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Structured Land Domain Modeling for Sustainable Land Administration in Sri Lanka

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ABSTRACT

Developing countries face challenges in identifying suitable land due to insufficient administration systems, leading to governance issues and economic decline. A well-functioning land administration system is crucial for development. This technical paper elaborates an easy pathway to develop a local land administration Domains toward an effective and efficient Land Administration. Introduction of Land Fabric Domain (LFD) and the Localized Land Domains (LLD), are new concept for structuring of land parcels at comparatively low accuracy but well-defined topologically adjusted feature classes to manipulate as electronic information base to sustain the national land administration, real estate management and spatial data infrastructure development. The system architecture designs and the descriptive feature class overview elaborate the land administration system developers to begin their own LLD systems and interactive collaboration with national domains in order to manage overall system compatibility and consistency. The research focuses on the land information system (LIS) currently maintained and operated by the Survey Department and national issues in sustainable land administration of the country. Research focuses to analyze the prevailing process and outcomes of the LIS and introduces possible successive system architectures for implementation. The introductory LFD will be discussed against the feature topology on the basis of geospatial data science and then detailed feature classification will further be discussed accommodating entity relation diagrams. Proposed LLD with process architecture models will be conceptualized for successive implementation. The localized land domains will be structured and interactively linked through national LADM ISO-19152 guidelines for sustainable land administration of the country.

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1. INTRODUCTION

Land administration is essential for social and economic development. It provides a sense of security and allows people to invest in their land and the future (Klaus

Deininger, 2003). In real estate perspectives, land administration system (LAS) is crucial for realizing of real estate infrastructure and property management for sustainable development of a country

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and it will ensure a solid foundation for economic growth and social stability, and environmental conservation.

Transparency is a critical component of a functioning land administration particularly in view of the scarcity of clear and credible information on land laws and policies, land availability, land prices and transactions (Joan Clos, 2013). In view of urbanizing world, the relentless urbanization around major cities has led to the depletion of available land within city boundaries, prompting the establishment of new urban centers in remote areas, characterized by towering smart city complexes. The scarcity of land and the absence of reliable up-to-date information manifest significant obstacles to sustainable planning and development which would eventually improve chaos in real estate sector.

A cadaster is normally a parcel based, and up-to-date land information system containing a record of interests in land. It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements (fig.net; n.d.).

In recent decades, there has been a global trend promoting the adoption of multi-purpose cadasters, often based on commercial software developed by various vendors. However, due to disparities in accuracy and adherence to national mapping agency standards, many countries have faced sustainability challenges. Today, many countries have recognized the necessity and advantages of multi-purpose cadasters. However, a major hurdle lies in accurately surveying the land parcel boundaries. Consequently, the concept of "fit-for-purpose" is now gaining prominence within geospatial data producer communities.

In world context of Land Administration, the Land Administration Domain Model

(LADM) ISO 19152 was introduced in 2012 as the ISO recognized comprehensive global solution. This modular approach offers a well-regarded solution applicable in various country domains (Lemmen C. et al., 2013). However, despite more than a decade passed, the field of cadaster and land information in developing countries has not witnessed significant progress in land administration systems. This underscores the need for further initiatives to enhance the implementation of LADM in these regions.

A Land Information System (LIS) serves as a crucial instrument for efficient land administration, with the Cadaster taking on a central role in its facilitation. Establishing and sustaining a Parcel-Based Land Information System, composed of land parcels at varying levels of accuracy, become an intellectual endeavor in land administration.

Land Administrative Domain Model (LADM) ISO 19152 can further be customized for any country through a localized functional mechanism. Introduction of Land Fabric Domain (LFD), is a new concept for structuring of land parcels at comparatively low accuracy but well-defined topologically adjusted feature classes to manipulate as electronic information base. The proposed system architectures and the feature class overview elaborate prospective initiatives for developing of LAS that suits in respective local land administration forum.

1.1 Land Information System (LIS) of Sri Lanka

The parcel based LIS developed and maintained by the SDSL is the only bestowed LIS in Sri Lanka. SDSL initiated the Land Information System in 2007. LIS has been followed in many transitional stages to overcome the issues prevailed in spatial data processing in different times. While the broad meaning of Cadastre and Land Information System

in facilitation towards a better Land Administration, Sri Lanka LIS from its inception, has been structured to cater the need of land ownership in order to deal with specific project; . Bimsaviya for issuing of land titles in collaboration with the three stakeholder organizations; Registrar General Department (RGD), Land Settlement Department (LSD) and the SDSL itself.

