LAND ADMINISTRATION

A new model for the City of Johannesburg Information

PART 2

The application of the Land Administration Domain Model (LADM) to the City of Johannesburg Land Information System is based on the fact that different organisations have different responsibilities in data maintenance. **By Serena Coetzee, Centre for Geoinformation Science, University of Pretoria, and Dinao Tjia, City of Johannesburg**

THE BASIC administrative unit (LA_BAUnit) in the LADM corresponds to LIS.UNIT in the City of Johannesburg Land Information System (COJLIS) data model. The LA_BAUnit may consist of 'zero or more spatial units against which one or more unique and homogeneous rights, restrictions and responsibility are associated to the entire entity as included in a land administration system' (ISO 19152:2012). A right, restriction or responsibility may be held by one or more parties for the whole LA_BAUnit. A right, restriction or responsibility can relate to a specific portion of a spatial unit where the geometry of such portion is absent: for instance, the right of way servitude of which the area and location are described textually (and not specified with coordinates or reference points). The attributes of LA_BAUnit are: name, type and uID (identifier). Table 6 shows an attribute comparison between LA_BAUnit and LIS.UNIT.

LIS.UNIT_TYPE identifies the type of basic administrative unit, including full title, servitude and long term lease. Many of the attributes in LIS.UNIT are related to a sectional title unit only, which could lead one to think that the entity represents only sectional title units. The DOOR_NO, FLOOR_NO and LIVING_UNITS attributes are populated by the Valuation department. The LEGAL_AREA and PART_QUOTA_PERC attributes are used for the valuations. The sectional title unit information is represented in SCHEME_NO, SCHEME_NAME, UNIT_NO and SCHME_YEAR and is imported from the data from the Deeds Office. LIS.UNIT includes the two mandatory attributes (type, uID) specified for a LA_BAUnit in the LADM.

The LADM defines a spatial unit as 'a single area (or multiple areas) of land and/or water, or a single volume (or multiple volume) of space' (ISO 19152:2012). Spatial units support the creation and management of basic administrative units. There are different types of spatial units: sketch-based, text-based, point-based, line-based, polygon-based, or topology-based. The attributes of LA_SpatialUnit are: area, dimension (of the spatial unit), extAddressID (link(s) to external address(es) of the spatial unit), label (a short textual description of the spatial unit, e.g. for local purposes), referencePoint (a coordinate set of a point

Table 6 LA_BAUnit and LIS.UNIT attribute comparison

LA_BAUnit	LIS.UNIT	LIS.UNIT attribute description
Name*	-	
Type	UNIT_TYPE	Identifies the type of unit: full title, sectional title, long term lease, servitude, prospecting contract, mining stand or cession of rights.
uID	UNIT_KEY	System generated unique identifier for the unit.
-	DOOR_NO	Door number of the unit, which could differ from the unit number. Only applicable for sectional title schemes.
-	FLOOR_NO	Floor number of the unit. Only applicable for multi-story sectional title schemes (e.g. flat blocks).
-	LIVING_UNITS	Number of living units (households) on the unit.
-	LEGAL_AREA	Legal area of the unit.
-	PART_QUOTA_PERC	The legal area as a percentage of the total area of the sectional title unit. Only applicable for a sectional title unit.
-	STATUS_SUBTYPE	Status indicator of the unit, i.e. registered, approved, withdrawn, etc.
-	SCHEME_NO	Number of the sectional title scheme. Only applicable for a sectional title unit.
-	SCHEME_NAME	Name of the sectional title scheme. Only applicable for a sectional title unit.
-	UNIT_NO	Unit number in a sectional title scheme. Only applicable for a sectional title unit.
-	SCHEME_YEAR	Year in which the sectional title scheme was registered. Only applicable for a sectional title unit.

