EXPLORING OPTIONS FOR STANDARDISATION OF PROCESSES AND TRANSACTIONS IN LAND ADMINISTRATION

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Abstract

Processes and transactions in Land Administration are outside the scope of the Land Administration Domain Model Edition I published in 2012. Reason is that processes were considered to be country specific. Generic processes would be too difficult to model. This view needs reconsideration – given developments as Fit-For-Purpose Land Administration, Apps and blockchain.

In many countries different organizations have their own responsibilities in data maintenance and supply, but may communicate on the basis of standardised administrative and technical update processes. Operationalisation and implementation of LADM requires attention to this aspect - at least at conceptual level (not prescriptive). This will an issue in the development of LADM Edition II and this is the issue that is explored in this paper.

Key Words: Land Administration, Standardisation, LADM

1. Introduction

Land Administration in many countries develops and improves over time, the pace at times dictated by the rate of change in technology as much as societal demands. From the geographic, spatial, cadastre and land registry perspective, many tools are available to support and enhance this progress. Relevant in this progress was the development of the ISO 19152 – The Land Administration Domain Model (LADM).

The 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.

In many countries different organizations have their own responsibilities in data maintenance and supply, but may communicate on the basis of standardised administrative and technical update processes. Operationalisation and implementation of LADM requires attention to this aspect: maintenance of land ownership data requires further standardization. This will be at least an issue of discussion in the development of LADM Edition II and this is the issue that is explored in this paper. Are the differences between maintenance processes in land administration systems in different countries so big that standardisation cannot be achieved? Or is it possible at conceptual level to define more generic "modules" with maintenance functionalities as: "reception of a request", "acceptance of an application request", "allocation to workflow depending on type of request (maintenance of data with transactions as buying/selling, establishment of mortgage, inheritance, valuation and taxation)", "update attributes", "send confirmation", etc.? to be implemented in a sequence that meets the requirements of the user. More generic approaches are expected to be feasible – for example based on the use of blockchain technology and modelled semantics.

Processes in land administration vary from regular updating (may be with support of blockchain technology), data collection (administrative data and surveying), to service provision.

Apart from update procedures based on transactions (see section 2) and may be on blockchain technology (see section 3) one can look broader. With modern technology participatory surveying (section 4) is possible where citizens collect the cadastral date themselves – with inclusion of legal/administrative data. Professionals and government representatives have roles in supervision, organisation, data handling and quality management. Participatory surveying is a process. Participatory surveying is also possible with imagery. Generic processes can be designed in support to organising availability of imagery (printed or digital) in the field (section 5). Processes as spatial planning, designing, permitting, financing, construction, maintenance and suchlike require full 3D or 4D (section 6). This fits also for life cycles of buildings and constructions. Infrastructure and semantics are needed for seamless integration of data (section 7) – this is in fact also a process.

2. Update processes

Updates in land administration concern for example: transactions of buying/selling, establishment of rights (including mortgage), subdivisions of parcels (and merging) and also quality improvements of existing data, processing land consolidation and land readjustment.

The currently established update procedures are expected to be simplified in the future. For example, to subdivide and sell a part of a parcel requires the involvement of 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), via web services, seller and buyer design and draw the new boundaries of the subdivided part of the parcel and complete the transaction.

Spatial units that are not yet included can be added to this type of infrastructure – e.g. conversion from social tenure to legal tenure and fit-for-purpose (FFP) approaches need facilitation. The required web services and protocols are currently 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 go outside to perform a survey. The reference material can also

include 3D aspects. 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.

3. Blockchain in support to transactions

The blockchain is a secure mechanism to handle and store transactions in a distributed ledger environment. Once a transaction has taken place it cannot be altered or erased from existence. A transaction is irreversible. An additional advantage is that not only the transaction itself, but also the history of transactions is safely captured, making the data immutable and hence providing trust by definition. Blockchain is also known as the 'distributed ledger'; it is the database that provides proof of who owns what at any given time, and it is publicly available and publicly maintained. A blockchain is transparent. That means: everyone who would like to see the transactions is able to do so and verify the transaction. This makes the process of value exchange visible, so normal people can see any injustice. This development requires co-operation with ICO TC 307 on Blockchain. FIG is involved here.

Smart contracts are contracts whose terms are recorded in a computer language instead of legal language. Smart contracts can be automatically executed by a computing system, such as a suitable distributed ledger system. The smart contract is the layer that fully utilises the potential of blockchain technology. Smart contracts contain the computer code that executes the contract.

The simplest way to use the blockchain is by storing the hash values of documents on the blockchain. The hash value is unique to one document. Using the blockchain in this way can improve the integrity of the land administration mainly because it will prevent illegal changes to the land administration, and by being able to prove the authenticity of documents used in the land administration process and possibly kept by parties involved. Hash values can be included in LADM as identifier of source documents.

The next solution is adding identifying information to the blockchain. Identifiers of subjects (parties) and objects (spatial units) from the source document can be stored in the blockchain. This type of solution requires that objects and subjects can be identified uniquely nationwide and that it is possible to reliable extract this information from the documents stored. The next step is to add the content of the transaction as described in the source document to the blockchain. This can be information on what rights are transferred, the price of the transaction, the location of the parcel and other information relevant to a land administration. Knowledge on the process resulting in a transaction can be added to the blockchain. Process information is information on who has to do what when approving the transaction. LADM has roles already included as well a series of dates as interaction to processes.

