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Modelling of Temporal Query of 3D Legal Objects in Turkey

Türkiye'de 3B Yasal Nesnelerin Zamansal Sorgulamasının Modellenmesi

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Abstract

Turkey's existing cadastral system consists of two primary components. These are title recordings and cadastral recordings. Immovables are registered to the title in three ways: land, independent section and permanent rights. The third dimension on land and real estate is registered in title with right, restriction and responsibility (RRR is as permanent rights). On the other hand, the Turkish cadastral system allows real estate to be registered temporarily. A real estate property is registered to the existing cadastral system with transaction date and time. Thus, any transaction can be monitored over time temporarily. Therefore, the results of the study contribute to the literature by examining the scope of the Turkish legal system with a 3D cadastre. Besides, the RRR legal system with time aspect in the Turkish cadastral system is modelled based on the ISO 19152:2012 LADM. In this context, the paper consists of five main chapters. In section 1, the literature on 3D cadastre and LADM is given. The methodology of the study is described in section 2. Chapter 3 discusses 3D RRR scope of the evaluations regarding the legal objects in Turkey. Besides, time data and RRR are incorporated into Chapter 3. Sections 4 and 5 include discussion and recommendations.

***Keywords**: 3D RRR, Temporal query, LADM, Land title*

Özet

Türkiye'nin mevcut kadastro sistemi iki ana bileşenden oluşmaktadır. Bunlar tapu kayıtları ve kadastro kayıtlarıdır. Taşınmazlar tapuya üç şekilde kaydedilir: arazi, bağımsız bölüm ve sürekli haklar. Arazi ve gayrimenkul üzerine üçüncü boyut, hak, sınırlama ve sorumluluk ile tapuda tescil edilir (RRR, kalıcı haklardır). Öte yandan, Türk kadastro sistemi gayrimenkulün geçici olarak kayıt altına alınmasına izin vermektedir. Bir gayrimenkul, işlem tarihi ve saati ile mevcut kadastro sistemine kaydedilir. Böylelikle herhangi bir işlemin zaman içinde gerçekleşmesi geçici olarak izlenebilir. Dolayısıyla, çalışma sonuçları Türk hukuk sistemi kapsamını 3 boyutlu kadastro ile inceleyerek literatüre katkı sağlamaktadır. Ayrıca, Türk kadastro sisteminde zaman yönü olan RRR hukuk sistemi, ISO 19152: 2012 AİTM'ye göre modellenmiştir. Bu bağlamda makale beş ana bölümden oluşmaktadır. Bölüm 1'de 3 boyutlu kadastro ve AİTM ile ilgili literatür verilmektedir. Çalışmanın metodolojisi 2. bölümde açıklanmıştır. Bölüm 3 Türkiye yasal nesnelerine ilişkin değerlendirmelerin 3D RRR kapsamı tartışılmıştır. Ayrıca, zaman verileri ve RRR bölüm 3'e entegre edilmiştir. Bölüm 4 ve 5, tartışma ve tavsiyeleri içermektedir.

***Anahtar kelimeler**: 3D RRR, Zamansal sorgulama, AİTM, Tapu kaydı*

1. Introduction

Cadastral studies are seen as the cornerstone of the land administration system. According to many researchers, cadastral maps should provide complete information to record RRR on the cadastral parcel within the scope of 3D cadastre (Kaufmann and Steudler, 1998; Stoter and van Oosterom, 2006). However, most of the countries create cadastral maps based on 2D land parcels for land administration systems (Döner et al. 2011; Ho et al. 2015; Rajabifard et al. 2018; Alkan et al. 2018; Surmeneli et al. 2020). Thus, RRR on the land cannot be adequately represented.

Therefore, the need for three dimensional cadastral data increases. As a result of this need, the demand for the 3D cadastre representing the real world has come up. International studies on future cadastral systems have been investigated e.g Cadastre 2014 (Steudler, 2014) and 2034 (ICSM, 2015). Within the scope of Cadastre 2034 vision, the cadastral system of the future should include all RRR related to real estates with advanced policies, standards and models.

Over the last decade 3D Cadastral systems and immovable properties have intensively studied by institutions and scientists (Karki et al. 2010; Aien et al. 2011; Döner et al. 2011; Guo et al. 2011; van Oosterom, 2013; Paasch and Paulsson, 2014; Kitsakis et al. 2016; Alkan et al. 2020; Surmeneli et al. 2020). It depends on these studies, 3D cadastral studied could listed in the five main headings in FIG publication (van Oosterom, 2018).

- Legal foundations for 3D Cadastre
- Initial Registration of 3D Parcels
- 3D Cadastral Information Modelling
- 3D Spatial DBMS for 3D Cadastres
- Visualisation and New Opportunities

Exploring the examples from 3D Cadastre worldwide, it has been found many similarities. The proposed solutions are similar, even different aspects of 3D features are taken into account, based on the structure of their cadastral systems, the types of recorded objects, etc. There are regulations in Australia (Aien, 2013) and Canada (Stoter and van Oosterom, 2006), which contain detailed explanations on how to measure and register a parcel in 3D. The Netherlands changed the Civil Law on Cadastre in 2007, thus redefining the ownership of land, which lead to a registration of 3D objects determined by the law independently from the parcel (Wakker et al. 2003). In the Netherlands and Switzerland, there is a separate Line cadastre for the recording of underground networks (Wakker et al. 2003; Steudler, 2015). In Norway, the registration of underground structures is not mandatory and is made optional (Herdlevær, 2018). In Switzerland, studies have been carried out to convert the existing cadastral database into a 3D state. For the Swiss Cadastre, a comprehensive plan covering the transition to 3D cadastre was prepared (Steudler, 2015). In some countries, the whole cadastre is already digital. However, there are still countries that are continuously working in this direction, such as Greece (van Oosterom et al. 2018).