Table 6 LA_SpatialUnit and LIS SP_PROPERTY attribute comparison

LA_SpatialUnit	LIS.SP_PROPERTY	LIS.SP_PROPERTY attribute description
extAddressID*	-	
area*	AREA_SQMT	The area as calculated by a cadastral capturing tool.
dimension*	-	
label*	SG_ID	The complete description of the property by land parcel type, stand number, registration division identifier, township number. For example, 'Erf 45 Braamfontein'.
	STAND_NO	Unique stand number within the proclaimed town, e.g. '45'.
	TOWN_NAME_KEY	The foreign key that links LIS.SP PROPERTY to the township name entity (not represented in CoJLIS core of this article).
referencePoint*	-	
suID	PROPERTY_ID	The unique property identifier.
surfaceRelation*	-	
Volume*	-	
-	LEGAL_AREA	This area is captured from the Surveyor-General approved plans or diagrams.
-	LAND TYPE_CODE	The type of land: erf, farm, agricultural holding, etc.
	ACTIVATION_DATE	Date on which this property was activated in the CoJLIS.
	REGISTRATION_DATE	Date on which this property was registered at the Deeds Office.
	DEACTIVATION_DATE	Date on which this property was deactivated in the CoJLIS, e.g. if it is not approved and thus will not be registered at the Deeds Office.
	STATUS_SUB_TYPE	Status indicator of the property, i.e. registered, approved, withdrawn, etc.
	LEGAL_AREA	Legal area of the property.
	LEGAL_UNITS	Units in which the legal area is represented, e.g. ha or m².
	DIAGRAM_HOTLINK	Link to a copy of the document. See explanation in 4.5.

Table 8 LA_AdministrativeSource attribute comparison

LA_AdministrativeSource	LIS.SP_PROPERTY	LIS.SP_PROPERTY attribute description
acceptance*	-	
availabilityStatus*	-	
extArchiveID*	DIAGRAM_HOTLINK	A link to the title deed document.
lifeSpanStamp*	-	
maintype*	-	
quality*	-	
recordation*	-	
sID	-	
source*	-	
submission*	-	
text*	-	
type	-	

A property is identified by a unique property identifier that is made up of an external identifier (SG_ID) and additional digits to represent the complex urban environment of the city. The SG_ID is the identifier of the land parcel (cadastral property) in the Surveyor General's cadastral information management system. There are two types of areas in the LIS.SP_PROPERTY: the legal area and the area calculated by a cadastral capturing tool.

LIS.SP_PROPERTY contains only 2D representations of land parcels, therefore the dimension and volume attributes are not relevant. The surfaceRelation attribute is not applicable, because the COJLIS does not distinguish whether the property is on, below or above the surface.

There are different registered types of property, namely: erven (i.e. cadastral parcels in an urban area), farms (normally associated with rural or areas outside the cadastral demarcations), agricultural holdings and others (refer to the LAND_TYPE enumeration).

In the LADM, the LA_SpatialUnit class has two specialisations: LA_LegalSpaceBuildingUnit and LA_LegalSpaceUtilityNetwork. The LA_LegalSpaceBuildingUnit provides for the registration of legal space in a building as opposed to traditional models where registration of legal space was limited to land parcels only. In the COJLIS, LIS.UNIT may be associated with zero or more buildings (LIS.PROPERTY_BUILDING). A building property has attributes such as a building name, building area, effective date, a status code and living units. The BUILDING_AREA attribute represents the legal space that can be covered by a building.

LA_AdministrativeSource and the COJLIS

Table 8 shows the attribute comparison for LA_AdministrativeSource. The LA_Source and its subclass LA_AdministrativeSource provide information about the availability and type of a source document, e.g. a title deed document for a property ownership right. An optional attribute in LA_AdministrativeSource specifies in which multimedia format the document is available. In the COJLIS, there are no entities corresponding to these two classes, but the DIAGRAM_HOTLINK attribute of the LIS.SP_PROPERTY class provides a link to the external source document.

inside the spatial unit), suID (spatial unit identifier), surfaceRelation (above or below the surface) and volume (in case of a 3D spatial unit). Table 7 shows an attribute comparison between LA_SpatialUnit and LIS.SP_PROPERTY.

LIS.SP_PROPERTY contains information related to the geospatial component of the rights. Sectional scheme and township boundaries are not included here, but are modelled separately in the COJLIS. The property data is captured from approved Surveyor General general plans and diagrams. LIS.SP_PROPERTY has a corresponding attribute for the single mandatory attribute (suID) in LA_SpatialUnit.

