



A Profile of Land Administration Domain Model Core Packages for Iranian Jurisdiction (Selected Paper in the 8th ISPRS Geospatial Conference 2025, University of Tehran, Iran)

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Article Info

ABSTRACT

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In recent decades, Iran has encountered significant challenges in land ownership, registration, and spatial management due to population growth and the expansion of land use. The coexistence of formal and informal registration systems, the diversity of cadastral documents, and the fragmentation of responsible institutions have emphasized the need for a unified and standardized data model.

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This study qualitatively examines the Land Administration Domain Model (LADM) and its main packages and classes, analyzing their structure and relationships in relation to Iranian cadastral and legal frameworks. A preliminary feasibility analysis was conducted to evaluate the implementation of a national LADM profile for Iran, followed by outlining key implementation stages including profile scope, stakeholders' involvement, and conceptual modeling.

For each class and its fields, the relevant laws were extracted. The relationships, their cardinality, and several code lists were reviewed and customized based on national regulations to ensure semantic alignment with Iran's legal and administrative context.

Keywords:

LADM v2,
Country Profile,
Iran,
Conceptual Model,
UML,
Cadastre.

The findings highlight that the LADM framework can effectively support the modernization of Iran's land administration system by enabling the integration of legal and spatial data within a harmonized structure, thereby enhancing transparency and promoting efficient land governance and combating corruption.

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1. Introduction

The population of Iran is approximately 86 million ([Iran Statistical Yearbook, 2019](#)). In light of this, the demand for housing has increased, leading to a significant rise in the construction of multi-story buildings ([Einali et al., 2022](#)). According to a report by the Statistical Center of Iran, more than 131,000 building permits were issued by municipalities in 2022 (1401 in the Iranian calendar), of which over 85.2% were related to residential units ([Iran Statistical Yearbook, 2019](#)). This trend, combined with extensive migration to urban areas, compels governments to employ land governance instruments and systems, thereby establishing an institutional infrastructure for the implementation of pertinent policies and strategies. Such infrastructure encompasses institutional arrangements, legal frameworks, operational processes, technical standards, geospatial land information, administrative systems, land markets, and mechanisms for monitoring, evaluation, and control. These tools and frameworks play a pivotal role in optimizing land access and utilization, and can substantially contribute to the country's socio-economic development.

The data model can be designed in such a way that information, including the source of documents and the details of individuals responsible for data maintenance processes, is recorded comprehensively, accurately, transparently, and in an indisputable manner. Such a structure prevents corruption, disputes, and legal conflicts, while enhancing public trust, reducing property transfer costs, facilitating investment, and ultimately promoting economic development ([Ahsan et al., 2024](#)). Although conventional data models are capable of organizing information within a specific project or organization, they face challenges when addressing broader needs, such as inter-organizational data exchange, flexibility, long-term sustainability, and comprehensive coverage of legal and spatial dimensions. Therefore, the use of a standardized data model becomes necessary.

This standardized data model, in addition to establishing a common language for data storage and exchange, enables the convergence of cadastral data across organizations and provides a comprehensive and sustainable framework for land management at both national and international levels. Furthermore, the data model must possess sufficient flexibility and be compatible with the national spatial data infrastructure to allow the addition or modification of data without disrupting other datasets, thereby enabling the growth and evolution of the land management system.

In 1923 (1302 Hijri Shamsi), the Department of Deeds was renamed to "Department of Deeds and Properties," and in 1989 (1368 Hijri Shamsi), the Iranian Cadastre Plan Law was ratified by the Parliament as part of the responsibilities of the National Organization for Registration of Deeds and Properties. Accordingly, in 1990 (1369 SH), the "Technical Council of Cadastre" was established, and the preliminary studies for this plan commenced ([Mehrzaad, 2013](#)). Although

numerous studies on the legal aspects of cadastre are conducted annually in Iran, its technical dimensions have received comparatively less attention. Since the land registration system in the country is primarily utilized as an informational tool for property transactions and data maintenance relies on the deeds and cadastre system, various challenges exist that highlight the necessity of employing a standardized data model. Such challenges may lead to issues including conflicting transactions, forgery or alteration of documents, and infringement of property rights.

