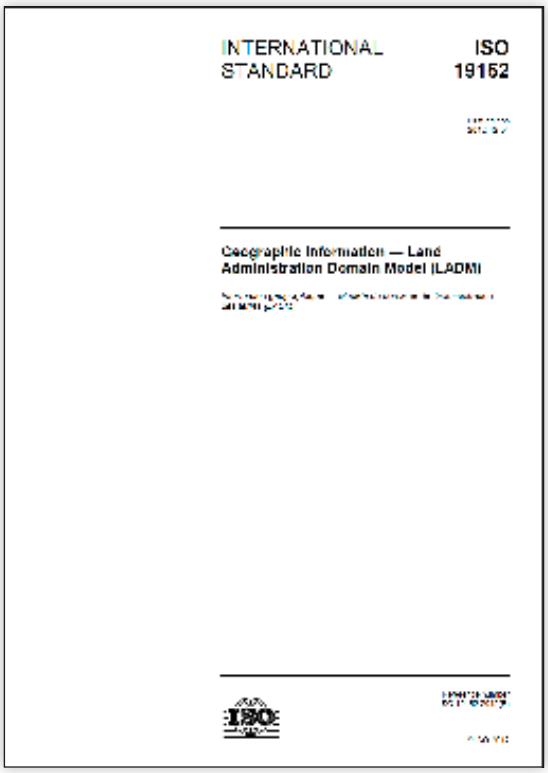
DEVELOPING A SECOND EDITION OF THE LAND ADMINISTRATION DOMAIN MODEL

Trends in **Spatial Domain Standards**

The Land Administration Domain Model (LADM) facilitates the efficient set-up of land administration and can function as the core of any land administration system. LADM is flexible, widely applicable and functions as a central source of state-of-the-art international knowledge on this topic. LADM is of one of the first spatial domain standards. Some future trends in the domain and the maintenance of the standard are presented and discussed here. These trends may be relevant for the development of a second edition of the LADM over the coming years.



▲ *Figure 1, The Land Administration Domain Model Edition I was published in 2012 (ISO 19152). Initial preparations have started for the Edition II.*

The use of information and communication technology (ICT) in society will continue to advance and develop. The authors expect that by the year 2025 meaningful information exchange between different domains or disciplines will be possible at a global, national and local level. This information exchange will be based on several well-established and harmonised domain standards, such as the LADM (see Figure 1). The information infrastructure will provide society with integrated and seamless access to several data sources from different domains. Furthermore, the information infrastructure will provide the environment in which these sources can be maintained in a consistent manner.

INFORMATION INFRASTRUCTURE

Domains will have links with other domains, which require that updates take care of consistency with related registrations. For land administration systems, as the cornerstone of the information infrastructure, these links with other registrations are numerous and include persons, buildings, rights or topography, for example. Satellites can monitor changes, providing information for linking to 'RRR-SpatialUnit' and other data layers ('RRR' stands for 'Rights, Restrictions and Responsibilities'). Inclusion of land administration in global spatial data infrastructures is under debate – among others within the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). A characteristic of all these registration issues is that people, spatial objects or spatial phenomena are important, and so too are the relationships between them.

FOURTH DIMENSION

The increasing complexity and flexibility of modern land use requires that land administration systems will need an improved capacity to manage spatial units in three dimensions, i.e. not only in two dimensions as a representation of parcels on a conventional cadastral map. A temporal (fourth) dimension can be integrated with the spatial dimensions, or as separate attributes. In the long term, for future versions of LADM, an integrated 4D registration of all objects will be the most effective solution. The 4D integrated space/time paradigm, as a partition of space and time without gaps and overlaps (in space and time), is a very generic and solid basis.

SEMANTICS

The differences in legal and other concepts, terminology and languages which are used in the various land administration systems still limit the access to and understanding of land administration data in an international context. However, as with all other kinds of knowledge, legal concepts of the different countries will be formalised using semantic web technology. These formalised semantics are used in mapping between the concepts and terminology from different countries,

Figure 2, The use of high-resolution imagery will become more and more relevant in relation to land administration. (Image courtesy: Kadaster)

allowing users to access all information in an unambiguous and understandable manner. Therefore by the year 2025, thanks to these semantic translators, 'outsiders' such as foreigners – and even machines – will be able to understand and rely on the contents of a land administration system just as easily as natives do.