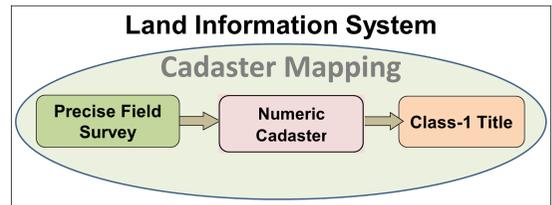
The Survey Department of Sri Lanka (SDSL) has regularly conducted preparation of survey plans for land administration over the country following the Departmental Survey Regulations (DSR),

Land administrative survey plans were often created to establish clear records of land tenure and ownership. They provided a systematic way to document and map land parcels, delineating boundaries and indicating ownership rights and interests. These plans helped to ensure secure land rights, resolve disputes, and facilitate land transactions. It is important to note that SDSL had continuously adapted the similar purposes and practices related to land administrative survey plan preparation.

The Land Information System (LIS) introduced and initiated in 2007, is based on the limited attribute data provided through the SDSL cadaster survey plans; Lot number, Land name, Extent, Calment's name, Land-use and other specific details under remarks.

Direct conversion of cadaster mapping source data into LIS, aiming to issue a class-1 title; ownership certificate as illustrated in figure-1, has provided only the organization needs to prepare conventional land administration plans and then keeping of their digital archives.

Figure 1: LIS and Conventional Cadaster Mapping



1.2 Demand of Potential Land Administration Services

It can be studied that the following sector information are crucial demands for land administration in national forum and they become the potential services through the LIS.

- I. **Land Taxation and Revenue Collection:** Land administrative plans are used as a basis for assessing and collecting land taxes and revenues. They provide information on land use, area, and value, enabling governments to levy appropriate taxes and generate revenue for public administration and infrastructure development.
- II. **Land Use Planning and Regulation:** Land administrative plans are instrumental in land use planning and regulation. They help authorities to identify suitable areas for different purposes such as agriculture, residential, commercial, or industrial use. By mapping land uses and zoning restrictions, these plans guide development activities, ensured orderly growth, and protect environmental resources.
- III. **Infrastructure Development:** Land administrative plans support infrastructure development initiatives. They facilitate the identification of suitable locations for transportation networks, utilities, public facilities, and other infrastructure projects. These plans aided in coordinating and managing the allocation of lands for

public infrastructure, enhancing overall urban and rural development.

IV. Land Administration and Management: Land administrative plans serve as a fundamental tool for land administration and management. They provided a comprehensive overview of land parcels within a jurisdiction, enabling efficient management of land resources, monitoring land use changes, and maintaining accurate records for land administration purposes.

V. Disaster Risk Management: Land administrative plans play a role in disaster risk management by identifying areas prone to natural hazards such as floods, earthquakes, or landslides. By mapping these risks, authorities could develop strategies to mitigate the impact of disasters, plan for emergency response, and implement appropriate land-use policies in high-risk areas.

1.3 Challenging Issues of the LIS against the Prospective Demands

The changing governance structures, and societal needs over the time, have influenced the diverse objectives and methods of land administrative planning. Meanwhile, the computer assisted land administration systems (LAS) have been developed continuously with state-of-the-art applications. Many countries over the world, have developed their own LASs to cater their national land administrative needs with latest IT applications. However, the SDSL has still been preparing the conventional land administrative survey plans as the only reference document for national land administration.

The decisive information for modern land administration which can be traceable to populate the current parcel based LIS are

immense and feasible mechanisms yet to be designed.

The LIS, at its current status, aims to produce cadastral survey plans for issuing of land Title Certificates through the Registrar General Department (RGD). Besides that, the high accurate field surveyed parcel data, collected at higher cost, are not being utilized for dynamic integration to cater the nationally important issues discussed later in section 1.2. The current issues of Sri Lanka LIS in its thematic orientation towards land title registration and no contribution has yet been paid in prospective land valuation, taxation, planning and land use issues as illustrated in Figure 2.

Figure 2: Ownership based Land Information System (LIS)

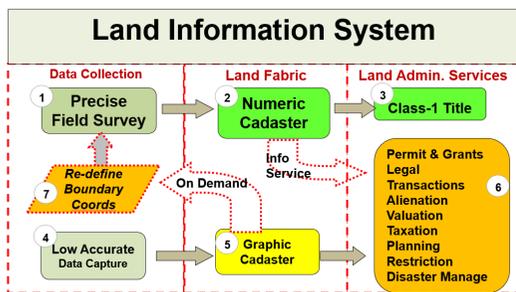


Taking in to account the current progress of LIS in SDSL, is approximately 2 million land parcels out of 12 million of total estimation over the country has yet been completed and found in LIS database. Concerning these figures, the LIS commenced from 2007, yet have completed only 17% of total estimate and that proves the need of an alternative mechanisms for achieving of national LIS for country scope.

