan and Polat, 2017). This law was re-issued as Land Registry Law No 766 after the changes in 1964 and 1966. Cadastral works in rural and urban areas until 1987 were made under these two laws (Alkan and Polat, 2017). Today all these cadastral works and regulations are made according to the provisions of Cadastral Law No 3402 coming into force in 1987 (Demir et al. 2015, Alkan 2005).

The utilisation and arrangement of the land in Turkey are managed following the Constitution and the related institutions, and the measuring and registry of immovable properties subject to these arrangements are executed by General Directorate of Land Registry and Cadastre (GDLRC). The components of land management in Turkey are schematized in Figure 1.
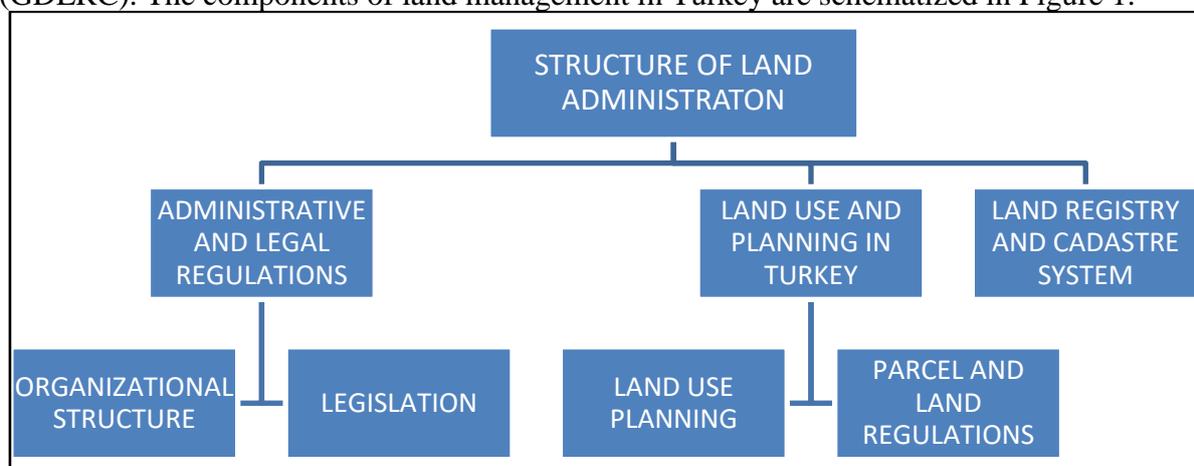
Figure 1 The general structure of land administration in Turkey (Ulger and Sevindik, 2015)

Alkan and Polat, 2017 is stated the goal of existing cadastre system in Turkey "indicating the borders of immovable properties on the land and map, depending on the cadastral and topographic cadastral map of the country by country coordinate system, and determining their legal status; thereby establishing the deed registry as assumed by Turkish Civil Law No. 4721, and building the infrastructure of spatial information system". Cadastre in Turkey is executed as two-dimensional and parcel-based. Currently, the cadastre works in Turkey are executed by GDLRC following the Cadastre Law No. 3402 and Law on Change in Cadastre Law No. 5304. Transactions related to all rights and lands have been carried out by GDLRC

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and under the responsibility and guarantee of the state (Gür and Demir, 2006). The transactions are divided into four categories according to their purpose: (1) Transactions based on contract (sale, donation, subdivision, exchange, and mortgage), (2) Transactions for registry, (3) Archive transactions and (4) Transactions for other public body and institutions. Transactions performed by the Directorate of the Land Registry are listed in Table 1.

