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Editorial

Cadastral Systems IV

This is the fifth of a series of theme issues on 'Cadastral Systems' in Computers, Environment and Urban Systems (CEUS: Lemmen & van Oosterom, 2001, 2002, 2003, 2004). The focus in this issue is on standardisation in the cadastral domain. A cadastral system entails land registration (the 'administrative/legal component'), and georeferenced cadastral mapping (the 'spatial/surveying component'). Together these components facilitate land administration, and a land-registry/cadastral system provides the environment within which the process takes place. In this editorial we review a range of recent developments and issues.

1. Standardisation in the cadastral domain

One of the main dilemmas in the cadastral domain involves the lack of a shared set of concepts and terms. International standardisation of such concepts, that is, the development of a common ontology, could potentially resolve many problems. Motivations behind standardisation efforts include meaningful exchange of information between organisations and efficient, component-based, system development through the application of standardised models.

Data is initially collected, maintained and—probably the most relevant issue in standardisation—used and updated within a distributed environment. In principle this means that data could be maintained by different organizations, such as municipalities or other planning authorities, private surveyors, conveyancers and land registrars—depending on local traditions. Standardization of the cadastral domain is in the initial phase and many non-co-ordinated initiatives have begun to emerge.

1.1. Standardisation in the cadastral domain

A workshop on 'Standardisation in the Cadastral Domain' took place at the University of Bamberg, Germany, on 9th and 10th December 2004. The workshop was held in the

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context of the European COST Action G9 'Modelling Real Property Transactions' and jointly with FIG Commission 7 'Cadastre and Land Management'.[1]

As indicated above standardization of the cadastral domain serves several purposes. In order to develop this, the workshop brought together representatives from different communities and disciplines involved in the cadastral domain: legal specialists, surveyors, ICT-specialists, etc. from different organisations (land registry and cadastral organisations, standardisation institutes, industry and academia). An initial model has been developed based on the results of a first workshop (Lemmen et al., 2003) and this was an input to the Bamberg workshop. However, the workshop was not limited to this specific model alone and also included:

1. efforts at the national level that do not (directly) aim at an international standard,
2. work that goes beyond the current scope of the core cadastral model and addresses, for instance, process modelling.

The general goals for this workshop were to bring together the different communities, publish the results and standardise the cadastral domain model; the specific goals were as follows:

- to further develop administrative/legal aspects of the model, such as: rights of persons to lands, customary and so-called 'informal rights', 3D aspects, legal and survey-based source documents;
- further formalisation of the model (semantics, ontology, knowledge engineering);
- to test the current model in different countries, i.e., evaluation; and
- to involve the geo-ICT industry and standardisation institutes in support of implementations of the model.

Of great importance for the implementation of interoperable cadastral and land information data is the Land Information Initiative of the Open Geospatial Consortium (OGC), covering among others the translation between LandXML and Geography Markup Language (GML) XML encodings of relevant object classes.

1.2. Developments and outcomes

The workshop brought together 61 experts from nineteen countries, all representing various communities and disciplines involved in the cadastral domain. Twenty papers were presented, with keynotes from Andrew Frank, Austria, and Jürg Kaufmann, Switzerland. A fundamental question was, should there be one general legal model or many models?

[1] *COST*—the acronym for European *CO*operation in the field of *S*cientific and *T*echnical Research is the oldest and widest European intergovernmental network for cooperation in research. Established by the Ministerial Conference in November 1971, COST is presently used by the scientific communities of 35 European countries to cooperate in common research projects supported by national funds.

FIG—the International Federation of Surveyors was founded in 1878 in Paris. It is a federation of national associations and is the only international body that represents all surveying disciplines. It is a UN-recognised non-governmental organisation (NGO) and its aim is to ensure that the disciplines of surveying and all who practice them meet the needs of the markets and communities that they serve. It realises its aim by promoting the practice of the profession and encouraging the development of professional standards.

Common steps in workflows had to be identified, involving modelling of the legal situation in different countries. During the workshop it was concluded that a single standard model might not be possible but a core model based on common concepts should be achievable: the Core Cadastral Domain Model (CCDM). There should be a common set of concepts, allowing communication across boundaries. From the reported tests in and between different countries it was concluded that no two systems are alike.

