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Reform of Icelandic Cadastre

Spatial delimitation of ownership rights remains absent from the land-registration procedure in Iceland, resulting in confusion. Increasing value of land has, among other issues, induced the need to move from a partially descriptive cadastre to a fully spatial one. The authors present considerations surrounding how to proceed with reform. Land registration in Iceland is administered by the government through the Land Registry of Iceland (LRI), under the auspices of the Ministry of Finance. At regional level, municipalities and Land Registry offices supplement these bodies. The LRI has a complex role and services many ministries.

Land Registry
The primary function of LRI is to register units of real property. Auxiliary functions involve conducting property valuation and assessment, conducting reconstruction and insurance valuations, and providing data for taxation and economic statistics such as price indices. It also provides various institutions with certified statements on property ownership, and administers and operates the Land Registry Database (LRD). The LRI collects and evaluates spatial data concerning boundaries and buildings; however, spatial data remains separate from the registration process and there are no tools in place through which this information can be visualised and explored. It has now been decided to take the first steps towards development of a spatial component in the LRD.

Descriptive Cadastre
Both the market and changing land practises create reasons for reform. As property prices rapidly increase, every square metre counts and so detailed cadastral mapping grows in significance. The majority of farms are defined simply by textual boundary descriptions, many of which date from the late 1800s and employ local place-names. But this approach is no longer feasible; place-names change and younger generations are not so familiar with the landscape and its history as were their ancestors. What is more, the landscape itself has often been changed dramatically by cultivation and natural influences over time. In some cases properties have never been spatially located, or the knowledge needed to decipher descriptions has been lost (the text box shows an example of a boundary description). The need for an efficient cadastre has also been highlighted by a debate centring on farmlands being bought up, subdivided or agglomerated and sold for purposes other than agricultural. A nation-wide cadastral map would provide a more efficient tool for regulating such changes in land use. At present many different bodies are involved in collecting boundaries, whilst co-ordination is lacking; this can result in data being acquired on the same boundaries by different bodies using differing methods and disparate sources and quality parameters. A cadastral map would help to prevent such duplication and reduce possible confusion.

Spatial Cadastre
The proposed reform addresses issues including conversion of all hard-copy data into digital format, development of a cadastral map, and streamlining of information flows. The LRD is an information service and data-management system which supports the recording of information on land, land parcels and properties, buildings, addresses, mortgages, values, etc. throughout Iceland. The LRD comprises four components and it is envisaged that the cadastral map will form the fifth, replacing diverse data sources currently used to delimit land (Figure 1). The LRI possesses or has access to a wide range of geographical data of diverse quality. The accuracy, coverage and availability of these spatial datasets vary particularly when it comes to land boundaries. Primary data sources are the address repository, the farm-boundary database, Land Information Systems (LIS) belonging to some municipalities, government institutions, and private companies. A cadastral map would also provide an essential tool allowing support of complex spatial analyses, validation of existing property data, support in data creation and maintenance and efficient property valuation, integration of zoning plans, and development of new services providing new sources of income.

Reform Plans
The main goal is to develop a cadastral map as an integral part of the LRD and enhance its potential for better land administration. This implies a re-engineering of the current registration model. There currently exists no model that describes the registration system in detail, whether database or procedures (activities, roles and responsibilities). This has caused difficulties, as the understanding of certain terms and definitions (ontology) varies from one division to another and the LRD is structured such that any minor change within a class can affect diverse aspects of the database. The system thus needs to be redesigned using a more Model-Driven Approach (MDA) to define the foundation packages and specify how they interrelate while remaining independent from each other. In a country where the ratio of landmass to population is large, complete and detailed mapping of cadastral entities is too big a project to complete in one attempt. Ambition is great but resources scarce. The intention is thus to emphasise parcel boundaries, the extent of structures coming as second priority; these can always be located via their implicit link to parcels. Systematic surveying is required. The laws on cadastral registration are many and out of date and need adjustment to the new era of cadastral registration. Many regulations related to implementation are required, such as certification of cadastral surveyors.