Each country designs specific systems for land administration and management according to its policies and institutional structures, and these differences reflect how land administration is organized within that country. In this context, moving toward the development of a standardized national profile for Iran is not merely a choice but a necessity for the modernization of the land registration and cadastre system. Utilizing an international standardized data model provides the capacity to simultaneously cover both technical and legal aspects, guiding Iran's land registration and cadastre system toward an intelligent, efficient, and globally aligned framework.

One of the most important data models is the Land Administration Domain Model (LADM). This model can be considered a common language and an integrated structure in the field of land management, which many countries aim to adopt in order to organize their data in a standardized manner. Such an approach enables data analysis and comparison without compromising the local characteristics of each country ([Kara et al., 2024](#)). LADM is a conceptual and descriptive standard model designed using Unified Modeling Language (UML) diagrams to describe and manage information related to land and associated assets. It is recognized as an international reference framework for land and property information management and plays a crucial role in facilitating data exchange and interoperability among different systems ([Lemmen et al., 2015](#)).

The Land Administration Domain Model was first published in 2012 as an international standard under the code ISO 19152:2012, with the initial version primarily focusing on land ownership. In the second edition of this standard, released in 2022, its scope was expanded to include not only land ownership but also topics such as land valuation, spatial planning, and information related to marine environments ([Kara et al., 2024](#)).

Developing conceptual models helps us create an abstraction of reality, allowing us to focus on the data required within the system. Such a model consists of one or more core standards—or subsets thereof—along with selected clauses, classes, options, and parameters tailored to perform a specific function. When this configuration is officially recognized at the national level, it is referred to as a "country profile" ([Kalantari et al., 2015](#)).

One of the objectives of the LADM is to achieve sustainable development goals (SDGs). Sustainable development is a fundamental strategy that seeks a new way

to meet the needs of society without harming resources for future generations (Imperatives, 1987). The Sustainable Development Goals include 17 goals that were introduced in 2015 by the United Nations to align programs and policies toward preserving the planet, achieving peace, and ensuring sustainability for present and future generations (Hák et al., 2016). The implementation of LADM addresses several SDGs, including Goal 1 (No Poverty), Goal 2 (Zero Hunger), Goal 5 (Gender Equality), Goal 8 (Decent Work and Economic Growth), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), Goal 16 (Peace, Justice and Strong Institutions) and Goal 17 (Partnerships for the Goals) (Okembo et al., 2024).

According to the Sustainable Development Report, Iran has performed relatively well in certain goals such as education and poverty reduction; however, it continues to face significant challenges in areas such as gender equality, sustainable cities and communities, climate action, and global partnerships (Sachs et al., 2025). This situation highlights the necessity of employing standardized data models such as LADM, as their implementation can contribute to achieving sustainable development goals by promoting transparency, ensuring property rights, and facilitating the international exchange of spatial data.

One of the fundamental bases for developing an LADM country profile is the creation of a Property Information Report (PIR), which includes diverse details to assist buyers, sellers, and real estate consultants in evaluation and decision-making (Ahsan et al., 2024). This report includes information such as property specifications (area, address, and type), ownership history (previous owners and transfer dates), taxation status (taxes and financial assessment), legal status (legal records, permits, and licenses), zoning information (zoning type and restrictions), physical characteristics (structure and amenities), and market status (market price and time to sell). The Deeds and Properties Registration Office carry out the registration of property specifications, ownership history, and legal status. The Tax Office records tax information and zoning information is registered by the Municipality. As a result, at least three organizations — the Tax Administration, the Registration Office, and the Municipality — are interconnected to be able to create a comprehensive Property Information Report.

Many countries have been able to develop LADM so far, gain many successful experiences, and move towards a clear vision. By using these successful experiences, we can play an important role in creating, developing, and wider acceptance of the LADM profile for Iran. In this paper, the general features for developing country profiles are examined in Section 2, in order to understand the primary objective of creating this country profile for Iran and to identify the key users and institutions that will benefit from this system. Section 3 briefly reviews the core packages in the Land Administration Domain Model (LADM), including party, administrative, and spatial packages and the

administrative package suitability for Iranian land administration. Section 4 reviews the recent researches on the topic and critically discuss their outcome and propose alternative solutions.

2. General Features for the Development of Country Profile

The general features identified for developing country profiles are based on the results of literature reviews of country case studies, analyses of key resources, and consultations with experts (Kalogianni et al., 2021). Their aim is to identify commonalities and differences and to extract best practices from existing profiles. These features, which form the basis of a methodology for country profile development, include the profile scope, stakeholder involvement, the current status of land administration systems, the profile development stage, 3D land administration, and future scope considerations (Kalogianni et al., 2021). These features are inherently flexible and can be adapted to the context of any country. Given that an LADM profile for Iran has not yet been developed, following these steps is essential as an initial phase in creating the country's profile.