1.4 LIS Diversification and Suggestions to Change

Considering the above facts discussed, a land information system should be adjusted to provide those products as reliable and up-to-date sources at affordable prices. Therefore, beyond the conventional high cost and time consuming cadaster mapping procedure, low cost, less time consuming effective land information system must be designed to cater the above demands as illustrated in the figure-3.

Figure 3: Diversifications expected in Land Information System



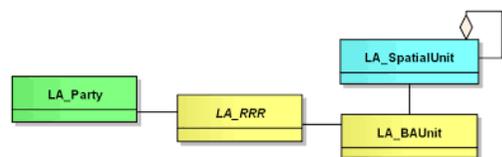
While the conventional precise field surveying (figure-3: process-1) is carried out aiming to issue of class-1 titles (figure-3: process-3), through high accurate numeric cadaster (figure-3: process-2), a new set of processes should be introduced to consider the low accurate survey data (figure-3: process-4) for manipulating fit-for-purpose; a graphic cadaster (figure-3: process-5) to elaborate the extended land information services (figure-3: process-6). However, while the diversified LIS is being functioned, the on demand requests can be accommodated to issue class-1 titles by accelerating the process of 'redefine boundary coordinates' (figure-3: process-7) adapting precise field survey proceedings.

2. LAND ADMINISTRATION DOMAIN MODEL (ISO-19152) AND E-LAND ADMINISTRATION

Land Administration Domain Model (LADM) ISO-19152, also known as the "ISO 19152: 2012 - Geographic information - Land Administration Domain Model (LADM)," is international standard domain model developed by the International Organization for Standardization (ISO). LADM provides a conceptual framework and data model describing the legal, spatial, and administrative aspects of the land and spatial unit. LADM provides a conceptual model with four main classes related with;

- 1) LA-party Parties (people and organizations);
- 2) LA-RRR Rights, responsibilities, and restrictions related with BAUnit / SpatialUnit
- 3) LA-BAUnit Basic administrative units,
- 4) LA-SpatialUnit Spatial units (parcels, and the legal space of buildings and utilities)

Figure 4: Basic Classes of LADM-ISO 19152: 2012

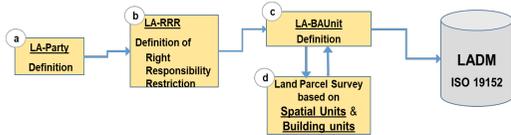


As classified, the LADM consist of LA-Party, LA-RRR, LA-BAUnit and LA-SpatialUnit feature classes, which are broadly attributed in respect of relevant directives. Especially, the Spatial-Unit represents a physical portion of the Earth's surface and is used to model land parcels, buildings, and other spatial objects relevant to land administration.

2.1 LADM Process Architecture

The illustration shown in the figure-5, describes LADM process architecture with classified relations.

Figure 5: LADM Process Architecture



LADM classified architecture is consist of four main processes as detailed in the following context;

Process-a; LA-Party Definition is the study of ownership parties and the ownership types. The respective classification will be elaborated later in the following chapters.

Process-b; LA-RRR Definition is about Right, Responsibilities and Restrictions. Each spatial entity can have one or more of RRR and they will be detailed under RRR classification.

Process-c; LA-BA Unit is the Basic Administration unit which can be defined in concern with the prevailing customs of Sri Lanka land administration as follows;

- i) Land parcel bounded by vertex coordinates or well defined boundaries.
- ii) Building defined by walls as polygon entity representation.
- iii) Condominium property or Strata ownership defined by house unit bounded by six directions; North, East, South, West, upper direction usually denoted by zenith and down by nadir.
- iv) Legal Spaces such as access road, car park, stair ways, lobby etc. with defined boundaries.

Process-d; Definition of spatial units

2.2 Spatial Unit and the Accuracy Measures

The spatial Unit serves as the central entity for capturing information about the spatial and legal aspects of a land parcel, building unit or other defined spatial bodies. The absolute positional accuracy of the spatial unit should be followed by the national survey regulations so that the respective land parcels shall be undoubtedly recognized to legal provisions of land administration over the country.

The Spatial Unit feature class should generally be enclosed with the following parcel-entity inherited attribute fields:

1. Geometry: This attribute captures the spatial representation of the spatial unit, such as points, lines, or polygons.
2. Identification: This attribute contains unique identifiers or codes assigned to each spatial unit for identification purposes.
3. Administrative Hierarchy, captures the hierarchical relationship between spatial units, such as parent-child relationships.
4. Spatial Extent, represents the extent or boundaries of the spatial unit, defining its geographic coverage.
5. Descriptive Information, includes additional descriptive data about the spatial unit, such as its address, purpose, or physical characteristics.