4. Participatory Surveying processes

Cadastral survey requires the participation of neighbours, family members where everyone can monitor the on-site process in the field. During the initial field survey, the collected data can be transmitted from the mobile device directly to a cloud-based GIS environment, enabling everyone to follow the process remotely. The field survey is about creating an overview of all existing people-land relationships, including formal ownership and informal land use and also overlapping claims. Owners or claimants are invited to walk the perimeters of their land parcels and to point the vertex points of the boundaries *themselves* holding a GPS antenna. A surveyor or grassroots surveyor records the observations with an App installed on a mobile device. Satellite imagery of the area is displayed on the screen of the mobile device. Data collection is done in an integrated way: the perimeter is stored as a closed polygon together with the claimed type of right, combined with a photo of the face of the owner or claimant, and a photo of the owner's or claimant's ID. A preliminary identifier is used as linking key. The GPS antenna may be handheld-low-accuracy. The walked perimeters identify a boundary from two spatial units. If those are within a pre-defined tolerance the boundary demonstrates agreement.

Accuracy is not so much about the geometry, but is rather focused on linking spatial and administrative data or, in other words, linking people to polygons. The quality of this link is in many countries not so good, because of distributed responsibilities for cadastre and registry.

Since citizens are required to provide proof of their identity in this participatory surveying, the government has to be represented in the field. This is of general importance for the success of this methodology.

An alternative is in drawing the boundaries on top of an image where the owner or user draws the boundaries (in the field or even in office – digital or analogue).

It is crucial to get an overview of areas under dispute and to collect the geometry of the disputed area. 'Dispute holders' need to 'agree' on the area and the location of the dispute. During the adjudication process in the field, disputes may lead to the creation of overlaps between polygons. In that case, those overlaps are mapped and the corresponding authorities know the exact location and the type of land-related conflict. After field data collection, the data must be checked for completeness and prepared for public inspection. Some editing time was needed in order to present the spatial data – this concerned mainly the calculation of average locations of double observed boundaries (surveying by walking perimeters means that boundaries are observed twice).

Usual procedures, such as public inspections, are conducted at village meetings – often in the local town hall – accompanied by trusted third parties. At a village meeting, community members gather to view all the collected data on a map and discuss and reconcile the results. Note: imagery can be collected from satellites, traditional aircraft or unmanned aerial vehicles (UAVs).

Digital pens may be used. Such pen can be used to draw identified boundaries on a paper with printed imagery. The paper is prepared and coded – the pen can read identified pixels on the paper image. This means that all drawn lines can be uploaded to a computer and visualised overlaying the digital version of the georeferenced image.

Community-based cadastral mapping can be integrated into LADM implementations through its functionalities for source documents for spatial and non-spatial data.

5. Generic processes supporting use of imagery

Processes such as initial data acquisition may concern millions of spatial units (amongst them parcels) where people-land relationships have to be determined, documented and reviewed before publication can be organised.

The geographic data/software industry provides tools, products and services to support a number of processes required in Land Administration. Image-based acquisition of cadastral boundaries needs access to huge image libraries – including historical imagery – to support large-scale implementations. Detection and selection of cloud-free imagery is needed to create cloud free compositions, possibly from different sensors. Data collection based on imagery can be done in the field or during public meetings – where people identify the spatial unit on top of the imagery. In the latter case there may be a higher risk on interpretation errors. This could be reduced by inviting neighbours identifying their spatial unit independently.

By using orthophotos to produce spatial frameworks, the imagery is typically linked to the national geodetic reference frame through GNSS. Furthermore, automated feature extraction and feature classification appear to be very promising developments for the generation of coordinates from visual objects in an imagery, as well as Lidar and radar technologies can also be used for this purpose. 'Pre-defined' boundaries resulting from feature extraction may be plotted on paper or visualised in interfaces, and can then be declared identical to cadastral boundaries in the field.

6. Integration of the 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, is a very generic and solid basis.

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 (or 4D). 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.

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) and was already discussed in the LADM Workshop held in Delft, The Netherlands, in March 2017. 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. Data sharing means the data is collected once and used many times through establishing linkages with for example SDIs. Duplicative efforts in data collection and maintenance can be avoided. Data has to be 'kept at the source'.

7. Infrastructure and semantics

The use of information and communication technology (ICT) in society will continue to advance and develop. The authors expect that 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. 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.

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.

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, allowing users to access all information in an unambiguous and understandable manner. Therefore by the year 2025 or so, 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 easy as natives do.

8. Concluding remarks

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 – on land rights, spatial units and accuracy. All this is needed for the implementation of FFP approaches in land administration. 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.

Further steps are needed to operationalise those FFP methods and related processes, at scale. The Open Geospatial Consortium initiated such development and there is cooperation with the International Standardisation Organisation in this respect. This development requires, apart from attention to data models, also attention to process models to support data maintenance and transactions in land administration. If this could be included in a new edition of LADM there would be a basis at conceptual level (not prescriptive) and allowing understanding of each other's processes.

The highlighted developments can provide the foundation for further development of LADM, where needed.

Further reading

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