Table 1 Land registry and cadastre transactions in Turkey

Transaction types	registration required	no registration required	Land registry transaction	Cadastre transaction
Sales (Satış *in Turkish*)	✓		✓	
Donation (Bağış in Turkish)	✓		✓	
Exchange (Trampa *in Turkish*)	✓		✓	
Contract of support for life (Ölünceye kadar bakma akdi *in Turkish*)	✓		✓	
Transfer by inheritance (Miras yoluyla intikal işlemi *in Turkish*)	✓		✓	
Share (Taksim *in Turkish*)	✓		✓	
Mortgage (İpotek in Turkish)	✓		✓	
Usufruct right (İntifa hakkı *in Turkish*)	✓		✓	
Construction servitude (Kat irtifakı kurulması *in Turkish*)	✓		✓	
Condominiums (Kat mülkiyeti kurulması *in Turkish*)	✓		✓	
Subdivide (Ayırma *in Turkish*)	✓		✓	✓
Land amalgamation (Birleştirme *in Turkish*)	✓		✓	✓
land use conversion (Cins değişikliği *in Turkish*)	✓		✓	✓
Easement (İrtifak hakkı *in Turkish*)	✓		✓	✓
Error handling (Düzeltme *in Turkish*)	✓		✓	
Annotation matrimonial home (Aile konut şerhi *in Turkish*)	✓		✓	
Plan example (Plan örneği *in Turkish*)		✓		✓
Location description (Yer gösterme *in Turkish*)		✓		✓
Application (Aplikasyon *in Turkish*)		✓		✓
Control of maps and plans subject to registration (Tescile konu olan harita ve planların kontrolü *in Turkish*)	✓			✓
Maps of expropriation of land for roads (Yola terk haritaları *in Turkish*)	✓			✓
Maps of remaining land from roads (Yoldan ihdas haritaları *in Turkish*)	✓			✓
Restriction maps (Sınırlandırma haritaları *in Turkish*)	✓			✓
Maps of parceling (Parselasyon haritaları *in Turkish*)	✓			✓
Expropriation maps (Kamulaştırma haritaları in Turkish)	✓			✓

With the effect of technological developments, some projects and works were developed in order to develop to a modern, computerised cadastre in Turkey. A digital environment increases the level of cadastral service and brings a platform for improvement of data quality (Alkan and Polat, 2017). The aim of the projects and works and related 2014 Cadastre principles (Kaufmann and Steudler 1998) are summarised in Table 2. Projects were partially successful, a three-dimensional cadastre after completing two dimensioned cadastre in the whole country is not yet achieved in technical terms. The other reason is insufficient regulations in legal terms to pass to multi-purpose cadastre.

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Table 2 The relationship between each project and Six Statements on Cadastre 2014 and their realisation percentages.

Name of Activity/Project	Start/End date	The Six Statements on Cadastre 2014					
		1- Cadastre 2014 will show the complete legal situation of land, including public rights and restrictions	2- The separation between 'maps' and 'registers' will be abolished!	3- The Cadastral mapping will be dead! Long live modelling!	4- 'Paper and pencil - cadastre' will have gone!	5- Cadastre 2014 will be highly privatized! Public and private sector are working closely together!	6- Cadastre 2014 will be cost recovering!
Land Registry and Cadastre Information System (TAKBIS)	2005-2013	✓	✓		✓		
Spatial Property System (MEGSİS)	2011-continues		✓		✓		
Land Registry Archive Information System (TARBİS)	2005-2009		✓	✓			
Land Registry and Cadastre Modernization Project (TKMP)	2008- continues	✓				✓	
Map Data Bank (HBB)	2004-2008			✓	✓		✓
Turkey's National Geographic Information System (TUCBS) Project	2006-2011	✓			✓		
licenced mapping and cadastre offices	2005-continues					✓	
Tax and fees							✓
Applied percentages of Statements on Cadastre 2014 (in Turkey)		60-80	100	60-80	80-100	100	100

3. A BRIEF REVIEW OF LAND ADMINISTRATION DOMAIN MODEL (LADM)

The aim of LADM is to improve communication through introducing standard concepts or vocabulary in the land administration domain. According to Tjia and Coetzee (2012), "*this is aimed at improving interoperability between cadastral or related land information systems, thus improving exchange of land information between local, national, and international organizations (both private and public) and information society at large.*''
LADM has capability to provide an abstract description and conceptual schema (van Oosterom et al., 2015, Lemmen et al. 2015) concerning land administration components such as parties (person and organization), basic administrative units and RRR in case of ownership,

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spatial unit (e.g. parcels, buildings, and networks), spatial source (measurement) and spatial representation (geometry and topology). LADM also gives terminology (Lemmen et al. 2015, Paasch et al. 2013) for land administration based on either national or international system that is developed as simple as possible for practical purposes (Kalantari et al. 2015, Leksono et al. 2011).