The “Spatial-Unit” feature class should be designed to facilitate the land administration systems by providing well defined data sets. It enables the integration and sharing of land data across different systems and jurisdictions, supporting efficient land administration processes and decision-making. Most of the developing countries are still being

failed to utilize the LADM perspectives and awaiting with ambiguous questions to sketch the respective land parcel boundaries at high precision level. Therefore, it is necessary to suggest an alternative mechanism to waive the delays and retarding forces adhered with high accuracy concept of land surveying and parcel boundary mapping for making a land information database. Meanwhile, it is important to follow up high accuracy levels for land transaction, demarcation, consolidation, and alienation issues where the boundary consistence should be strictly adhered.

3. INTRODUCTION TO LAND FABRIC² DOMAIN (LFD)

As of the aforementioned detailed, it is obvious that the LADM has been modeled with a massive bundle of information related to land administration. LADM data can also be modeled by any interested party to suit with their own country domain. However, as the most of the developing countries experienced, Sri Lanka too faces the critical issues in maintaining of Land Information System (LIS) at nationally accepted accuracy standards as defined by the National Mapping Agencies (NMA) and the follow-up survey regulations.

The land ownership based Sri Lanka national cadaster and the LIS; directly contribute towards land rights aspect as illustrated in figure-1, indicates a lesser contribution towards other important service directives. Therefore, in this research, I propose and draft formats for a specific spatial data domain; Land Fabric Domain (LFD) in order to manipulate the land parcel entities acquired at comparatively low accuracy levels. LFD is logically assigned at lower accuracy hierarchy status in comparison to LADM. The LFD is expected to follow a few topological rules in order to assure the data consistency and compatibility issues so that the LFD shall represent the ground

reality of the respective parcel adjacent boundaries.

It should be noted that Land Fabric Domain (LFD) is not the same as the Parcel-Fabric defined by the ESRI which assures a comprehensive accuracy standard with network adjusted coordinates. LFD is assumed to provide a comprehensive cadaster within the context of fit-for-purpose cadaster concept detailed in section-1.4 above.

3.1 Importance of the LFD

Making a model of land administration in Sri Lanka is quite complicated due to adjudication and the disputes of ownership boundary definitions. Therefore, extraction of land parcel boundaries and follow up proceedings for validation and consistency checking would consume a considerable duration, while further more duration need to be allocated for ownership adjudication and verification proceedings. This complex situation is manifested with the extended duration that the land surveyors employed in the Survey Department yet take a one month to accomplish their monthly work norm; 20 allotments. Hence, the complete process of identification, survey of spatial units and data processing to LADM with adjudication follow-up might take considerably a longer time duration. The reason behind the slow process of surveying by the Survey Department, also manifest by its productivity and the remaining workload of 10 million land parcels out of 12 million estimation of country coverage. Even, the tracing of land attribute information in addition to boundary surveying are yet at minimal measures.

Considering the extended attribute information with LA-RRR and LA-Party ownership are merely descriptive enough to consider separately and selectively define from LFD for respective Basic

Administrative Units for successive LADM.

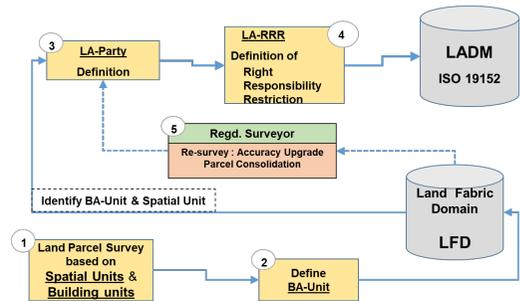
3.2 LFD Designing Criteria

In concern with the sustainability measures of the LFD, it is necessary to understand the ultimate goals of the system against its inputs and the expected outcomes. Generally, geospatial data, which represent by points, lines, polygons and raster imageries, should be structured according to the predefined data model. LFD focuses on both spatial and non-spatial components so that the data will be integrated amongst different spatial data accuracy levels and the whole LFD system with respective parallel geospatial data service models too. Therefore, in designing of LFD, following disciplines should be observed throughout.

1. LFD should assure compatibility and consistency with LIS and LADM.
2. Facility for integration of varied accuracy hierarchies within individual layers.
3. Facility for Accuracy level upgrading from low levels to higher levels.
4. LFD should assure system interoperability with other land information protocols.
5. LFD should assure a minimal feature topology conditions as introduced in the system, for all its entities.

Hence, LFD eventually elaborate a sustainable system as LADM pathway, while it individually plays an amazing role in Efficient and Effective, Electronic Land Administration (EEELA).