In this paper, our motivation is to support the regulation and analysis of 3D land rights, restrictions, and responsibilities for the Turkish Cadastre System based on the international standards with the LADM within ISO 19152 aspect of time. In the current research, we share our main output: design 3D legal model with time aspect using LADM for the Turkish cadastral system.

1.1 3D RRR and LADM

Within the Cadastre 2034 (ICSM, 2015) vision is recommended that the cadastre should be considered and registered in 3 dimensions by emphasising that the ideal cadastral system should show the entire legal status of the land including public rights, responsibilities and restrictions. Lemmen and van Oosterom (2013) explain three specialisation classes of right, restriction and responsibility: 'A "right" is an action, activity or class of actions that a system participant may perform on or using an associated resource. Examples are ownership right, tenancy right, possession, customary right or an informal right. A "restriction" is a formal or informal entitlement to refrain from doing something; e.g. it is not allowed to build within 200 meters of a fuel station, or servitude or a mortgage as a restriction to the ownership right. A "responsibility" is a formal or informal obligation to do something; e.g. the responsibility to clean a ditch, to keep a snow-free pavement or to remove icicles from the roof during winter or to maintain a monument.

The three-dimensional cadastre is a cadastre that provides information on the rights, responsibilities and restrictions on registration and not only on the parcel but also the 3D possessive units (Alkan et al. 2020). In this context, the Basic Model of Land Administration constitutes a basic class in order to define the rights, responsibilities and constraints concerning the 3rd dimension of the real estate. With this class structure, the management of the rights, responsibilities and restrictions that may occur on the spatial unit will be ensured. The main starting point of the Land Administration Domain Model (LADM) is to establish a common ontology for RRR affecting the land administration and its geometric components. Thus, it will enable communication between related parties within a country or between different countries (van Oosterom et al. 2006; Lemmen et al. 2015). The LADM is developed in line with the Cadastre 2014 (Stuedler, 2014) vision and complies with international ISO and OGC standards (Lemmen et al. 2009; Lemmen et al. 2011; Tjia and Coetzee, 2013). Besides, it has been conducted in the studies showing the compatibility of LADM with INSPIRE (Alkan and Polat, 2017; Alkan et al. 2020; Surmeneli et al. 2020).

LADM has three main packages and one sub-package. These are LA_Party (Party package), LA_AdministrativePackage (Management package) and LA_SpatialUnitPackage (Spatial Unit package) and LA_SurveyingAndRepresentation (Figure 1).

LA_VersionedObject is a superclass. Classes LA_Party, LA_GroupParty, LA_PartyMember, LA_Mortgage, LA_RRR, LA_BAUnit, LA_SpatialUnit, LA_SpatialUnitGroup, LA_RequiredRelationshipSpatialUnit, LA_RequiredRelationshipBAUnit, LA_Level, LA_- BoundaryFaceString, LA_BoundaryFace, and LA_Point are all subclasses from LA_VersionedObject. LA_VersionedObject has attributes for the management of versions of objects in LADM and for the management of data quality.

It also supports the time component of the Land Administration Basic Model. The most important feature of the model is a flexible model and can be expanded within specified standards. It is possible to associate with external classes such as Valuation, Address, and the Land cover as required by the model feature.

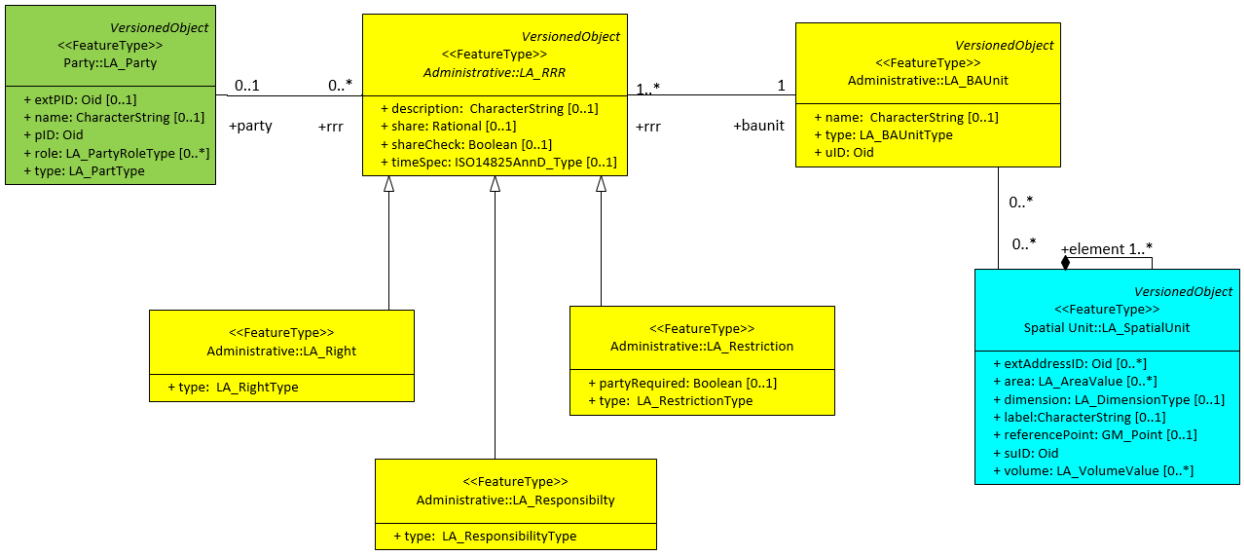

Figure 1. LADM core classes (Lemmen et al. 2015)