The Land Administration Domain Model is based on four (sub) packages classes with involved packages also (Fig 2.). The basic packages of LADM are described below.
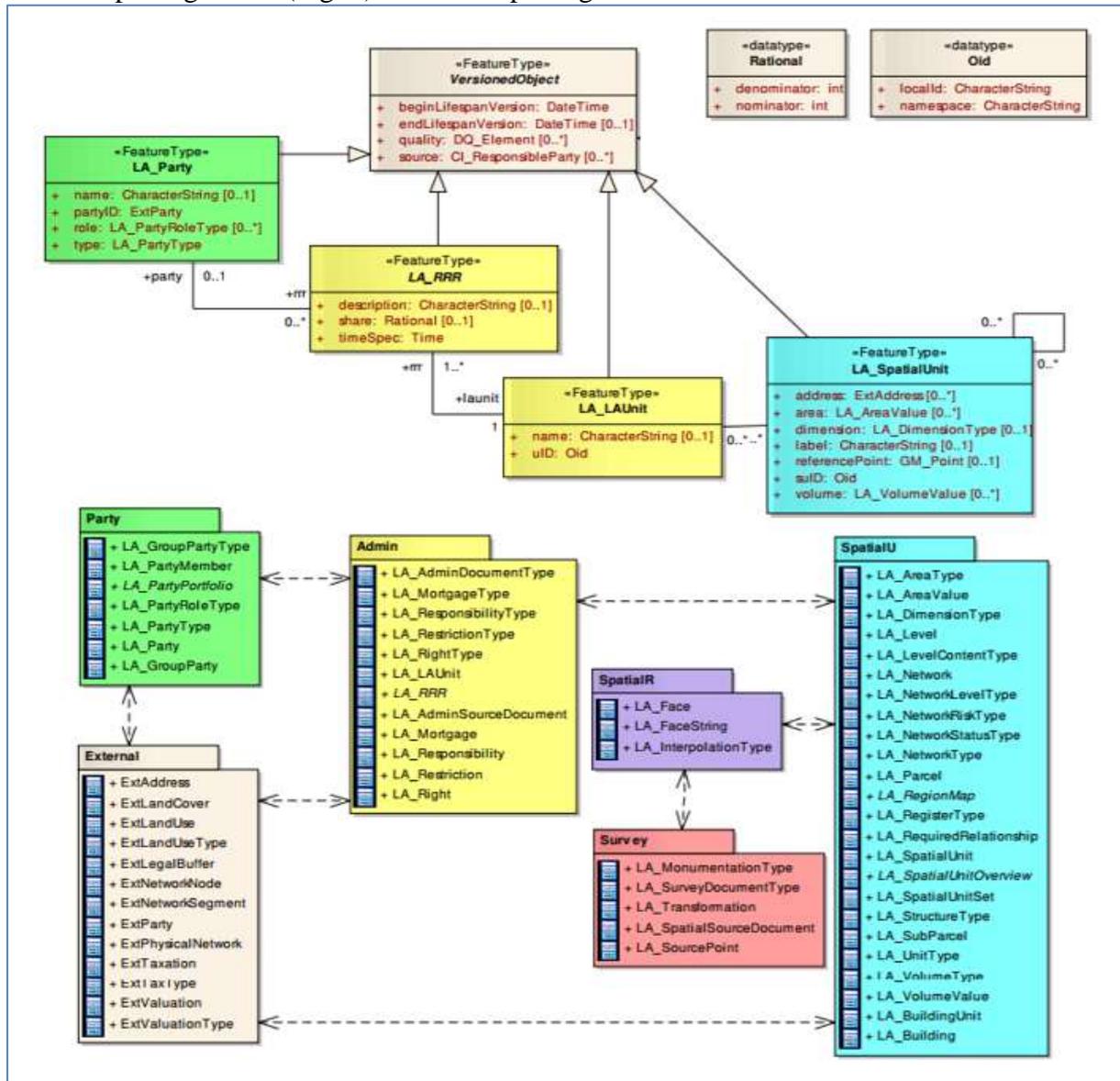
Figure 2 LADM Core Model Representation and involved packages (Ghawana *et al.* 2010).