SPATIAL DEVELOPMENT LIFE CYCLE

When considering the complete development life cycle of rural and in particular urban areas, many related activities should often also support 3D (and temporal) representations. Not just the cadastral registration of the 3D spatial units associated with the correct RRRs and parties, but also activities such as spatial planning, designing, permitting, financing, construction, maintenance and suchlike should be conducted in full 3D. Furthermore, information should be shared among the various phase of the life cycle without too much effort and without information losses. Therefore, several of these activities and their information flows need to be structurally upgraded from 2D to 3D representations. Because this chain of activities requires good information flows between the various actors, it is crucial that the meaning of this information is well defined – an important role for standardisation. Relevant are ISO 19152 LADM and ISO 19156 Observations and Measurements. Also closely related and partially overlapping is the scope of the OGC's LandInfra Standards Working Group, with more of a focus on civil engineering information, e.g. the planned revision of LandXML: InfraGML (to be aligned with LADM). 3D cadastre registration is being tested and practised in an increasing number of countries. For example, for buildings (above/below/on the surface or constructions such as tunnels and bridges) and (utility) networks, the overlap between LADM and InfraGML is clear (in the context of full life-cycle support). LADM is focused on the spatial/ legal side, which could be complemented by civil engineering physical (model) extensions. It is important to reuse existing standards as a foundation and to continue from that point to ensure interoperability in the domain.

COMMUNITY-DRIVEN CADASTRAL MAPPING

The currently established update procedures are expected to be simplified in the future. For example, to split and sell a part of a parcel requires professionals, such as notaries, surveyors and registrars, each performing certain sub-tasks. Based on authenticated identification of persons and trusted reference material (e.g. high-resolution and up-to-date georeferenced imagery - see Figure 2), via web services, seller and buyer draw the new boundaries of the split part of the parcel and complete the transaction. Spatial units that are not yet included can be added in this type of infrastructure – e.g. fit-for-purpose (FFP) approaches are facilitated. The required web services and protocols are currently being developed and implemented, e.g. based on web feature transaction (WFS-T) services. The accuracy of digital reference material will become so high that there is no need to perform an external survey. The reference material can also include the 3D aspect, e.g. in The Netherlands the completed elevation dataset was available in 2012 with an accuracy of 2-3cm, about 10 points per m^2, with nationwide coverage. Integration of outdoor geoinformation with indoor spatial information and building information modelling is underway. The role of local authorities will be to provide the required infrastructure and links to other parts of the geoinformation infrastructure and to perform quality control and validate transactions. Community-based cadastral mapping can be integrated into LADM implementations by its functionalities for source documents for spatial and non-spatial data.

LADM DEVELOPMENT

With LADM and also its specialisation the Social Tenure Domain Model (STDM), information-related components of land administration can be registered worldwide in a standardised way. The standard focuses on flexibility based on a variety of continuums. This concept has several dimensions:

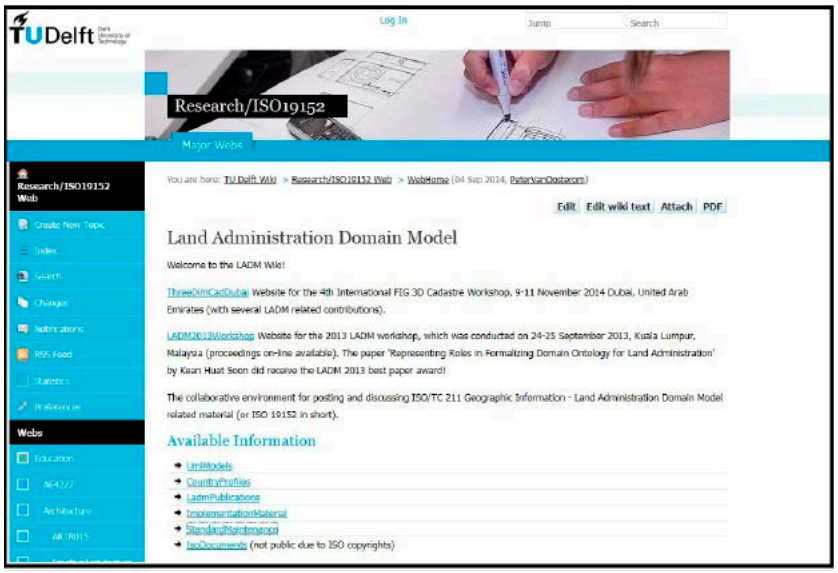
- it recognises that a continuum of tenure exists in terms of social tenure relationships, ranging from formal ownership to occupancy, usufruct, informal

rights, customary rights, indigenous right and nomadic rights
- in the same way, parties holding the rights may not only be natural or legal persons, but could be a family, tribe, community, village or a farmers' cooperative
- the spatial unit may not only be a 2D area (polygon), but can also vary according to where the rights and social relationships apply, e.g. a point cadastre rather than a parcel boundary or 3D volumetric parcel, or it could be text based or photo based
- similarly, one may talk about a continuum of data acquisition methods or technologies that will include what could be called a 'continuum of accuracy'
- another dimension could be a continuum of land recording and credit accessibility, ranging from informal land offices in an informal settlement to a governmental land registry.

This is needed for implementation of FFP approaches in land administration. For example, the FFP approach could use large-scale aerial or satellite imagery or aerial photos showing how land is divided into spatial units (parcels and plots) for specific use and occupancy. The FFP approach focuses on the purpose of the systems such as providing security of tenure for all and managing the use of all land. The land administration system can then be upgraded and incrementally improved over time.

MAINTENANCE AND DEVELOPMENT OF STANDARDS

The LADM standard, as introduced by ISO towards the end of 2012, is now being used and it is inevitable that further issues will arise. These may range from detecting and correcting simple textual errors or omissions to further extension of the standard, e.g. extension of the legal model. These could also include valuation/taxation extensions or moving informative code list values to normative parts of standards, possibly including semantic technologies for more precisely defining code list values, e.g. a semantic hierarchy. Within the standardisation processes there are different methods for handling these issues/requests: the corrigendum for fixing small mistakes, or revisions of the standard for significant changes and extensions by the TC211 of the ISO. In the meantime the LADM Wiki at isoladm.org (see Figure 3) functions as a collective memory.



▲ *Figure 3, The LADM Wiki.*

CONCLUDING REMARKS

It is the vision of the authors that, as we advance towards the year 2025, access to land-related information will be enabled for everybody (via the internet), creating a 'spatially enabled society'. Many ICT-related developments will strengthen the relationship between land administration and other registrations, such as building, address, company and population registrations. Options such as data integration will be aligned with institutional strengthening and development. The highlighted developments can provide the foundation for further development of LADM, where needed. ◀

More information
isoladm.org
www.isotc211.org
www.fig.net

FURTHER READING

- Enemark, S., Bell, K.C., Lemmen, C.H.J. and McLaren, R., (2014). Fit-For-Purpose Land Administration. FIG Guide. Joint FIG/World Bank Publication. *FIG Publication No. 60*, FIG, Copenhagen, Denmark.
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- Steudler, D. and Rajabifrad, A., (2012). Spatially Enabled Society. Joint publication of FIG-Task Force on Spatially Enabled Society in cooperation with GSDI Association and with the support of Working Group 3 of the PCGIAP. *FIG Publication No. 58*, Copenhagen, Denmark.
- Uitermark, H.T., Van Oosterom, P.J.M., Zevenbergen, J.A. and Lemmen, C.H.J., (2010). From LADM - STDM to a spatially enabled society: a vision for 2025. World Bank Annual Conference on Land Policy and Administration, Washington DC, USA, 26-27 April 2010.

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