Data Model
The FIG Core Cadastral Domain Model (CCDM) provides for five stages through which the geometry of a parcel progresses within the

cadastral database: (1) text parcel, (2) point parcel, (3) general boundaries, (4) fixed boundaries and (5) 3D-parcel. Three-dimensional cadastre is not currently planned, but the MDA approach allows for the possibility of including it in the future. The CCDM covers cadastral registration by various organisations based on interoperability and MDA. Packages within the CCDM are legal/administrative, immovable object classes, geometry and topology. Representing parcels as simple polygons is at first glance the most obvious method. Examined more closely, however, it is seen not neâ€“cessarily to be the most practical. It means storing the same boundary in two adjacent polygons, causing data redundancy; inconsistency is introduced if two polygons always have to be adjusted in order to fix one boundary, and there is complex computation of relationship queries. It is also impossible to attach survey data to boundary polygons. The use of a topological spatial model in place of a simple geometrical one would solve these problems but is much more complex to implement. The proposal is to build upon the spatial model used in the CCDM and outlined in the ISO-19107 Spatial Schema.

Boundary Types

The spatial database will be stored centrally at the LRI, and the same concept employed as has been used for updating the cadastral register over the last few years. This means client-server technology. Users will connect remotely to the database and use a specially designed map client to submit updates or changes to boundaries. The natural features of the Icelandic landscape are in constant motion and change in extent and shape. This can affect the location of boundaries. In the CCDM, fuzzy boundaries may be employed and applied in such circumstances. The CCDM supports this concept using history attributes, but an approach using specially defined boundaries would be more appropriate. One way to adapt the CCDM to Icelandic requirements would be by conceptually defining a number of new boundary types (Figure 2). Boundaries the veracity of which has not been established, designated general boundaries can be identified only by further research. Fixed boundaries have been surveyed according to requirements as defined in laws and regulations. Dynamic boundaries are boundaries between public and private lands subject to change over long periods, such as coastline change, glacial movement or due to individual events such as volcanic activity. These boundaries are considered fixed at each period of time.
Fuzzy boundaries are those subject to more attenuated periods of change on a smaller scale; riverbeds are an example. Fuzzy boundaries can also be used to indicate areas of conflicting interests.

Concluding Remarks

For the completion of the project it is vital to ensure that there is sufficient financial support and capacity, that the project sticks to its schedule and that the legal environment is in place on time. Without a proper legal and organisational framework the system might not function as planned. The project also has to be introduced to geo-society, and in particular to stakeholders. Finally, property owners and taxpayers will need to understand its benefits. A well-laid foundation will ensure a strong future or, as Prof. Williamson once remarked, â€œA key to success is to start simple but incorporate sufficient components to allow the system to evolve and grow to serve multipurpose uses in the futureâ€.

Further Reading

â€¢ Lemmen and van Oosterom: The FIG Core Cadastral Domain Model, GIM International, November 2006.
â€¢ United Nations, 2005, Land Administration in the UNECE Region â€“ Development, Trends and Main Principles, Economic Commission for Europe UNECE, United Nations, Geneva.
â€¢ Williamson, I, 2001, The Evolution of Modern Cadastres, FIG Working Week 2001, Seoul, Korea.

Textbox:

Boundary Description: ArnarbÃ¦li, GrÃmsnes

Corner monument: the ruin close to Heidrimakelda spring, south of OddholtsmÃºla mound; from where there is a line of sight west to HÃ©dinslÃ¦kjabotnar hollow. From here the boundary follows HÃ©dinslÃ¦kur creek, and then HÃ¶skuldslÃ¦kur creek to the HvÃtÃ¡-river. To east of the above mentioned ruin close to Hedirimakelda spring the boundaries run south to verkelda spring, which runs from GaltatjÃ¶rn pond...(Source: National Archives of Iceland, 1884).