Figure 6: LFD to LADM Pathway Architecture



Process – 1: Land Parcel Surveying, based on Spatial Units and Building Units

This process will be formatted to Survey the land plots and the buildings therein at most possible accuracy through modern survey techniques with minimal time and cost parameters.

Process – 2: Define the Basic Administration Unit (BA-Unit)

Having surveyed the spatial units and the building units descriptively, a subsequent process will be introduced to define the basic administrative unit. In this process, each and every spatial unit and building unit will be reclassified with identification of legal spaces and spatial/building units. Here the terminologies in respect of legal spaces should be clearly defined. Terminologies used for legal spaces in Sri Lanka Condominium surveys are quite different of those denoted by the LADM. Generally, common elements and accessory units in condominium surveys are refers to the legal spaces in LADM.

Process – 3: LA-Party Definition is the study of ownership parties and the ownership types. The respective classification will be elaborated in the following chapters in this collection.

Process – 4: LA-RRR Definition is about Right, Responsibilities and Restrictions. Each spatial entity can have one or more of RRR and they will be detailed under RRR classification.

Process – 5: Re-Survey, Accuracy Upgrade & Parcel Consolidation

This process is introduced as an alternative mechanism for those land parcels, which are subject to change for subdivision, amalgamation or boundary correction, should be considered to follow up the nationally accepted survey regulations before align to LADM. The process should be carried out by a professionally registered surveyor and such corrected parcels may bilaterally update the LFD and LADM too.

3.3 Definition of Topological Rules to ascertain LFD Consistency

The Land Fabric Domain; LFD is designed to serve a specific purpose as pathway to LADM, often with a focus on providing basic land boundaries and land management information to support land tenure and property rights. While the exact topological rules can vary depending on the specific context and requirements, Four minimum mandatory topological rules that are typically relevant for Land fabric Domain can be listed as follows;

1. **Parcel Polygons Must Be Closed:** Ensure that all parcel polygons are topologically correct and closed. They should not have gaps or self-intersections, and each polygon should represent a discrete land parcel.
2. **Parcel Boundary Continuity:** Adjacent parcel polygons must share common boundaries, and these boundaries should align correctly. This ensures that there are no overlaps or gaps between neighboring parcels.
3. **No Dangling Nodes:** There should be no "dangling" nodes that do not connect to

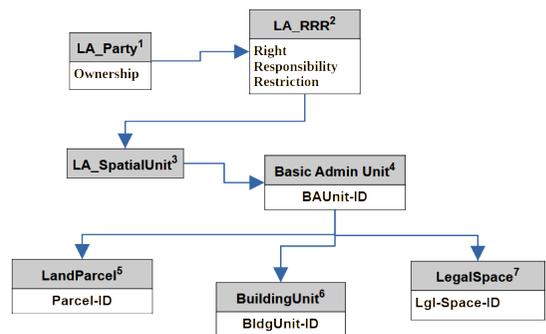
any parcel boundary or reference point. Every node should have a meaningful connection in the context of land parcel boundaries.

4. **Valid Parcel Topology:** Ensure that parcel polygons adhere to valid topological rules, such as the absence of sliver polygons (very small or narrow polygons) and avoidance of self-intersecting boundaries.

4. CLASSIFICATION OF LADM ISO - 19152 AT SRI LANKA LAND DOMAIN

In concern with the LADM main classes, illustrated in the figure-7, and the local land administration scope in Sri Lanka, LADM feature classification can be further customized with the feature classes illustrated in the Figure 7 below;

Figure 7: LADM Main Feature Classes in Sri Lanka Land Domain



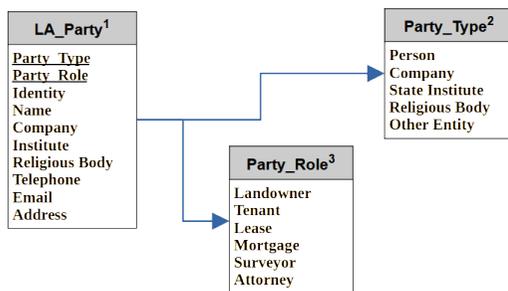
While LA-Party¹ details the ownership component, LA-RRR² stands for rights, responsibility and restrictions as in original classification. However, ‘Spatial unit³’ and the ‘Basic Administration unit⁴’ can further be studied by three feature classes; ‘Land parcel⁵’, ‘Building unit⁶’ and ‘Legal space⁷’ as illustrated in the figure-7.