However, the link is not yet functional in the COJLIS implementations (i.e. nothing happens when clicking on it). The COJLIS data model is thus incomplete when compared to the LADM requirements about LA_AdministrativeSource.

Association mapping

Table 9 maps LADM associations to the corresponding associations in the COJLIS data model. The associations in the COJLIS are either equivalent or more restrictive than those in the LADM, except for LA_BAUnit's associations to LA_Right and LA_Restriction. In the LADM there is a mandatory association between a basic administrative unit to a right or restriction, but in the COJLIS this association is optional.

Discussion of the results

The study compared the key entities in the COJLIS data model concerned with parties, rights, restrictions and responsibilities, administrative and spatial units of land against the LADM basic classes. While there are corresponding COJLIS entities for the relevant LADM basic classes, there are semantic differences between them. For example, the parties in the COJLIS are modelled as owners. This restricts the inclusion of other parties involved in the land administration process. Another difference is that the COJLIS data model contains descriptive lineage data for the spatial units only, whereas the LADM prescribes timestamps (but not descriptive information) for any change to an instance of most classes.

The duplication of owner name information in LIS.OWNER and the one-way flow of this information from COJLIS to the SAP billing system, results in discrepancies in owner information. For example, when the new owner is filled into the OWNER_NAME attribute but the SAP billing system does not yet reflect the new owner in the other five attributes. Such discrepancies have been the cause of billing problems and bad publicity for the City of Johannesburg (COJ) in the past.

The COJLIS data model includes the relevant mandatory attributes specified for rights and restrictions in the LADM. However, additional information about the property transaction is included for the ownership right in the COJLIS data model.

The identification of the nature of registered rights in the COJLIS is not straight forward. It requires the interpretation of codes used to describe the types of rights. For example, the prefix and suffix before and after the serial number and year in the title deed number specifies the nature of the deed or document. This system of codes originates from the South African Deeds Office. Similarly, the identification of restrictions is a function of interpreting codes.

Information about restrictions on land, such as land use, zoning and building plans, is included in the COJLIS but does not have individual unique identifiers, as prescribed in the LADM. The reason is that these restrictions are managed in different systems at other COJ departments. The disconnection between these systems and the COJLIS is a cause for concern. Additional restrictions, such as coverage of buildings, floor area ratios, building lines and other general restrictions are not represented at all in the COJLIS, which is another cause for concern.

Responsibilities, such as maintenance of the property by the owner, e.g. fencing of the property, are commonly found in the deeds document and in the conditions of township establishment. The responsibility information is contained in the original deed document, but the COJLIS does not include

Table 9 Comparison of mandatory associations in the LADM and COJLIS

LADM Source class	LADM Destination class	COJLIS Source entity	COJLIS Destination entity
LA_Party (0..1)	LA_Right (0..*)	LIS.OWNER (1)	LIS.UNIT_OWNER (0..*)
LA_Party (0..1)	LA_Restriction (0..*)	LIS.OWNER (1)	LIS.ENDORSEMENT (0..*), via LIS.UNIT_OWNER, LIS.UNIT and LIS.SP_PROPERTY
		LIS.OWNER (1)	LIS.PROPERTY_USE (1..*), via LIS.UNIT_OWNER, LIS.UNIT and LIS.SP_PROPERTY
		LIS.OWNER (1)	LIS.ZONING_PROPERTY (1..*), via LIS.UNIT_OWNER, LIS.UNIT and LIS.SP_PROPERTY
		LIS.OWNER (1)	LIS.BUILDING_PLAN (0..*), via LIS.UNIT_OWNER and LIS.UNIT
LA_Party (0..1)	LA_Responsibilty (0..*)	n/a	n/a
LA_BAUnit (1)	LA_Right (1..*)	LIS.UNIT (1)	LIS.UNIT_OWNER (0..*)
LA_BAUnit (1)	LA_Restriction (1..*)	LIS.UNIT (1)	LIS.ENDORSEMENT (0..*), via LIS.SP_PROPERTY
		LIS.UNIT (1)	LIS.PROPERTY_USE (0..*), via LIS.SP_PROPERTY
		LIS.UNIT (1)	LIS.ZONING_PROPERTY (0..*), via LIS.SP_PROPERTY
		LIS.UNIT (1)	LIS.BUILDING_PLAN (0..*)
LA_BAUnit (1)	LA_Responsibilty (1..*)	n/a	n/a
LA_Right (0..*)	LA_Administrative-Source (1..*)	LIS.UNIT_OWNER (0..1)	LIS.SP_PROPERTY, DIAGRAM_HOTLINK (1), via LIS.UNIT
LA_Restriction (0..1)	LA_Administrative-Source (1..*)	LIS.ENDORSEMENT (0..*)	LIS.SP_PROPERTY, DIAGRAM_HOTLINK (1)
		LIS.PROPERTY_USE (1..*),	LIS.SP_PROPERTY, DIAGRAM_HOTLINK (1)
		LIS.ZONING_PROPERTY (1..*),	LIS.SP_PROPERTY, DIAGRAM_HOTLINK (1)
		LIS.BUILDING_PLAN (0..*)	LIS.SP_PROPERTY, DIAGRAM_HOTLINK, via LIS.UNIT
LA_Responsibilty (0..*)	LA_Administrative-Source (1..*)	n/a	n/a