2.1. Profile Scope

A country profile may describe the existing situation in the LA domain and adjust the current LAS into the LADM concepts or it may describe the vision/need for a future situation (Kalogianni et al., 2021). The scope of a national LADM profile is defined in a way that, on the one hand, it reflects the current status of data and processes related to land registration, management, and utilization, and on the other hand, it provides a solid foundation for future developments, inter-organizational data exchange, and support for high-level decision-making.

2.2. Stakeholders' Involvement

Stakeholders are defined as all institutions, organizations, and individuals that directly or indirectly benefit from or interact with the model. The key stakeholders in the development of national profiles typically include academic institutions, governmental bodies, and organizations responsible for land administration.

In Iran, these organizations comprise the State Organization for Registration of Deeds and Properties, municipalities, the Ministry of Agriculture Jihad, the Forests, Range and Watershed Management Organization, and the Ministry of Roads and Urban Development. Academic institutions, research centers, and consulting engineering firms contribute significantly to the design and development of conceptual models. Moreover, the legal framework—including notary offices and the judiciary—plays a decisive role in the storage, registration, transfer, and validation of land rights. Hence, the development of a national LADM profile must be founded on an integrated participation of three essential domains: academic expertise, institutional data, and legal frameworks.

2.3. Status of Existing LAS

Although a land administration system currently exists in Iran, its level of comprehensiveness and efficiency remains uncertain. Therefore, different approaches are being considered for aligning it with the LADM framework (Kalantari et al., 2015). The primary objective of developing LADM country profiles for Iran is to modernize the existing land administration system and adapt it to contemporary standards, thereby addressing critical challenges such as fragmented and decentralized data storage, the lack of support for three-dimensional data, and the inadequate performance of updating, querying, and retrieving information.

2.4. Profile Development Stage

At this conceptual modeling stage, profile development remains theoretical. Most profiles incorporate UML diagrams wherein the three core LADM packages are adapted to meet the country-specific requirements.

2.5. 3D Land Administration

This feature distinguishes between 2D and 3D representations. The first edition of the LADM standard supports the registration of 3D spatial units; however, its second edition will not only support registration but also include multiple 3D spatial profiles and a variety of implementation options.

Given the increasing development of multi-story and complex structures in Iran, the need for three-dimensional land administration (3D LA) has become imperative. The current cadastral system in Iran is based on two-dimensional representation, and elevation or depth information is not recorded in official documents or cadastral maps. Although technical infrastructures are available in the country, the lack of a legal and modeled framework has prevented Iran from aligning with the LADM standard in this regard.

2.6. 3D Land Administration

When a country initiates the development of an LADM profile, the first step is to define the scope of the profile for the relevant period, followed by the identification of stakeholders. If we aim to take a forward-looking approach, the profile scope must encompass a broader range of spatial units and related administrative information in order to adequately address evolving needs.

The future development of Iran's national LADM profile must extend beyond traditional property registration structures and should not be confined to 2D cadastral systems. The future vision must be grounded in the country's real needs, technological advancements, the increasing prevalence of volumetric (3D) ownership, and inter-agency coordination challenges.

In Iran, the development of the LADM profile is still at a conceptual and preliminary stage. In light of this, stages 5 and 6 will be examined at a later point. In the following, we will focus solely on stage 4 and, among the LADM packages, we will examine the administrative package in the context of Iran.

3. LADM Packages and Iran Conformance

The core of LADM consists of three main packages: the Party package (individuals and groups), the Administrative package (including the classes for rights, restrictions, responsibilities, and basic administrative units), and the Spatial Unit package, all of which are interconnected through association lines. In addition to these core packages, LADM also defines a supplementary Surveying and Representation package which are not covered in this paper.

A general schematic of the LADM model tailored for Iran can be represented as shown below (Figure 1). To better distinguish each section, different colors have been used: green for Parties, yellow for Administrative and blue for Spatial Units.