2. Methodology

This article primarily explores how existing Turkish cadastral data models address 3D RRR problems. Then he proposes a conceptual 3D cadastral data model as a solution that can provide 3D data. The 3D RRR model represents 3D legal objects. In this context, the 3D RRR data model is equipped with the Turkish cadastral system data model concepts. First, it facilitates the modelling of all existing interests as legal objects to develop an experimental 3D RRR data model for Turkish cadastral systems. The system methodology that invokes the design and development approach as shown in Figure 2. Within the scope of the methodology, first of all, 3D RRRs in the Turkish cadastral system were determined.

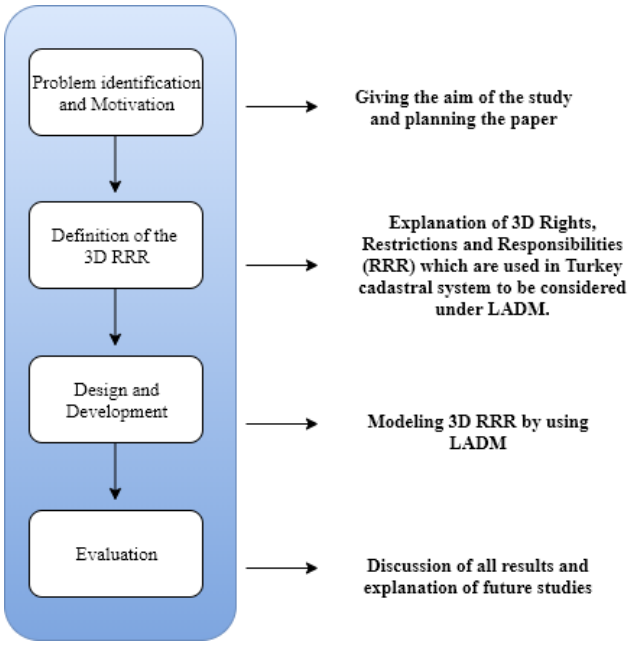

Figure 2. Methodology

3. Evaluation of Turkey Legal Objects Scope of 3D RRR

Today, in many cadastral systems, 2D cadastral parcels are the basis for registration of rights, which are the legal status of the buildings and the rights of the objects registered. Besides, above and below the rights of the objects and buildings are determined by rights related to registrations. The most comprehensive right a person can have is the right to property. Within the scope of the right to property, the person is free to use what anybody owns while observing the rights of others and taking into account the limitations of laws, rules, and non-written laws (Alkan et al. 2020).

The third dimension in the constitution is not sufficiently detailed in the explanation of the vertical rights. There are several rights set out in our constitution regarding the implementation of these rights regarding the third dimension. For example, the easement right is a right. Also, the easement right restricts the rights of the immovable in favour of another immovable. It is also a type of right that determines the limits on how to exercise the immovable rights. The types of easement in kind are listed as the right of access, superficies (right of construction), resource rights, and other easements. In the current cadastral system, the 3D spatial data related to the position where the rights are applied are not included in the cadastral register.

Furthermore, since the data of the objects located under the parcel are not available in the cadastre, the relationship of these objects with the parcels cannot be analysed in the current system. Another obstacle is the lack of representation of the 3D position within the condominium in the cadastral system. Another problem in the present system is that the parcels affected by any object positioned below or above the land surface cannot be questioned as a whole. Besides, the parcels that are transacted for a certain period (for instance, during a sale) cannot be queried as a whole. For example, parcels that are processed between two dates cannot be queried from the system. For each parcel, that transaction within a certain time interval can be displayed in the existing cadastral system. When the studies that were done worldwide and in Turkey were examined, the necessity for 2D cadastral operations to be replaced by 3D parcel object became clear. Besides, the cadastral operations on the 3D parcel object are emphasised. Cadastre 2014 and 2034 vision approaches, which are accepted internationally and constitute the basis for the cadastral systems, bring a different perspective to the cadastral system and become the main component of the land administration system (van Oosterom et al. 2018).

3.1. 3D RRR in Turkey

3D cadastre should have all the rights available in 2D cadastre. All rights and interests in the land should be recorded in 3D cadastre with the integration of temporal data. In this respect, according to the Turkish Civil Code, the real rights are divided into two as property rights and limited real rights.

The right to property is the right of real or legal persons to make all kinds of savings such as using, buying, selling, renting and lending that property on a real estate. According to the owner of the right to property:

- Single-person ownership
- Association ownership
- Cooperation ownership
- Common ownership

It is the state of being able to make all kinds of transactions on the real estate. The person has the Property right and Limited Real Rights on the real estate. The limited real rights are divided into two as Mortgage and Easement.

The right to the easement is a limited real right, which allows using an immovable property for a special reason. According to civil law, easement rights, personal easement, usufruct, residence right, superficies, resource right and other easement rights can be listed.