Detailed classification of LA-Party and LA-RRR will be discussed under the classification of LADM in relation with the basic administration unit (BA-Unit). In this technical paper, it is proposed that the LFD is an effective pathway to LADM so that the study of spatial unit and its subtypes and classification will be discussed in detail with entity relations under LFD classification.

4.1 Classification of LADM: LA-Party

"LA-Party" refers to a concept related to parties involved in land administration activities. In LADM, a party represents an individual or an organization that has a role in the land administration system. LA-Party subtypes can be introduced at the local land administration domain in order to add a meaningful definition to the main feature class. Therefore, the new attribute field; Party-type refers to a person, company, government agency, or any other entity that interacts with the land administration processes. The sub-category; party-role can be referred to land-owner, tenant, lease holder, mortgage, surveyor and attorney etc. These fields can further be elaborated subject to specific thematic requirements. See the Figure-8: LADM Party classifications as customized for Sri Lanka land Domain.

Figure 8: LADM Party Classification in Sri Lanka land Domain



While the attribute field; Party-type detailed about the different type of

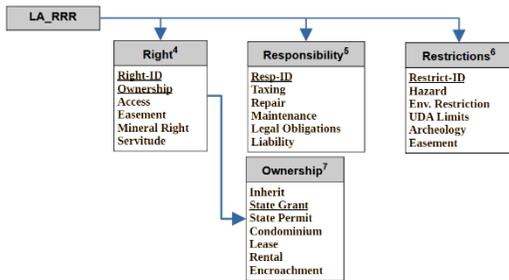
ownerships such as person, company, state institution, religious body etc. Party-role describes the different roles made by the individuals with the system such as land owner, tenant, lease and mortgage or even the related professionals like surveyor and lawyers etc. The most simplified attribute tables can be sorted out as illustrated in the Figure 8 above.

4.2 Classification of LADM: LA-RRR; Right, Responsibility and Restrictions

LA-RRR in LADM gives a clear definition of a land parcel value in the sense of right, responsibility and restrictions. Right to a land parcel means the various measures that would enjoy the occupants with legal provisions. These measures may differ from country to country or even from municipality limits and localities. A few of the right parameters are listed in the figure-9 as applicable in Sri Lanka Land domain. Responsibilities of the party; owner and occupant are mostly varied in different countries and even those individual responsibilities are not legally recognized in most cases. Therefore the responsibilities listed in the figure-9 should still need to be extended based on the implementing area. The restrictions are most affected in land value measures. There can be a plenty of restriction issues in many areas. Figure-9 listed certain restrictions mostly found in Sri Lanka land domain such as, environmental, urban development, Archeology, Cultural etc.

It is noteworthy that the RRR can broadly be elaborated in respect of the LADM specific objectives. Therefore, the respective data model should be designed purposefully to reach the end goals. Any LADM that is customized in different geographical domain will not be productive to implement in other country domain without mapping the system to the realistic ground truth.

Figure 9: LADM RRR Classes in Sri Lanka land Domain



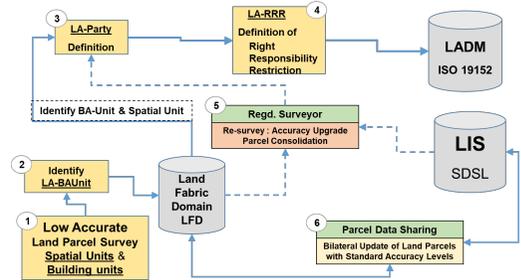
Rights linked with the spatial-units are identical and they can be learned through a common set of attributes such as ownerships, access, easement, mineral, surface and atmosphere etc. However, in Sri Lanka national land administration domain, most the owners are inherited with land surface rights. The land ownerships are varied explicitly in respect of national laws. The respective fields of attributes; ownership in the figure-9, can be extended such as inherit, state grant, state permit, condominium, lease, rental and encroachment in case of no rights at all.

Responsibilities can further be detailed for taxing, maintenance, repair, legal obligations and liabilities etc. However, the land related responsibilities in Sri Lanka are mostly not been customized against adjudication forum and left to the willingness of the property owners.

There are various types of **Restrictions** that are legally empowered in different times. It is very important to visualize the restriction zones graphically so that the land demand and land valuation can then be streamlined through user requirement study. The figure-9 elaborates a few set of attribute fields; hazards, environmental restrictions, Urban Development Authority and archaeology sites etc.