The issues involved in a CCDM are now the subject of scientific debate; further activities have to be identified in an international context, including developing countries, together with the ICT industry, academia, COST, EULIS (the European Land Information Service, www.eulis.org) and professionals, and with a strong focus on and involvement of users. The CCDM might become the centre of a complex with interfaces, data exchange and interoperability. The market will drive the Geo-ICT industry; models will be developed as and when they are needed. Semantic aspects also require further attention. From a European prospective, it can be expected that financial institutions such as banks, mortgage lenders and security firms, amongst other users, will drive development of a CCDM—but who will assume the lead role? It was felt that an authority such as the FIG, with its well-established network, would need to drive development of the CCDM. A co-ordinating group was also needed. 'Model boundaries' (what should and should not be included) required further investigation; rights, restrictions and responsibilities related to land should be included, as well as extension of fiscal rights and responsibilities. It was of the utmost importance to better communicate and disseminate the concept of the CCDM.

Whilst access to data, its collection, maintenance and updating should be facilitated at a local level, the overall land information infrastructure should be recognized as belonging to a uniform national service so as to promote sharing within and between countries. There was a need for a CCDM in which the associations between classes of objects, attributes and operations could be specified for different local tenure systems. To summarize, a standardized CCDM will thus serve at least two important goals: it will avoid re-inventing and re-implementing the same functionality over and over again, instead providing an extensible basis for efficient and effective cadastral system development; and it will enable stakeholders, both within any country and between different countries, to engage in meaningful communication based on the shared ontology implied by the model.

2. Overview of the papers selected for this issue

This issue of CEUS contains a selection of papers presented during the Bamberg workshop and peer reviewed following it. From these the best papers were selected and this special issue contains revised versions of the workshop papers.

Heß and de Vries present a prototype query translator for the cadastral domain. The missing possibility of exchanging cadastral information between different countries in an efficient way leads to rather complicated procedures of collecting and analyzing cadastral data in land transactions with multinational parties. In their paper, they propose an approach to query translation based on the core cadastral model (Lemmen et al., 2003), which serves as connecting piece between various national cadastral systems. They show, by demonstrating a query translation from one national cadastral model into another, that interoperability between cadastral systems conforming to a core model can be achieved. A prototype Query Translator demonstrates the practical utility of their approach.

Further they recommend including (postal) address for search purposes, and providing more classes for groups of attributes in core and national cadastral models. These complex data types group 'attribute classes' that belong together. Candidates are for example: Address, PersonName, OrganisationName, PostalAddress, LocationAddress, ParcelNumber, etc. They state that harmonisation of attribute values would improve query translation.

Heß and Schlieder observe that reference models, often called core models are developed in various application domains. No computational support has hitherto existed for the task of verifying the conformity between core models and their respective domain models. The approach developed at Bamberg University uses semantic web technologies to examine whether or not a domain model is a derivation of a core model. This ontology-based conformity verification supports an iterative modelling process in which core or domain models are modified. Inference services as provided by ontologies can be used to analyse the relationships between core and domain models Heß and Schlieder suggest the CCDM must be refined in close cooperation with experts for the national cadastral systems who, in turn, must be willing to modify their national model in order to achieve conformity. It is important to discuss core and national cadastral models using the same level of abstraction. The core model is considered to present a promising approach to standardisation in the cadastral domain, since it can be adapted to local requirements using domain models and data may be exchanged between national organisations using the minimum common data of all domain models.

Hespanha, van Oosterom, Zevenbergen and Paiva Dias describe the implementation of an object oriented, conceptual cadastral model, adapted to the Portuguese Cadastre and its related real estate register. They describe how UML (Unified Modelling Language) literate modelling was used to represent top-level classes through a structured mix of UML Class Diagrams and natural text. The important contribution of this paper is the evaluation of the FIG core cadastral model to the Portuguese case. It turns out that a limited number of the classes of the core model are not currently needed (but some of them might be used in the future) and that other classes are necessary to accommodate the Portuguese case. Many similar cases are discussed in UNECE (2004).