The mortgage is the right of the right holder to guarantee a receivable and to sell the property through forced execution and to ensure that it will receive it if the debtor does not fulfil his debt. The mortgage has three categories; mortgage, mortgage certificate, land charge note.

It is the part where the information is restricting the use of limited real rights in the land register. These restrictions can be listed as representations, right and liabilities, annotations, mortgage and easement. There is a “representations” column on the land register page for each property. The information in this column is called a “representation.” In general terms, a representation is a process of formalizing some issues regarding the actual and legal status of the real estate. The representations are recorded in the land register with the subject, which is a transaction, the page number of the land register, and the document number. The RealEstateID, Share and Area related to real estate are included in the representations class. To query temporal data are RegisterDate, RegisterTime, DeleteDate, and DeleteTime in the representation class.

Rights and Liability class is the part where rights such as easement, usufruct, right of access, and timeshare property rights are registered to the land register. It is registered in its field as representations.

The annotation process is part of the restrictions for any real estate. The annotation process is registered in the area of the land register as in the representations process.

The mortgage is both a type of right and restriction. Some rights and restrictions may overlap, such as the mortgage.

These are the obligations that an interest holder must fulfil on the real estate. These obligations include the tax on the real estate, maintenance, and repair according to the type of real estate, or regular payments and payment of the easement rights related to the real estate. There may be at least one or more types of responsibility on an immovable.

A logical data model has been created in line with all this information. It has been determined which data will be used in the designed model. Tables 1 and 2 have been created accordingly.

Table 1 shows the comparative representation of the data and classes to be used in the model based on LADM.

Table 1. Comparison of 3D RRR used in Turkish land registration system with LADM

Turkey Legislation Profile	LADM	Turkey Conceptual Data Model Class
Undefined	LA_RRR	TR_RRR
Right	LA_Right	TR_Right
LimitedRealRight	LA_Right	TR_LimitedRealRight
RealRight	LA_Right	TR_RealRight
Mortgage	LA_Mortgage	TR_Mortgage
Easement	LA_Right	TR_Easement
RightofLandChanges	LA_Right	TR_RightofLandChanges
Restriction	LA_Restriction	TR_Restriction
RightAndLiability	LA_Restriction	TR_RightAndLiability
Annotations	LA_Restriction	TR_Annotations
Representation	LA_Restriction	TR_Representation
Responsibility	LA_Responsibility	TR_Responsibility

Legal procedures used in current cadastral systems in Turkey are classified under RRR that are classes of LADM (Table 2).

Table 2. The legal process used in Turkish cadastral system is classified under RRR

Right	Restriction	Responsibility
Ownership	ZoningImplementation	RealEstateTax
Coownership	BanOnConstruction	IrrigationCanalsMaintenance
UsageRight	ProhibitedMilitaryZone	HistoricalArtifactsMaintenance
RentalRight	FillingArea	IncumbranceOnRealEstate
RightOfAccess	ZoningStatus	
Pasture	Mortgage	
Usufruct	Easement	
ResidanceRight	Coastline	
Superficies	CulturalProperty	
TimesharePropertyRight	HistoricalMonumentMaintenance	
Preemtive	Forest	
ChargeonLand	RiskArea	
InformalResidance	ArchaeologicalSite	
ShootingDrillRight	Glebe	
PlayFieldsRight	ConstructionFacilityBan	
WaterWayRight	CultivatedArea	
AgriculturalActiviteRight	MiningAnnotations	
TradinationalRight	22/a Implementation	
Mortgage	LandConsolidation	
MortgageCertificate	Expropriation	
Resale	UrbanTransformation	
RentalAndSaleCondition	Mortgage	
RetrievalAndSaleCondition	Annotations	
	Representation	
	Easement	
	RightOfAccess	
	TimesharePropertyRight	
	Usufruct	
	Lien	
	Sequestration	
	LandRental	
	ContractToSell	
	RefusalContract	
	PersonalRight	
	ConstructionRightInReturnForFlat	
	PreeptionContract	
	RestrictionOfRightAlienation	
	BanningOfRightAlienation	
	Mortgage	
	MortgageCertificate	
	Resale	
	RentalAndSaleCondition	
	RetrievalAndSaleCondition	

3.2. The time aspect of 3D RRR in Turkey

The boundaries, geometry, and owner information of cadastral data change over time. In this case, changes in the cadastral systems should be followed in temporal (Alkan, 2005). The integration of time data into cadastral systems will make it easier to keep up with changes that occur over time. The Turkish cadastral system allows real estate to be recorded temporarily. A real estate property is registered in the existing cadastral system with originating right in the type of registration date and registration time. Thus, the realisation of any transaction over time can be monitored in temporarily. In the Turkish cadastral system, cadastral data is recorded temporarily in the title. Cadastral operations performed on a cadastral object are seen in the paper-based cadastral system. Then, the cadastral objects were transformed from a paper-based system to a CAD-based system.

So, the cadastral processes performed on a cadastral object can be questioned temporarily in passing the cadastral data to the CAD system. Thus, the whole process can be displayed for only one cadastral object. However, the deficiency of the system is its inability to query for more than one cadastral object within a certain period of time. Figure 4 shows how the transactions occurring in real estate are recorded temporarily. There may be more than one transaction on immovable property. The temporal expressions of these processes were explained by van Oostreom et al. (2006). Temporal values can be disjoint, touch, overlap, inclusive and equal (Figure 3).