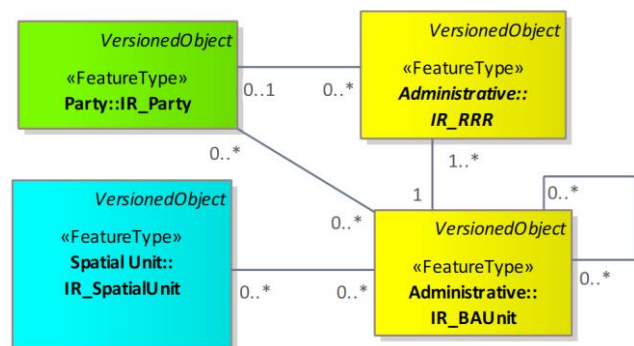


Figure 1. Core classes of LADM standard.

3.1. VersionedObject Class

In order to record the history of ownerships, transactions, and spatial changes using this model, it is necessary that all the classes depicted in Figure 1 be defined as versioned objects. In this configuration, the start and end times of version validity can be easily recorded, allowing changes to be applied at any time, the status of entities to be reconstructed at any given moment, and reliable historical records to be produced. In this structure, each object has lifecycle temporal attributes, including:

- `begin_Lifespan`: The time when that version becomes valid in the system.
- `end_Lifespan`: The time when that version ceases to be valid.

Upon a legal change (e.g., a court order to cancel a deed from 5 years ago), the previous version of the object is not deleted or edited. Instead, the `end_Lifespan` of the previous version is set to the start time of the new version. A new version of the same object is created with a new `begin_Lifespan` value. This new version reflects the updated legal status (e.g., changing the status of a right to 'canceled'). Consequently, no historical information is overwritten or deleted, and the temporal chain of changes is preserved without gaps. This structure enables the reconstruction of the legal or spatial status of a property at any past point in time and fully guarantees the integrity of the historical timeline.

In the relationship between `IR_Party` and `IR_RRR`, a person may hold zero or more rights and responsibilities.

Conversely, a right may either be associated with one person or be unrelated to any specific individual.

The next relationship, between IR_RRR and IR_BAUnit, both located within the Administrative package, is one-to-many. That is, each right must be assigned to exactly one basic administrative unit, while a single basic administrative unit may have one or multiple rights defined for it. The relationship between IR_BAUnit and IR_SpatialUnit is many-to-many, meaning that each basic administrative unit may be related to none, one, or several spatial units, and vice versa.

3.2. Party Package

This package, shown in yellow, includes individuals, groups, institutions, or organizations involved in land transactions or land administration processes (Kara et al., 2024). The components of this package are categorized into two primary classes: IR_Party and IR_GroupParty (Figure 2).

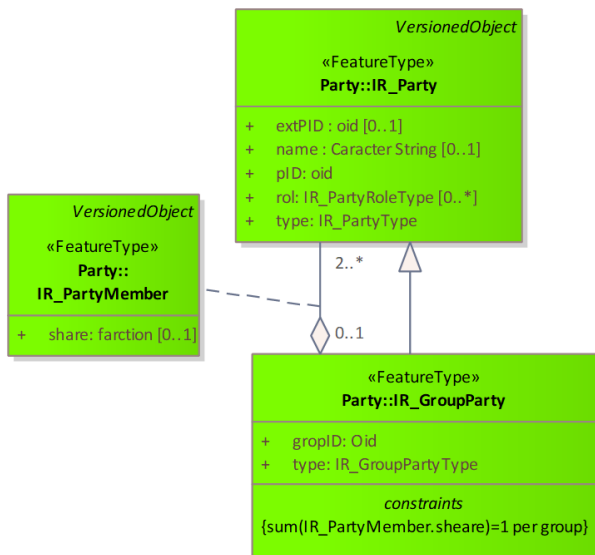


Figure 2. Core classes of LADM standard.

Through IR_PartyType, a party can be defined either as a natural person such as an owner, tenant (approvals of Islamic Consultative Assembly ((Civil Code, 1928); Article 466) or as a nonNaturalPerson such as a municipality, companies, or organizations ((Commercial Law, 1932); Article 588). The roles of individuals (IR_PartyRoleType) in Iran may include owner, applicant, notary office, certified expert, real estate agent, and surveyor.

IR_GroupParty represents a form of collective ownership; for example, families who collectively own a specific parcel of land fall into this category. For the establishment of such a group, at least two persons are required. If it is possible to assign independent identifiers to each member of the group and to specify their individual shares of rights and ownership, the IR_PartyMember class can be defined accordingly. However, if such identification

is not feasible—such as in the case of an entire tribe where separate identifiers cannot be assigned to each individual—this class will not be instantiated. Moreover, due to the dynamic nature of group membership over time, the PartyMember must be defined as a versioned object (Figure 2).