Astle, Mulholland and Nyarady evaluate the Cadastral Data content Standard developed by the US Federal Geographic Data Committee (FGDC). They observe the need for a more comprehensive list of attributes (such as date of submission, registered date, source documents, etc.). They provide detailed and extensive examples of attributes that might be included based on the FGDC standard.

Steudler observes that in Switzerland, the need for a standardized data exchange format for cadastral data was first expressed in 1987. The requirement for a clearly defined data model that can be adapted in flexible ways leads to the concept of a specific data description language, with which the whole cadastral core data model was defined. The data description language was named INTERLIS, while the data model for cadastral surveying became known as AV93, enacted in 1993 with a Federal ordinance. The requirements for the core data model as well as the data description language subsequently evolved. INTERLIS has been developed in a number of ways and became INTERLIS2 in 2003. A revised core data model, DM.01, was adopted in 2004. The concept of the INTERLIS data description language is very similar to GML/XML, and this paper describes the experiences made with INTERLIS and the cadastral core data model in Switzerland over the last 15 years. It also includes two case studies of practical applications.

Wallace and Williamson describe how past use of the Australian land registration system to manage bureaucratic controls, permits, licences and regulations has had substantial negative and unforeseen consequences. Land registration is now used, or is capable of being used, to provide building and planning officialdom with opportunities for enforcement of controls upon: standards relating to chemical hazards; wiring and electricity installations; cable capacity; business compliance; domestic safety standards; plumbing, heating, building permits and certificates; registration of plumbers, builders and electricians; and other administrative functions. This prospect of accommodating public regulation management within a Torrens type register appears especially attractive to those who require evidence of certificates or installations in premises at the time of sale, as a means of enforcement of regulations which would otherwise likely be avoided.

The capacity of cadastres has increased in recent years, yet the process of cluttering the register in the interests of assisting day-to-day enforcement of restrictions and regulations remains a real issue. Governments are making more regulations, not less and some of the more open-ended or multi-faceted restrictions and responsibilities (RRs) are problematic in the context of cadastral modelling. A key question is then how or why new RRs might be incorporated into a cadastral fabric when they are not clearly identifiable characteristics of physical objects with precise spatial coordinates. The problems associated with RRs are thrown into sharp focus by management of the marine environment with the assistance of marine cadastres. Such applications highlight the clash between cadastral certainty and rigidity (seen in its focus on defined parcels, or on realisable spatial definitions) and management needs, technical capacities and fuzzy, natural and other kinds of boundaries.

van Oosterom, Lemmen, Ingvarsson, van der Molen, Ploeger, Quak, Stoter and Zevenbergen present the latest version of the Core Cadastral Domain Model and an overview of the other results of the workshop. Besides the three well-known concepts, Parcel, Person and Right, at the class level the core model also includes immovables such as Building and OtherRegisterObject (geometry of easement, like a right of way, protected region, legal space around utility object, etc.) and the following concepts: SourceDocument such as SurveyDocument or LegalDocument (e.g. deed or title), Responsibilities, Restrictions (defined as Rights by other Person than the one having the ownership Right) and Mortgages. At the attribute level of the model the following aspects are included: SalePrice, UseCode, TaxAmount, Interest, Ranking, Share, Measurements, QualityLabel, LegalSize, EstimatedSize, ComputedSize, TransformationParams, PointCode, and several different date/times. The heart of the model is based on three classes: RegisterObject (including all kinds of immovables and movables); RRR (right, restriction, responsibility); and Person (natural, non-natural and group). The model supports the temporal aspects of the involved classes and offers several levels of Parcel fuzziness: Parcel (full topology), SpaghettiParcel (only geometry), PointParcel (single point), and TextParcel (no coordinate, just a description). The geometry and topology (2D and 3D) are based on the OGC and ISO/TC211 standard classes. The model is specified in UML class diagrams and it is indicated how this UML model can be converted into and XML schema, which can be used for actual data exchange in our networked society.

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