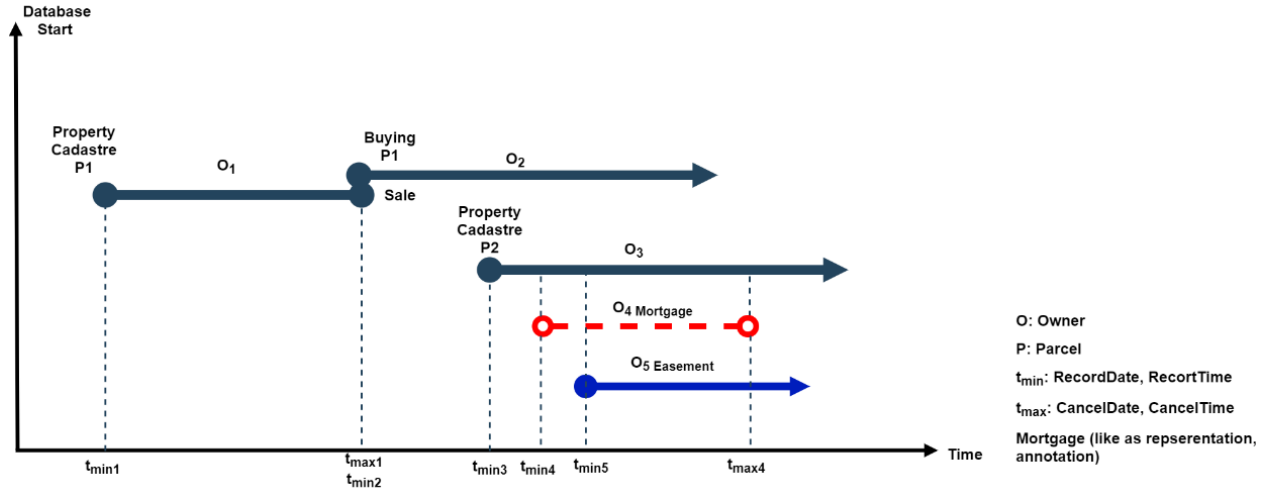

Figure 3. Time registration of immovable properties in Turkish cadastral system

Thus, it is possible to examine the status of the cadastral object or group for a certain period. It will monitor these changes in the cadastral system, including where, when, and how the changes occurred. What kind of changes occur and the reasons for the changes. Figure 4 shows in which operations the cadastral objects occur over time and their final status.

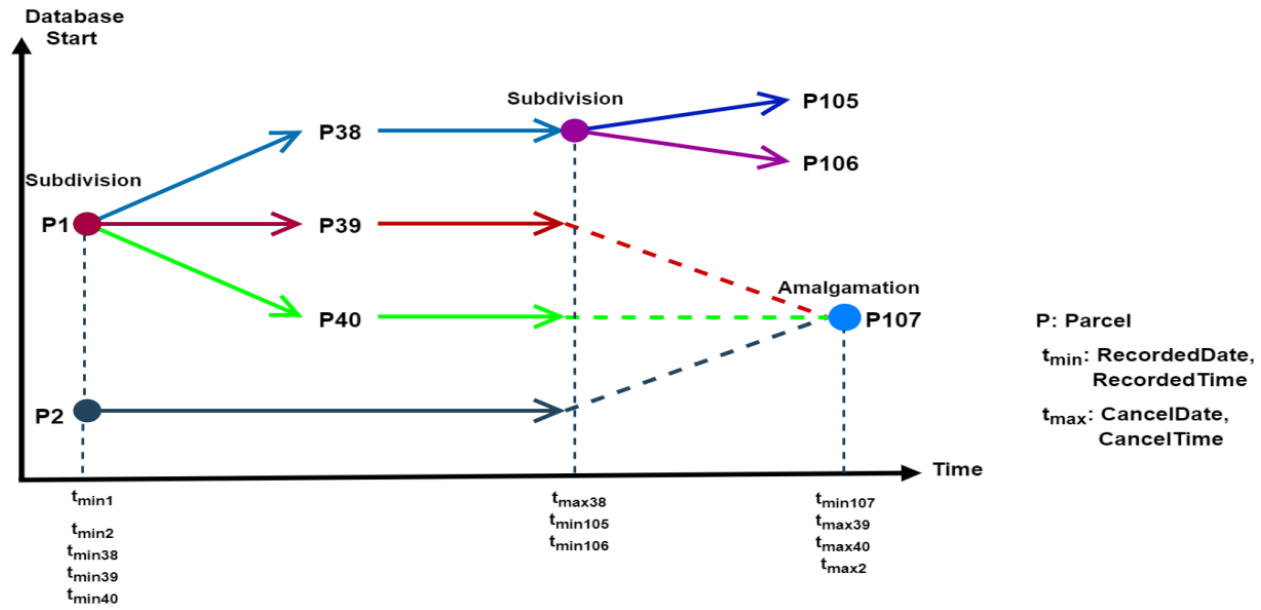

Figure 4. Temporal monitoring of transactions on a real estate

4. 3D RRR Model Scope of LADM

The TR_RRR package is based on the LADM. TR_RRR is an abstract class in which the rights, restrictions and responsibilities set out in the Civil Code are represented to represent the 3rd dimension. The TR_RRR package has three sub-classes TR_Restriction, TR_Responsibility and TR_Right.