5. INTEGRATION OF LFD WITH THE LAND INFORMATION SYSTEM (LIS)

Figure 10: LFD to LIS & LADM Pathway Architecture



The LIS, developed and maintained by the Survey Department in support of the national land administration in Sri Lanka, obviously needs to be upgraded with supportive attribute information for effective land administration. Therefore, a successive integration between the LFD and the LIS will be a booster in support of land administration in many aspects. The figure-10 illustrate the related mechanism through the processes 5 and 6. As described earlier, process-5; ‘re-survey, accuracy upgrade and parcel consolidation’ can further be linked with LIS for integration towards the LADM process. In this process, a surveyor professional should attend the proceedings under the direction of the surveyor general’s authority in order to secure the system consistency. The new process, noted as process-6 ‘parcel data sharing’ has been introduced in the architecture in Figure 10 to support following mechanism.

Process – 6: Parcel data sharing; bilateral update of Land Parcels with standard accuracy levels.

Land Fabric Domain (LFD) is consisting of spatial entities at multiple accuracy levels. LFD authority is responsible to update the entity accuracies from lower to higher hierarchies. Land parcel subdivision, amalgamation and boundary changes should be accommodated and restored in suitable hierarchy order in accordance with the national standards. Therefore, it is advisable to make an agreement with the Surveyor General for bilaterally sharing of spatial units with LIS at accepted accuracy hierarchies.

5.1 LFD Entities and Feature Classification

Detailed classification of spatial unit and its sub-classes, illustrated in Figure 7 will be discussed within the LFD scope. Land Fabric Domain; LFD will be modeled as an information base to support the national land administration. Therefore, the LFD entity; spatial unit should be explicitly detailed to suit the respective needs. Additionally, LFD is considered as the pathway for LADM while it should bilaterally update the LIS. Hence, LFD entities and classifications should be compatible and consistent with those provided by the LADM and LIS.

Land Information System (LIS) governed by the SDSL is confined with the Departmental Survey Regulations (DSR) for preparation of land administrative plans. Also, the positional accuracy of the LIS spatial entity; land parcel should be constrained at accepted standards so that the scope of the LIS is restricted to observe regular accuracy standards. Therefore, LFD is the conceptual model, proposed to follow an alternative process for acquiring spatial data and pathway to LADM with easy interaction for LIS updating. Hence, LFD consists spatial data in varied sources at highest possible accuracy levels with defined topological rules.

5.2 LFD Main Feature Classes

LFD will mainly focus on the entity; ‘Spatial unit as the Basic administrative unit’ and it will be defined with a feature identity; ‘BAUnit-ID’. Basically in land administration domain, a spatial unit consists a ‘Land parcel’ and optionally it would contain one or many ‘building units’ and ‘legal spaces’ too. Table-1 shows the main feature classes with their key attributes.

Table 1: LFD Main Feature Classes and Key attributes

Spatial Unit	Key Entity
Basic admin unit	BAUnit-ID
Land Parcel	Parcel-ID [should not be ‘null’]
Legal space	Legal Space-ID
Building unit	BU-ID
Building unit dimensions	BU-ID
Land use type	LU type-ID
Land use	Land use-ID
Location Index	IDs for GN, DSD, District, Province etc.

5.3 Basic Administration unit and the Scope

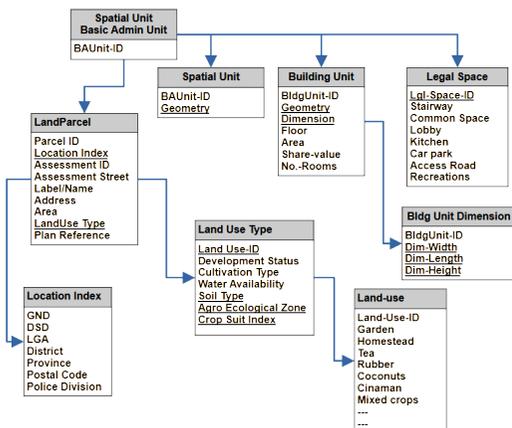
The Basic Admin Unit, as the LFD’s spatial component will undertake all the possibilities that stand for representing the ground reality. Land parcel, Building unit and the Legal space with their key identities will be related to the Basic Administration unit. There are land parcels which do not have any building and sometimes even no legal spaces too. Therefore, in LFD feature classification, ‘Basic Administration unit’ will be learned with aforesaid three main entities; ‘Land Parcel’, ‘Building unit’, and ‘Legal space’ from which ‘Land Parcel’ should not be a ‘null’ value at any circumstance.

Especially, in Strata and Condominium applications, while the building unit represent Basic Administration units, its accessory units and common elements are represented by the legal spaces.

5.4 Detailed feature classification

Detailed feature classification of the LFD at minimal number of attribute fields is illustrated in the figure-11. The relations between the normalized tables and the respective key attributes are also shown herein. Further, an extended classification can be expected for specific organizational or project oriented applications.

