Article

ISO 19152:2012, Land Administration

An international 2D and 3D Representation Standard

By Christiaan Lemmen, Rod Thompson and Peter van Oosterom

After more than a decade of modelling and building international concensus, the LADM is now a formal international standard: ISO 19152. The LADM offers a very generic spatial representation model, as it has to be applicable world-wide, for a variety of spatial units (normal land parcels, legal spaces around buildings, legal spaces around networks/utilities). Furthermore, both 2D and 3D and mixed 2D/3D representations are supported with various levels of accuracy: text-based, point-based, unstructured (line)-based, polygon-based or topology-based.

Figure 1: The LADM standard supports both 2D and 3D and mixed 2D/3D representations (source: Wikipedia)

Introduction

The Land Administration Domain Model (LADM) unanimously passed the final vote towards becoming an International Standard (IS). After technical editing by ISO secretariat, the first edition was officially published on 1 December 2012 as International Standard ISO 19152 "Geographic information — Land Administration Domain Model". The LADM can support business process reengineering, with standardized data models. It covers all land registration and surveying source documentation; this means building a complete and full digital cadastre. A major advantage in adopting LADM is the classification and structuring of the Rights, Restrictions and Responsibilities (RRRs). In addition, 3D representations are treated in such a way that these integrate seamlessly with existing 2D registrations.

The LADM standard

The purpose of the LADM is not to replace existing systems, but rather to provide a formal language for describing them. This enables their similarities and differences to be better understood. It is a descriptive standard, not a prescriptive standard. Land administration is a large field; the focus of this International Standard is on that part of land administration interested in rights, responsibilities and restrictions affecting land (or water), and the geometrical (geospatial) components thereof. The LADM provides a reference model. Based on this conceptual model, a more refined country profile can be developed: selecting the relevant classes from LADM and adding country specific attributes, associations or even classes. The LADM covers both the spatial aspects (main class LA_SpatialUnit) and the non-spatial aspects of land administration (main classes LA_Party, LA_RRR, and LA_BAUnit); see Figure 2.

Spatial representation

Within the LADM classical cadastral, concepts such as "parcel" and "boundary" have been extended to include spatial representa-

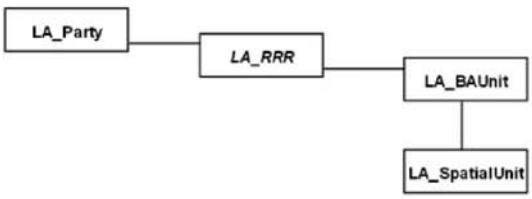

Figure 2. The 4 basic classes of the LADM; from ISO 19152

Domain Model

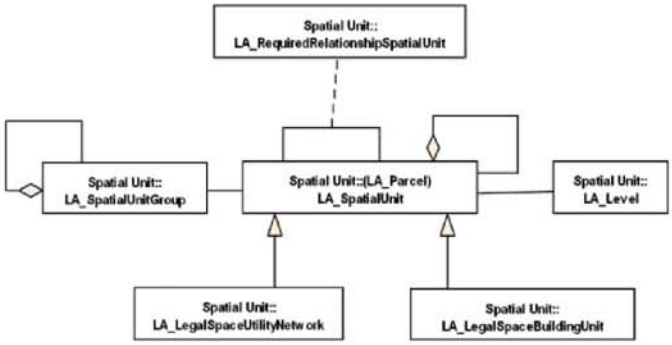

Figure 3. Classes of Spatial Unit Package and associations between them; from ISO 19152

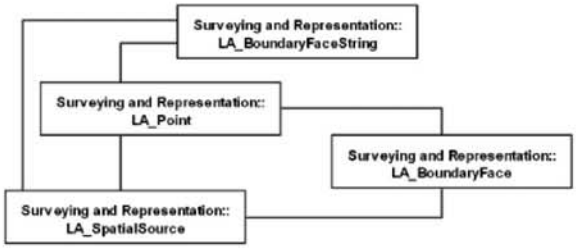

Figure 4. The LA_BoundaryFaceString and LA_Boundary classes of the LADM; from ISO 19152

tions of overlapping tenures or claims and also multidimensional objects: 3D and 2D/3D, combined with temporal dimensions. Text based, sketch, point, line, polygon, or topological based representations of spatial units (parcels) are possible. Spatial units may have a 3D representation, and a provision is made for a mixture of 2D and 3D spatial units to co-exist. A level is a collection of spatial units with a geometric or thematic coherence. This allows for the flexible introduction of spatial data from different sources and accuracies, including utility networks, buildings and other possible 3D spatial units such as marine objects, mining claims, or construction works. The main class of the spatial units' package of LADM is LA_SpatialUnit (with LA_Parcel as alias). Spatial units are refined into two specializations, both of which often have a 3D spatial representation (see Figure 3): 1. building units (LA_LegalSpaceBuildingUnit), and 2. utility networks (LA_LegalSpaceUtilityNetwork).

The 'Spatial Representation and Survey' subpackage of LADM allows a large number of possible representations of spatial units in 2D, 3D, or mixed (integrated 2D and 3D); see Figure 4. The LADM has been designed using key concepts such as LA_BoundaryFaceString and LA_BoundaryFace. Coordinates themselves are rooted in instances of LA_SourcePoint (mostly after geo-referencing, depending on the data collection method used).

In many countries a 2D description should be interpreted as a 3D prismatic volume with unspecified upper and lower bound (see Figure 5; upper left and upper right). Using this interpretation, 2D and 3D representations can be unified. The boundaries in the 2D descriptions are called LA_BoundaryFaceString: they use a normal 2D line string for storage, but these imply a series of vertical faces. For true 3D descriptions, which also have nonvertical boundaries, the class LA_BoundaryFace is introduced. A liminal spatial unit has a combination of LA_BoundaryFaceString's and vertical LA_BoundaryFace's. This method is used for a 2D spatial unit adjacent to a 3D spatial unit, with a split in the shared vertical face.

The concept of levels can be used very well in 3D situations; e.g. level 1 containing ownership (2D, liminal and 3D topological) and level 2 would contain ownership of 'legal space' around utilities crossing many other LA_SpatialUnits from which the utility network space could be subtracted.

In the LADM, 2D and 3D data are treated in a consistent manner throughout the model. It is important to realise that there is a difference between a 3D physical object and the legal space related to this object. The LADM only covers "legal space"; that is, the space that is relevant for the land administration (bounding envelope of the object). This is usually larger than the physical extent of the object itself (for example including a buffer zone). To be able to register the (2D or 3D) parcels in the cadastral registration, all real estate objects must have a survey document (LA_SpatialSource), which should document to what space the real estate object refers.

Example from Queensland

In order to explore the issues associated with the mixture of 2D and 3D parcels, two 3D parcels were encoded and included in the database along with the 2D parcels from the Queensland DCDB. These parcels comprise a bus way, which is partially above and below ground level (identified as Lot 4 on plan SP149278), and a segment of an underground road tunnel, which runs below it (identified as Lot 160 on SP184385).

The encoding of the 3D parcels as spatial units made use of the 2D face strings, which were already in the database and which define the base parcels. Note that this bus way can be seen in Figure 11 at the bottom of the frame. In Figure 12 the face strings are represented as low "fences" at z=0 so as not to obscure the rest of the picture. The face strings and faces for Lot 4 are grey and blue respectively, while those for Lot 160 are light green and cyan respectively.

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For more information, have a look at:
www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=51206