3.3. Administrative Package

Administrative package consists of two subclasses: the Rights, Responsibilities, and Restrictions class (IR_RRR) and the Basic Administrative Unit class (IR_BAUnit) (Figure 3).

3.3.1. IR_RRR Class

This class refers to rights that are primarily related to the possession or use of land. Since the discussion concerns land and its utilization among individuals, the focus here is on proprietary rights. A proprietary right is a legal entitlement granted by the laws of each country to secure the material needs of individuals (Katouzian, 1927). According to the second version of LADM (ISO19152, 2025), the attributes that can be entered for Iran are as follows:

Description: Details related to the right, responsibility, or restriction, rID: Identifier related to the three RRR components, Share: The share of each right in the examined instance, ShareCheck: The total sum of the shares must equal 1, because a constraint is defined in IR_BAUnit which requires specifying how the ownership of the land is divided among individuals and TimeSpec: The time periods during which individuals have rights, and when they do not.

3.3.2. IR_Right Class

In this class, the rights that are mostly related to the possession or use of property are placed. Since we are discussing land and its use among individuals, the focus here is on property rights. A property right is a privilege granted by the legal system of each country to individuals in order to fulfill their material needs (Katouzian, 1927). In Iran, the types of rights that can be defined are as follows: ownership (Article 30), lease (Articles 466 to 497), tenancy (Article 466), usufruct (Article 40; (Civil Code, 1928)), etc.

3.3.3. IR_Restriction Class

A restriction refers to an obligation to refrain from performing a certain action. According to the definition provided in LADM, a restriction may relate to legal constraints on land use, construction, or the transfer of property rights. This concept is addressed in several major legal frameworks, including the Civil Code (Civil Code, 1928), the Registration of Deeds and Properties Act (The Registration of Deeds and Real Property Act, 1931), the Law on the Preservation of Historical Monuments (The Act on the Preservation of National Monuments, 1930), as well as various regulations and resolutions of the supreme council for Urban Planning and Architecture (Law of the Supreme Council of Urban Planning and Architecture of Iran, 1972).

In this class, there is an attribute called partyRequired, which specifies whether a person or an institution is associated with the restriction. Another attribute, type,

defines the nature of the restriction that can be specified. Examples of such restrictions in Iran include situations where the property has a servitude restriction ((Civil Code, 1928); Article 93), leaseToOwn ((Regulations on Bank Facilities Granted, 1983); Article 57), bufferAndMonumentZone ((The Act on the Preservation of National Monuments, 1930); Article 5), constructionHaltOrder, expiredConstructionPeriod, nonConformingUse (Assembly of Experts, 1979); Article 100), etc.

3.3.5. IR_Responsibility Class

In general, responsibilities are divided into two categories: individual and public. The first category refers to obligations imposed on individuals who own or use a property, such as paying property taxes, and so on. Public and national responsibilities, on the other hand, fall under the domain of governmental institutions—for instance, the preservation of historical monuments. This class only refers to the type of responsibility.