4. THE TURKEY COUNTRY LADM PROFILE BASED ON INTERNATIONAL STANDARDS

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In Turkey all the land registry and cadastral data under government guarantee which is operated by General Directorate of Land Registry and Cadastre (GDLRC). In other words, land registry and cadastral data are established under the control of GDLRC for the record of immovable properties in Turkey. Land registry is a registry recorded by the state with sole liability according to real openness system in order to indicate the existing real rights on immovable properties. Title registry does not mean a single deed or record that indicates the legal status of immovable properties. Title registry is the complete file that consists of various deeds, records and documents kept indicating all rights and liabilities on the immovable properties (Figure 3.). The way to keep a title registry is indicated by Title Registry Bylaw, which was put into effect on 08.10.1930. According to article 2 of this By-law; the deeds, accounts, and documents that constitute title registry are separated into two groups, as the primary registers and auxiliary registers. Primary registers are the book of real property registers, the book of condominium, the daybook, official documents, and plans. Auxiliary registers are owners' register, creditors' register, seizures' register, corrections register, passing documents register journal.
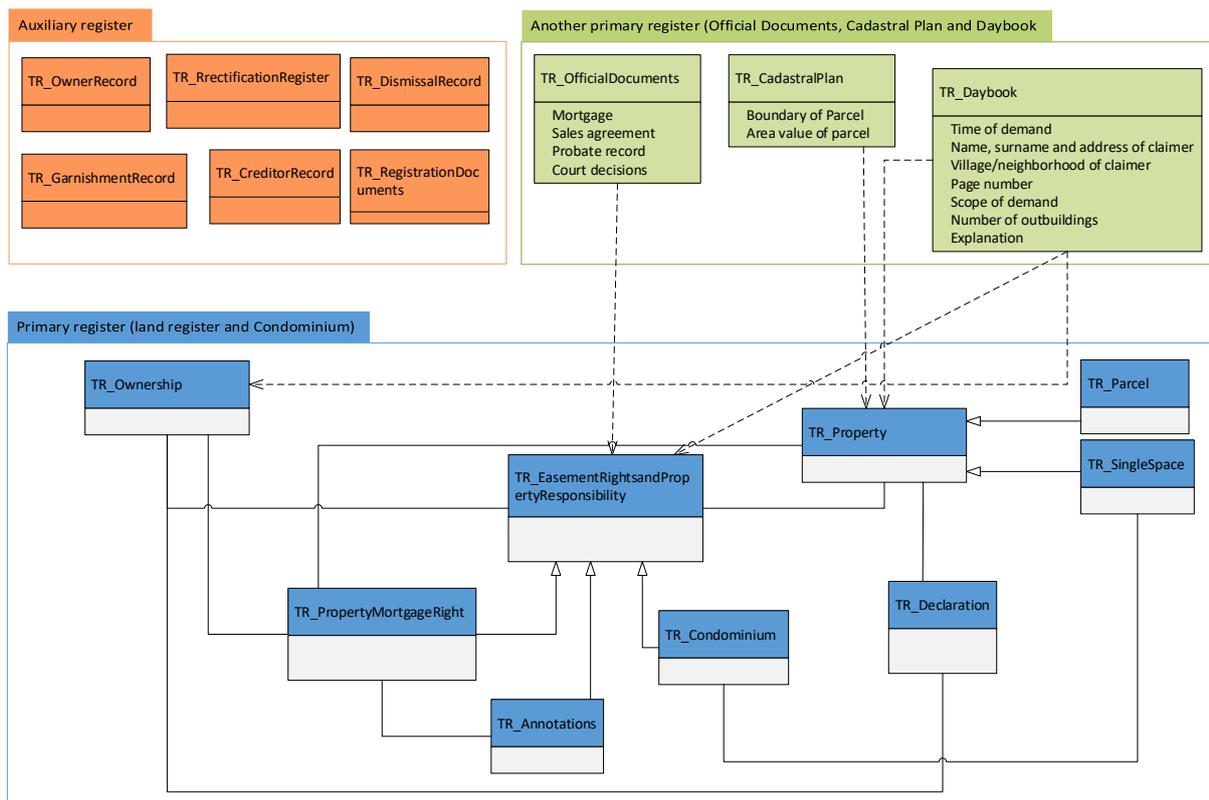
Figure 3 Land registries in Turkey

After the acceptance of LADM as a standard, developing a LADM-compatible model in Turkey for a sustainable land management structure has become indispensable. This study aimed to research in order to provide the integration of existing land management structure in Turkey country profile with the main classifications in ISO LADM.