responsibilities. Responsibilities are not required for the first conformance level of the LADM.

In the LADM, there is a mandatory association with a basic administrative unit to a right or restriction, but in the COJLIS this association is optional. The COJLIS does, however, include the two mandatory attributes (type, uID) specified for a LA_BAUnit in the LADM.

The type of spatial units in the COJLIS includes land parcels. These are 2D representations of property boundaries. In the absence of 3D cadastral boundaries, the sectional title units in a flat or multiple-storey building are not accurately represented geospatially. COJLIS does not specify whether the property is on, below or above the ground. One of the attributes of the spatial unit in the COJLIS links to a source document, i.e. a one-to-one association. This association is more restrictive than specified in the LADM, which allows multiple source documents for a basic administrative unit.

The cross-mapping of the LADM basic classes and COJLIS entities revealed that there are semantic differences in terms of class naming and attributes. There are also mismatches and similarities in terms of attributes that are stored in the LADM and the COJLIS. The attribute naming in COJLIS allows different interpretations. For example, the UNIT_TYPE attribute represents types of rights and the ENDORSEMENT entity represents private restrictions registered against the property by the Deeds Office. The ZONING_PROPERTY and the PROPERTY_USE entities contain public restrictions set according to the town planning ordinance applicable to the COJ. Such ambiguous interpretations can cause confusion.

Conclusion

This research compared the COJLIS data model to the LADM, an internationally standardised conceptual land administration domain model. The LADM offers an opportunity for the COJLIS upgrade project to develop an integrated property database model based on international standards. We have shown that the LADM can be used to describe land administration information at a municipality in South Africa, but that there are some semantic differences, as well as similarities and differences between classes, attributes and associations. Semantic differences are evident in the terminology discrepancies between the COJLIS and the LADM. A first step for COJ could be to convert the COJLIS terminology to correspond to the internationally accepted LADM terms and definitions. This would already improve communication about land administration within the city.

The current disconnect between different systems, each managing a different part of the land administration information at the COJ, is a cause for concern. It is our understanding that work on a single integrated system has started.

The results of this research improve the understanding of land administration at municipal level in South Africa, but additional work is needed to describe the deeds and cadastral information produced by the Surveyor General and Deeds Offices, i.e. a full South African profile of the LADM. For example, the COJLIS relies heavily on data received from the Deeds Office, where the type of the deed or document is embedded in the title deed number.

The COJLIS is based on the formal land registration system in South Africa, which deals with registered land rights at the Deeds Office. For this reason, the COJLIS model does not accommodate other property rights that have been created by the South African land reform programme. For the future, the incorporation of informal land rights is critical for the regularisation of COJ informal settlements. The concept of spatial unit could represent informal settlements in the COJLIS. Further investigation into the possible use of the STDM is recommended.

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