Figure 5 shows the TR_Right class. Freehold rights according to civil law, including applicable in Turkey and limited real rights are divided into two classes, and it is divided into two subcategories, namely easement and mortgage. Information regarding the real estate that is a mortgage is provided with the RealEstateID attribute.

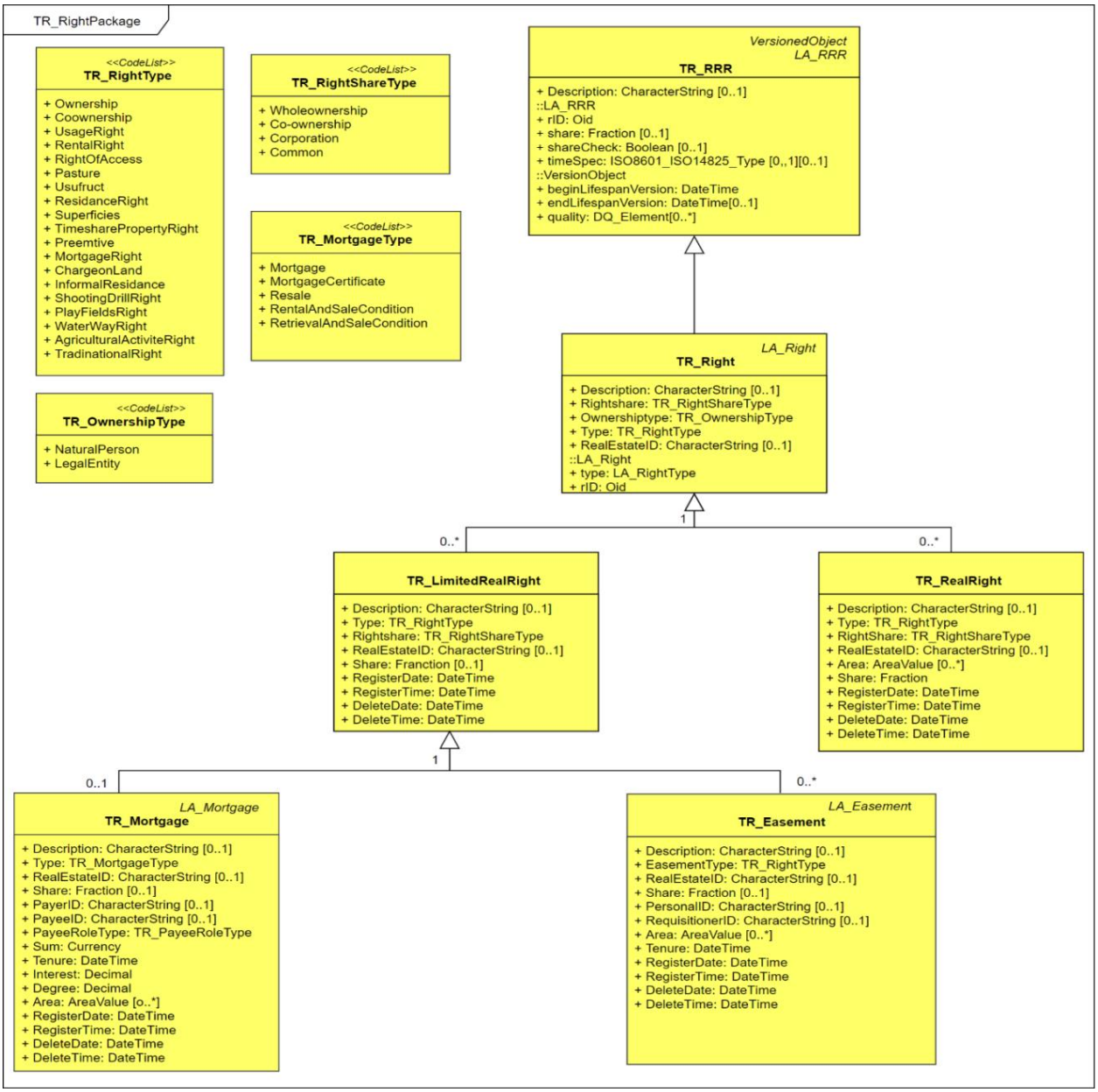

Figure 5. TR_Right class

The information of the debtor and the creditor can be queried with the attributes PayerID and PayeeID. According to the civil law, the amount of mortgage that is not certain or can be changed, an individual mortgage degree is placed and maintains its order regardless of the changes that will occur after the registration. According to this statement, the attribute of the Degree and Sum are in the mortgage class. At the same time, the amount of mortgage, duration, and interest information can be queried from the system. Lastly, information on the RegistrationDate, RegistrationTime, DeleteDate, and DeleteTime attributes are available when the mortgage entitlement starts and ends. The easement right is a type of right that gives the right holder the right to use and benefit from that real estate. The type of easement right can be one of the rights types specified in the RightType code list. Information about the real estate established in the easement can be queried with the RealEstateID, Share and Area attribute. The information of the real estate's owner can be determined by the PersonalID, the information of the person requesting the easement to be established by the RequestonerID attributes.

Finally, the RegistrationDate, RegistrationTime, DeleteDate and DeleteTime attributes are available for information on when the right easement entitlement starts and ends. General information about the right of the easement can be found in the description attribute. Since there may be no or more than one rights type related to a real estate, the relationship types 0 .. * (0-many) is determined.