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In the Turkish land, the registry has to record registers, where immovable properties are recorded, are the title deeds and property ownership deeds. Also, cadastral systems recorded by spatial data infrastructure relations with land registry data. The main groups that constitute the contents of these two deeds are Ownership class (in Turkish: TR_Ownership), Rights, Limitations and Responsibilities Class (in Turkish: TR_HKS), and the Real Estate Class (in Turkish: TR_Real Estate). The deed registry structure in Turkey is in general similar to ISO LADM main classes. ISO LADM main classifications, which are equivalent to the elements of the title registry in Turkey, are indicated in Figure 4.
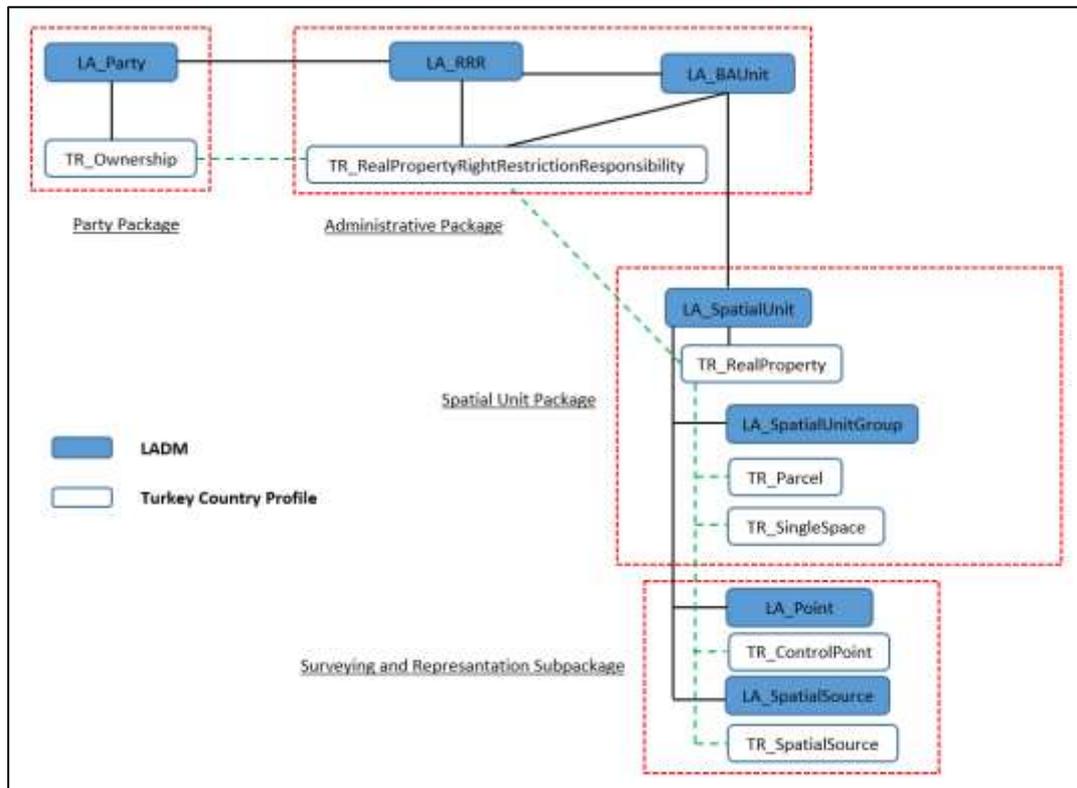
Figure 4. Turkey's land administration profile and corresponding LADM classes

The main classes are related to land management for Turkey country profile which is determined primarily during the development of an ISO LADM compatible model. These main classes are separated into four classes: (1) Ownership class, (2) Real estate class, (3) Rights, liabilities and limitations on the Immovable Property, (4) Legal and technical situation and documents about the immovable property. The original names, names in country profile and the equivalents in ISO LADM of these classes are summarised in Table 3.

Table 3 The main classes of Turkish cadastral model, classes of Turkey's country profile and related ISO 19152 classes

Turkish model original class name	Name in the Turkey's profile	Corresponding LADM class