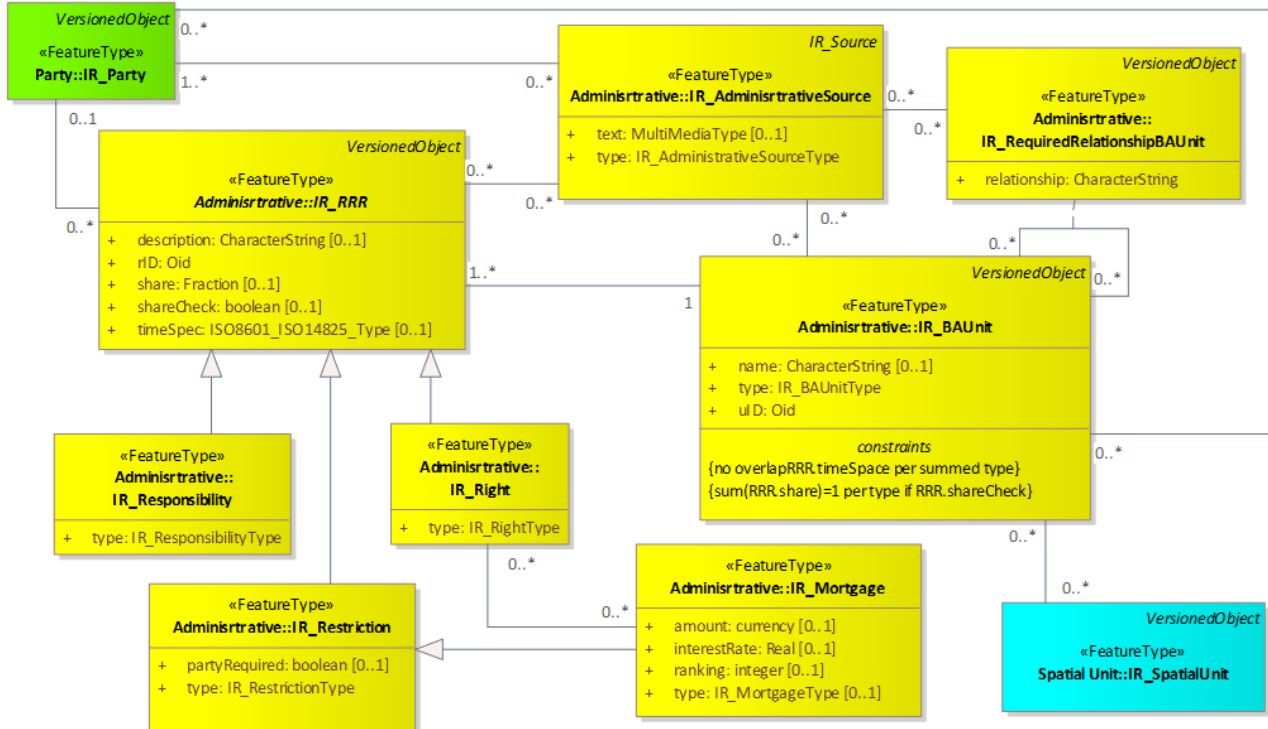


Figure 3. General view of the Administrative package (IR_Administrative).

Responsibilities that can be defined within the Iranian context MonumentMaintenance (Approval of the Bylaw on Cultural, Artistic, and Historical Assets of Public and Governmental Institutions, 2002); Articles 4 and 5, along with (Law on the Support for Restoration and Revitalization of Historic Fabrics, 2019); Article 13), PropertyTaxPayment ((The Direct Taxation Act, 1987); Articles 52 to 80), RoadMaintenance ((The Amendment to the Road and Railway Safety Act, 2000); Article 2), etc.

3.3.4. IR_Mortgage Class

This is a specific subclass of IR_Restriction and represents a form of restriction defined for rights arising from mortgage loans. According to Article 771 of the Civil Code, a mortgage is a contract through which the debtor provides an asset as collateral to the creditor. The one who gives the collateral is called the mortgagor, and the other party is referred to as the mortgagee (Civil Code, 1928). In the Mortgage class, there is an optional attribute called

amount, which is recorded only once and stores the loaned amount along with the corresponding national currency (Currency). The next attribute, purpose, is used to explain the intended use or objective for obtaining the mortgage. The source attribute specifies the provider of the mortgage funds, such as the name of a bank. Finally, the type attribute must refer to the type of mortgage, which is selected from a predefined code list discussed later. The types of mortgages defined in Iran include: SempelMortgage (Articles 771–794), UsufructuaryMortgage (Article 782; (Civil Code, 1928)) and BankMortgage ((The Islamic Banking Operations Act, 1983); Article 15).

3.3.6. IR_BAUUnit Class

The Basic Administrative Unit, or BAUnit, serves as a representation of an administrative unit in which the legal rights or regulations concerning at least one or more land parcels are recorded. For example, if someone owns a piece of land that has both rights and responsibilities defined on it,

all of these are stored within a single BAUnit. In essence, it encompasses both legal information and data related to the associated party. As shown in Figure 3, the relationship between this package and RRR is one-to-many, meaning each BAUnit may contain one or several RRRs. This class also has a many-to-many relationship with the Party class. However, the link between RRR and BAUnit is one-to-one, which indicates that each right must be tied to one specific package of rights and obligations (BAUnit).