Figure 6 shows the TR_Restriction class. The TR_Restriction class consists of four subclasses. These are TR_RightAndLiability, TR_Mortgage, TR_Annotations, and TR_Representation. The representations are recorded in the land registry with the subjects which are a transaction, the page number of the land registry and the document number. The RealEstateID, Share and Area related to real estate are included in the TR_Representations class. The Representation CodeList shows that what types of representations might be. Since there may be no or more than one representation related to a real estate, the type of relationship is determined as 0 .. * (0-many). The mortgage is both a type of right and restriction. Some rights and restrictions may overlap, such as the mortgage. If the mortgage expires, the information in the relevant line is overwritten, and the date and document number are written. As a mortgage can be established on real estate, the type of relationship is selected as 0..1 (0-one). Fig. 10 shows that all classes attribute in the Restrictions package.

TR_RightsAndLiability class is the section where the rights such as easement rights, usufruct rights, right of passage, and right of ownership are registered to the land registry (Alkan et al. 2020). The attributes required for registration to the land registry (such as date, document number, transaction description) are defined in the classes. Type of Right and Liability is in the Restrictions CodeList. 0 .. * (0-many) relationship type is selected for Rights and Liability.

TR_Annotation class is the part of the restrictions for any real estate. The annotation process is registered in the area of the land registry as in the representations process. Annotation types can be listed in Annotation CodeList. Relationship type is defined as 0 .. * (0-many).

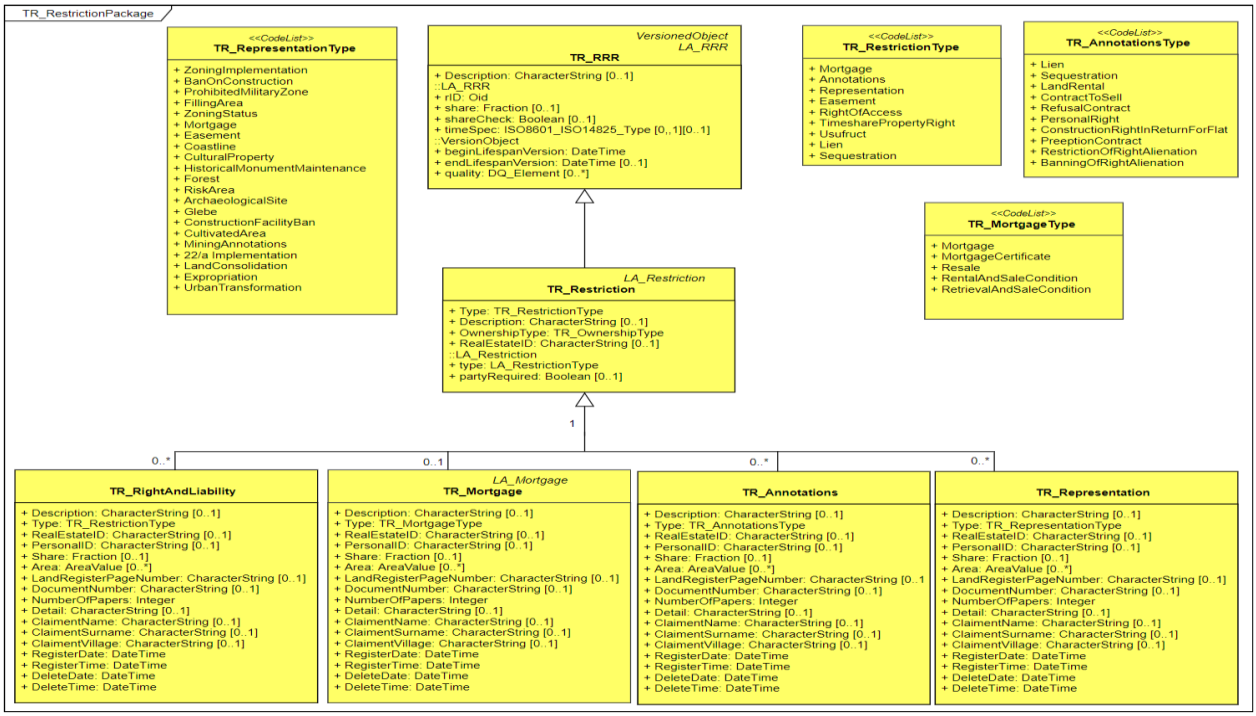

Figure 6. TR_Restriction class

In figure 7, the TR_Responsibility class is represented. It is the class in which a person's obligations to be fulfilled are represented. These obligations include the tax on the real estate, maintenance, and repair according to the type of real estate, or regular payments and payment of the easement rights related to the real estate. There may be at least one or more types of responsibility on an immovable. Therefore, the relationship type is determined as 1 .. * (one to many).