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	Ownership		
1	TK_GerçekKişi	TR_NaturalPerson	LA_Party
2	TK_TüzelKişi	TR_LegalPerson	LA_Party
3	TK_MüşterekMülkiyet	TR_Co-Ownership	LA_GroupParty
4	TK_KamuKurumu	TR_PublicInstitution	LA_Party
5	TK_KooparatifŞirket	TR_CooperativeAssociation	LA_GroupParty
	Real Properties		
1	TK_Parsel	TR_Parcel	LA_SpatialUnit
2	TK_Bina	TR_Building	LA_LegalSpaceBuildingUnit
3	TK_BinaBölümü	TR_BuildingUnit	LA_LegalSpaceBuildingUnit
4	TK_BağımsızBölüm	TR_SingleSpace	LA_LegalSpaceBuildingUnit
5	TK_Tesis	TR_Premises	LA_LegalSpaceBuildingUnit
	Rights related to properties		
1	TK_İrtifakHakları	TR_Servitudes	LA_Right
2	TK_Kısıtlılıklar	TR_Restrictions	LA_Restriction
3	TK_Sorumluklar	TR_Responsibilities	LA_Responsibility
4	TK_Şerhler	TR_Annotation	LA_Restriction
5	TK_İpotek	TR_Mortgage	LA_Mortgage
6	TK_ÜstHakkı	TR_RightOfSuperficies	LA_RightType
7	TK_YararlanmaHakkı	TR_RightOfUsufruct	LA_RightType
8	TK_GeçitHakkı	TR_RightOfPassage	LA_RightType
9	TK_DevremülkHakkı	TR_RightOfTimeshare	LA_RightType
	Address, Boundry Point, Lease and Legal Basis		
1	TK_SınırNoktası	TR_BoundaryPoint	LA_Point
2	TK_KiraSözleşmesi	TR_Lease	LA_Responsibility
3	TK_YönetimPlanı	TR_Building ManagementPlan	LA_SpatialSource
4	TK_VaziyetPlanı	TR_LayoutPlan	LA_SpatialSource
5	TK_ResmiDoküman	TR_LegalDocument	LA_AdministrativeSource
6	TK_DokümanTipi	TR_TypeOfDocument	LA_AdministrativeSourceType

5. DISCUSSIONS

Nowadays in Turkey cadastral system has 2D components with TAKBIS and MEGSIS. On the other hand, the cadastral parcel is the basic registration unit in Turkey, while some 3D/4D situations give in the text are defined and registered through limited rights, condominium rights, time sharing and other restrictions on intersecting parcels. Like many other countries, the traditional cadastral system has shown some limitations in Turkey to register and represent 3D/4D situations.

In Turkey, current land title and cadastral data model should be improved to reflect better all dimensions of the land. In this context, In Turkey, initiatives projects are developed for providing integration to vision on the future of cadastres. These are namely, Turkey National Spatial Data Infrastructure with GIS (TUCBS or TRGIS) and as an information system the Land Registry and Cadastre Information System (TAKBIS in Turkish). The TAKBIS and TUCBS include attempts to achieve standardisation in the area of cadastral data based on international standardisation approaches. The land registry data related to parcels are held in the Land Registry and Cadastre Information System. Therefore, all title data in our country is on e-government, but all parcel data not transferred at present. Turkey's Spatial Data Infrastructure with GIS Project (TUCBS in Turkish) has been designed according to the infrastructure of the ISO standard and compatible to Cadastre 2014 perspective. With this Project, land registry and cadastre metadata will be obtained by conformably to INSPIRE and

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LADM. Nowadays TUCBS has 2D components for the cadastral system in Turkey. In this, his paper, conformity of LADM for modelling land registry and cadastre situations in Turkey country profile was evaluated compared approaches of TAKBIS and TUCBS.

5. CONCLUSIONS

LADM is critical components for cadastral systems all over the world countries profile. As stated in LADM with Turkey country profile, spatial-temporal cadastral databases are formed by defining the position of the boundaries of land parcels together with its creation date and its removal date, the hierarchy of land parcels including the attributes that attach on them which are presented in cadastral maps, map plans and land books. Furthermore, 3D/4D spatial cadastral data with international standards and LADM-based should be defined by subsequent studies. On the other hand, LADM presents the general conceptual schemas for land administration. In this study designed Turkey country profile cadastral data model provides the basis for national and regional profiles and enables the combination of land management information from different sources in a coherent manner. For this reason, several countries apply LADM to establish a country profile for their land administration system.

The development of a conceptual schema could bring a common understanding within the domain of land administration with Turkey country profile for all land registry and cadastral data involved in the standardisation projects in Turkey, especially for TAKBIS and TUCBS. The study investigates and compared the basic entities in the Turkish TAKBIS and TUCBS which is concerning with basic land classes (e.g. parties, rights, restrictions and responsibilities, administrative, and spatial units) against the LADM basic classes. While there are similar Turkish country profile entities for the relevant LADM basic classes, there are semantic differences between Turkish cadastral system and LADM basic classes.

Finally, in this paper, the application of LADM was discussed with a focus on the academic and institutional studies in Turkey. The results of the study indicate that effective functioning for the Turkey country profile based on the LADM which requires proper integration of data, preceded by analysing the contents of existing data sets, indicating key registers and defining a linkage system between them.

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