The attributes of this class include name, where a custom name or identifier for the unit is defined—such as "Unit 10, Plot 57." Then comes type, which determines the nature of the administrative unit, based on a BAUnitType code list introduced later. The final attribute is uID, a unique identifier for each unit, similar to a national identification number. What sets this class apart from others is the set of constraints it includes. The first constraint, defined as "sum (RRR.share) = 1 per type if RRR.shareCheck," requires that the total shares of rights, responsibilities, and restrictions must sum to 1. The second constraint, "no overlap RRR.timeSpec per summed type," ensures that there is no temporal overlap between rights of the same type during a defined time period.

Types of BAUnits in Iran include the basePropertyUnit, referring to properties with official ownership documents registered as primary assets in the formal cadastre e.g., single-page title deeds in Iran ([The Registration of Deeds and Real Property Act, 1931](#); [Articles 22](#)); the leaseUnit, representing properties leased under fixed-term contracts between landlords and tenants; and the rightOfUseUnit, denoting cases where an individual has the legal right to use a property without owning it, such as usufruct or endowed (waqf) lands defined in [Article 55 of \(Civil Code, 1928\)](#).

3.3.7. IR_AdministrativeSource Class

Once the rights and their corresponding administrative units have been identified, it becomes necessary to determine whether the information collected, registered in the system, and attributed to an individual is accurate, legal, and valid. The IR_AdministrativeSource class is where all documents and sources that confirm or reject these claims must be recorded.

One of the main attributes of this class is text, which contains the legal content or relevant explanation, while another attribute, type, defines the nature of the document or source. All these documents are organized within a specific legal framework that governs property ownership and land tenure. Examples of such documents include a legal document ([Civil Code, 1928](#); [Article 1287](#)), a Sale Deed ([Civil Code, 1928](#)), and a Municipal Permit ([Municipalities Act, 1955](#)).

3.4. Spatial Unit package

This package represents the location and spatial dimension of legal land units on a map. In other words, while the previous package defines who holds which right, the spatial unit package specifies where these rights are exercised on the land parcel (Figure 4).

3.4.1. IR_SpatialUnit Class

A basic spatial unit representing a land parcel or building space with defined boundaries. It includes attributes such as area, volume, reference point, and address. In cadastral systems, this is usually represented as a polygon with topological relationships.

In Iran each property unit, either a parcel or an apartment unit, is uniquely identified by the combination of 6 components: a province, a city, a cadastral unit (Bakhsh Sabti), a region, primary and secondary plate numbers. We assigned 8 digits to the first four components (i.e. 2 digits for each) and two integer numbers for the primary and secondary plate numbers. Concatenation of these digits form a unique string. For example, 01-03-04-00-433532-343 translates to province 01, city 03, cadastral unit 04, region 00 and 433532-343 as the property number. We have captured this core link attribute in SpatialUnit::suID attribute (Figure 4). Right now, the Tax Office and Municipalities communicate through this identifier with the Land Register to uniquely refer to a spatial unit for property taxation, spatial planning and land development. This identifier could be used as a core link between these fragmented databases in a Service-Oriented Architecture (SOA).

3.4.2. IR_SpatialGroup class

This class represents a collection of spatial units grouped at a higher hierarchical level. For example, a building block containing several apartments, or a large land parcel subdivided into smaller plots. Attributes such as name, label, and hierarchical level are stored in this class. In Iran, this concept is mostly observed in land subdivision and partitioning, as well as in the hierarchical organization of building floors.

3.4.3. IR_Level class

In LADM, a Level is defined as a logical layer used to organize Spatial Units. Each Level may have a specific structure (StructureType) and a defined content (LevelContentType). For instance, a Level may contain cadastral parcels in an urban area, or a layer of the electricity network. In Iran, the Cadastre Department under the Registration Organization manages Levels for land parcels, while utility companies (electricity, water, gas) maintain corresponding Levels for infrastructure networks.

- Equals: Indicates the duplicate registration of a parcel with identical geometry, which can lead to conflicting ownership.
- Contains/Within: Indicates the issuance of a title for a sub-parcel while the larger parcel already has an established legal status.
- Crosses: Important in cases of conflict with right of way, road easements, utility networks, or public lands.
- Touches: Typically indicates permitted adjacency but is important for controlling cadastral boundary accuracy.

Given the characteristics of Iran's cadastral system, most conflicts arise from overlaps between state-owned and private lands, informal subdivisions, and duplicate registrations. Therefore, in a national implementation, the Overlaps, Equals, Contains, and Within relationships should be defined as mandatory topological controls in the property registration and transfer process, while the Touches relationship is primarily used for boundary validation.