Figure 11: LFD Entity Classification and Relations



While the LFD serves as an effective pathway to LADM, the LFD alone is designed to cater the needs of the country in the aspect of effective land administration so that the respective feature classes have been selected as the measures for land use and assessment parameters. Considering the specific land administrative needs of the country LFD even focuses in agricultural and plantation domain too. The local government authorities in Sri Lanka refers the individual land parcel or building unit with identical assessment numbers assigned for each. Therefore, the land parcel is directly attributed with the respective assessment numbers so that the

municipalities and the other authorities can easily link their already running databases with the LFD through the corresponding assessment numbers.

Sri Lanka plantation and agriculture sector is still running with conventional methodologies and use of GIS is yet a minimal. Therefore, LFD is attributed with land use categories, agro ecological zones, soil types and crop suitability index etc. to privilege such systems to collaborate with LFD.

Further, the condominium properties are still surveyed and executed with conventional survey plans referring to hard copy printouts. Therefore, LFD has been attributed with the respective building units and legal spaces too, in order to collaborate with digital approach in condominium surveys.

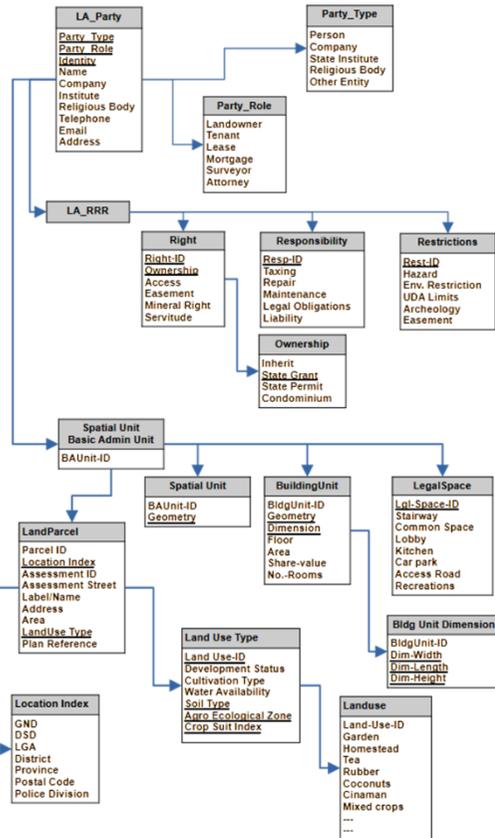
Hence, it can be assured that the LFD is feasible for collaborating with any other system that refers with spatial data components for catering the land administration efficiency and effectiveness of the country.

6. LOCALIZED LAND DOMAINS (LLD) FOR REAL ESTATE MANAGEMENT

Real estate management, also known as property management, refers to the operation, control, and oversight of real estate properties on behalf of property owners. The goal of real estate management is to maximize the value of a property while ensuring it is well-maintained and profitable. This field encompasses a wide range of tasks and responsibilities.

While the LADM ensures an extended solution for general land administration and real estate management, LFD can serve parcel base land information support in Real Estate Management. In concern with the Sri Lanka Land administration forum, organizational and adjudication

Figure 13: LADM detailed Feature Classification and Entity Relation in Sri Lanka land Domain



8. CONCLUSION

Configuration of organizational land domains (OLD) should be carefully handled with necessary privileges to link with available systems. It is advisable to seek technical guidance of GIS experts for establishing OLD. Feature class configuration of proposed OLD, should be methodologically designed to cater the respective thematic needs. It is necessary to realize the spatial data issues; consistency and compatibility in system designing stage for early rectification.

LFD Feature topology disciplines should be drafted prior to data collection so that the topological rules for feature overlapping, undershoot, gaps, dangles

and tolerances etc. be managed through system automated validation rules.

LFD’s main feature classes can further be extended with considering the respective organizational needs within the context of domain configuration. LFD architecture and the main feature classification can also be introduced for any country domain with customizing the sub classes in accordance with the respective users’ requirements.

Electronic Land Administration System (eLAS) is an essential component for a country’s sustainability and economic growth. Through an eLAS that plays a dynamic interactive services at modern multi-media tools, we can observe the reality of state-of-the-art applications therein. The introductory database component; LFD is drafted in such a direction to expedite the traditional mechanism of spatial data extraction and modeling as an easy pathway to LADM.

LADM ISO 19152 as the world recognized system, can easily be customized for local requirements through alternative ground truth scenarios. Therefore, new research directives are triggered for corrective path in sustainable cadaster and land administration systems in developing countries.

This research elaborated an easy pathway to develop a local land administration Models toward an effective, efficient and sustainable Land Administration in Sri Lanka. However, the concept can also be adapted for those countries that LADM perspectives had not yet been sustained.

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