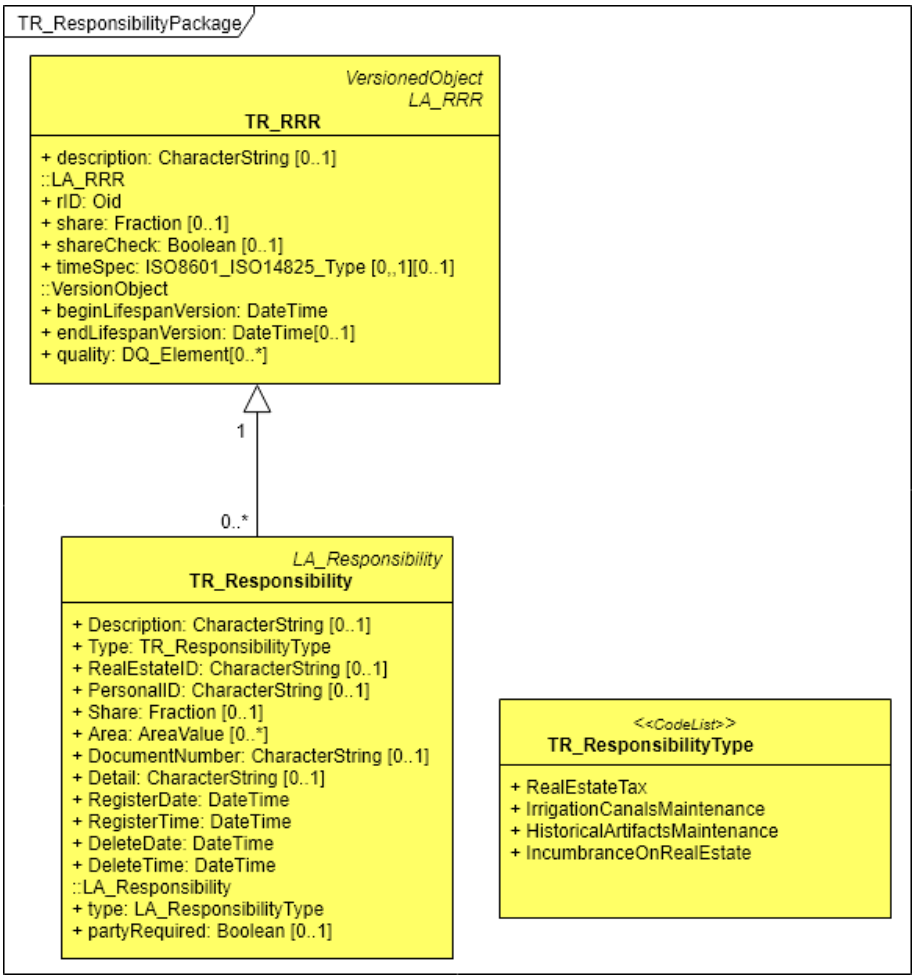

Figure 7. TR_Responsibility class

5. Results and Discussion

In the last two decades, modern technology has been developing with the 2D cadastre no longer responds adequately to the property needs. In this context, international standards as ISO 19152, LADM have been defined in order to develop 3D cadastre. Besides, international standards have been carried out in many countries for 3D cadastral systems. It is observed that in the context of an insufficient number of scientific studies on 3D cadastre in Turkey. When our study examines it, these studies are considered to be insufficient new cadastral models based on international standards for Turkey. From these academic studies, it can be categorised as direct cadastral studies and indirectly as cadastral studies. The studies carried out within the scope of 3D cadastre are generally aimed at analysing the cadastral situation of the country, examining the use of easement rights and legal regulations arising from the third dimension and presenting sample database designs for local cadastral installation.

In this study, the main objective is to contribute to the country profile of the 3D cadastre in Turkey. On the other hand, they are matching the title of the land registry with the LADM. Besides, the existing land registration system in Turkey was discussed in this paper. 3D RRR following the legal regulations in the title system has been determined with which attributes. After determining the required data and data types, 3D RRR is modelled based on LADM.

ISO 19152 LADM is an important step in terms of standardisation and communication of cadastre and land management systems all over the world. With this regards, it is essential to use of ISO standards for Turkish cadastral systems which the management of temporal data and 3D data/rights/boundaries will be significantly facilitated. For this reason, it is assumed that LADM is considered as a suitable template for analysing data requirements and international standards to design a model that will meet the requirements in the land registry and cadastre data. Also, the scope of the paper, RRR package, classes, properties, relations and methodology of LADM model elements were analysed and adapted to our model. Finally, in this study explains 3D cadastral systems with the international standards using compatible or not for Turkey.

6. Conclusion and Recommendations

Firstly, within the scope of this research, the 3D cadastral systems carried out in some of the countries are examined in the introduction. These studies are in line with that recorded in Turkey. Later, cadastral objects and 3D rights, restrictions, and responsibilities registered under legal regulations in the cadastral system and time data allowing for the temporal inquiry were identified. LADM was selected for the study as it is an ISO standard and suitable for the representative of the Turkish cadastral system. Then, logical and conceptual data models for 3D cadastral data were developed. The similarities and differences between the designed model and LADM have been identified and showed Table 1, and 3D RRR are modelled based on LADM.

The 3D cadastral systems have advantages and disadvantages that are determined in this study. It is also could be listed as follows. Firstly, to be held in Turkey in the future will contribute to academic studies related to 3D cadastre. Secondly, it will contribute to the cadastral studies which are carried out institutionally. International contributions are the introduction of the national profile of the Turkish cadastral system in the process of 3D cadastral transformation. At the same time, the use of LADM will not only provide interoperability but will also provide a common language for the promotion of the Turkish cadastral system on international platforms. The disadvantages are that the study remains only as a conceptual model.

As a result, this study determined the three-dimensional representation RRR based on LADM and international standards. Also, it is determined that the current Turkish cadastral system. On the other hand, the paper designed data organisation are compatible with a data model based on LADM. Finally, this study contributes to developing a national standard for 3D cadastral system. The result is a developed model which is of value for General Directorate of Land Registry and Cadastre and can be used as a basis of a 3D national data standard. Furthermore, it can contribute to the establishment of spatial data infrastructure in Turkey and can be internationally recognised.

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