4. Discussion

A preliminary needs assessment was conducted to evaluate the feasibility of implementing a national LADM profile for Iran. This assessment highlights the potential of Iranian land administration system to support standardized and integrated registration of legal and land-use information. Moreover, the profile is expected to align with both the national spatial data infrastructure (NSDI) and global SDI (GDSI) frameworks, promoting interoperability and long-term scalability.

The implementation process involves several key stages, including conceptual modeling of land administration components, harmonization with national legal frameworks, and technical adaptation to existing cadastral structures. As part of this process, the core code lists defined in LADM classes were customized based on Iranian laws and administrative regulations to ensure semantic consistency and institutional relevance.

In localization projects conducted in Iran (Zamiri et al., 2024), new classes such as IR_Parcel, IR_LandImprovement, and IR_CadastreUnit have been proposed to manage parcels, buildings (improvements), and cadastral units. However, our examination of the conceptual model of these classes suggests that some of them are unnecessary within the LADM framework.

For example, the attribute “rightOfBuilding” (the right to build on a land parcel) should, according to the conceptual structure of LADM, be modeled as a distinct right within the class LA_Right. Similar to the concept of Servitude, such a right must be associated with a single BAUnit rather than being associated directly to the land parcel itself. Therefore, including the rightOfBuilding attribute at the parcel level is inconsistent with the modeling principles of LADM and should instead be represented as an instance of LA_Right. Likewise, the parcel identifier or number (parcelNumber) does not require an additional attribute, since in LADM this

concept is already provided through the suID attribute within the LA_SpatialUnit class. Consequently, the proposed class IR_Parcel does not introduce any new conceptual element and merely results in redundancy within the model (Kalogianni et al., 2024; Kara et al., 2024).

Similarly, the IR_LandImprovement class was proposed to represent different types of physical or functional improvements to land (such as buildings or agricultural enhancements) and includes attributes such as ImprovementType and price. In LADM II land use is modeled within an external package (Landuse) that can be directly linked to LA_SpatialUnit (Kara et al., 2024). Therefore, attributes such as BuiltType or ImprovementType can be effectively modeled either through a linkage to the Landuse package or by introducing a localized code list within LA_SpatialUnit, without the need to define a separate class.

Regarding the IR_CadastreUnit class, the article identifies three categories of attributes: (1) Cadastre_Type (urban, rural, agricultural, national), (2) Property_Type (bare land, land with building, agricultural land, garden, building), and (3) LandUse_Type (residential, commercial, administrative, industrial, agricultural, livestock). However, these concepts are already represented within the standard structure of LADM, making the creation of a new class unnecessary. Specifically, the Cadastre Type can be expressed through the attribute LA_Level.registerType, which includes base values such as forest, mining, public space, rural, and urban, to which Iranian-specific types can be added as localized values. Finally, land use is defined in the external Landuse package (introduced in the second version of LADM, or LADM II), where localized land-use classifications can be represented through a code list such as LA_LanduseType. Hence, defining a new class for managing these attributes is unnecessary, as their semantics are already supported within the LADM framework (Kalogianni et al., 2024).

Conversely, adding new attributes that address Iran's specific requirements—such as the status of tenure security—is both logical and consistent with the LADM philosophy, as the standard explicitly allows for extensions via attributes and code lists. For greater flexibility, it is recommended that this attribute be modeled as a code list with multiple statuses (e.g., secured, under review, not secured), rather than as a simple Boolean value.

The practical applicability of the model for Iran's land and cadastral registration workflows is implied by the conceptual model: transfer of ownership, registration of bank mortgages, registration of legal restrictions, and recording of historical records precisely correspond to the current workflows in Iran's Land Registry Office. The definition of versioned objects and the management of validity periods enable the recording of legal changes resulting from transactions, judicial rulings, and document amendments—which is a practical requirement of Iran's registration system.

In conclusion, the flexible and multi-layered structure of LADM provides sufficient capacity to accommodate the localized concepts of Iran's land registration system. Through the precise application of this standard and the targeted development of national code lists and attributes, a country-specific yet internationally compatible model can be established. Such an approach not only maintains compliance with global standards but also facilitates data exchange and interoperability among land registration, cadastre, and land management systems—representing a major step toward achieving smart land governance in Iran.

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