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Editorial

Cadastral Systems II

In the fall of 1999 the guest editors distributed a call for papers for a special issue on 'Cadastral Systems' of the journal of *Computers Environment and Urban Systems* (CEUS). This resulted in 25 actual submissions and promises of others which could not meet the original deadline. Following careful peer review, 10 papers were selected and published in a double issue of CEUS (Lemmen & van Oosterom, 2001). The editorial of that issue concluded with a further call for papers for a second special issue again on the same theme. Again, the response was very good and the result of the review process accompanies this editorial. This provides a clear indication of the level of current scientific interest in the area of cadastral systems and the pace of associated developments!

The main focus of most of the papers in the first special issue could be characterised as 'conceptual'. In this second issue there is more balance because some more technical papers are included. Once again we want to stress that a cadastral system covers both land registration (the administrative/legal component) and the cadastral map (the spatial component). The (combined) process is called land administration and a cadastral system is the environment in which this process takes place. As guest editors, we are aware that the interest in developments in cadastral systems worldwide remains high, so we intend to produce a third special issue in the not-too-distant future. Please do not hesitate to contact the guest editors if you wish to submit a paper in this knowledge domain. The third special issue will be preceded by an even more specialised special issue, namely on '3D Cadastres'. In November 2001 the International Workshop on '3D Cadastres' was organized as part of the activity of Commission 7 (Cadastre and Land Management) and Commission 3 (Spatial Information Management) of the International Federation of Surveyors (FIG) in Delft, the Netherlands (van Oosterom, Stoter, & Fendel). Out of the 24 papers of the proceedings of the workshop, the programme committee identified the best papers and the authors have been requested to submit a revised version to CEUS, based on the comments of the programme committee and on the comments of three reviewers for each paper. The possibility to register property-objects in three dimensions efficiently (including under and above the surface) will facilitate the separate use of spaces. It should also stimulate the improvement of legal security of rights with regard to spatially complex 3D-objects.

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1. Geo-ICT

Framework datasets like cadastres, but also coverage data pertaining to soil, land-use, hydrography, geology and transportation are all necessary tools of effective government. Framework data provide information on people and the land where they live and work. They supply information on the location of administrative boundaries and of objects like buildings and roads. They provide information on soil-type and pollution, ownership (land tenure), value and use of the land as well as geological information. Framework data/information can help governments to determine how to deal with land in their policies to combat poverty, to achieve sustainable settlement goals and to manage natural resources (Groot & McLaughlin, 2000).

The processes of production, provision, use, maintenance, exchange and sharing of these data are complex in nature. Large data volumes have to be managed using database management technology and geographic information systems (GIS). The same holds for the foundation data-sets like geodetic control, national digital elevation models, orthoimagery and topographic templates. The managers of framework and foundation data are not only the custodians of cadastres, but also national mapping agencies, geological surveys, soil surveys, ministries, land use planning institutes and large municipalities. This second special issue is published at a time when the influence of the recent developments in the Geo-Information and Communication Technology (Geo-ICT) and the effect of these developments on cadastral systems has become more clear then ever before. Recent developments in Geo-ICT have important implications for the development of cadastral systems and Geo-Spatial Data Infrastructures (GSDI) surrounding cadastral systems. Both theoretical and practical developments in ICT in general, and specifically the advent of ubiquitous communications (the Internet), improvements in data base management systems (DBMS) and modelling, and more precise positioning systems can improve the quality, cost effectiveness, performance and maintainability of cadastral systems. Further, the users and the industry accept the standardisation efforts in the spatial area by the OpenGIS Consortium and the International Standards Organisation (e.g. the ISO T211 Geographic Information/Geomatics). This has resulted in the introduction of new spatially enabled ICT tools, such as eXtensible Mark-up Language/Geography Mark-up Language (XML/GML), Java (with geo-libraries), Unified Modelling Language (UML), object/relational Geo-DBMS (including both simple geographic features and topology management).

It is the first time that such a set of worldwide-accepted standards and development tools are available (UML, XML, OpenGIS standards). This creates new perspectives in both the development of new cadastral systems and in the improvement of or extension to existing cadastral systems. At the moment, the first Internet-GIS applications are already operational in a cadastral context. In the near future this will be extended to mobile GIS applications based on cadastral information in the framework of Location Based Services. Imagine a user ‘on the street’, such as a civil servant of the municipality, a real estate broker, or a police

agent, with a mobile device, using up-to-date cadastral information for their day-to-day tasks: 'who is the owner of this building?', 'when was this building sold and what was the price?', etc.

2. Overview of the papers

The first paper by Van der Molen (Netherlands Cadastre and Public Register Agency) addresses the dynamic aspect of Land Administration as an often forgotten component in system design. Initial adjudication and cadastral mapping basically record land tenure as it exists at a given moment, i.e. a static situation. The paper aims to analyse developments that might occur in a society with respect to tenure (e.g. by integration of indigenous rights to statutory system or in land reform processes), value (changes by autonomous developments, e.g. changing market values because of governmental land policies; or changes as a consequence of planning processes) and land use (e.g. changes because of human behaviour). The legal framework and public administration should be adaptable to dynamic representation, as should be the operational structure in terms of organisations and procedures. Where ICT is involved as a supporting tool, ICT support for these procedures should therefore be adaptable too. Special attention should be paid to the specification of the system (data models, processes, workflow) so that it ensures the responsiveness of the system to both spontaneous and planned developments concerning land in a society.

Anticipated further developments in cadastral systems is the subject of the paper by Robertson (New Zealand). There are a number of major developments that herald further substantial change in the form and function of cadastral systems around the world. This paper considers these factors, current international goals, and the opportunities and threats that arise in areas of impending major change. There is a need for much further consideration of the continuing role of cadastral systems and the strategic responses that need to be made to accommodate pending innovations. Four major directions of change have been identified as particularly relevant to the future administration and operation of cadastral systems. These are globalisation, the advent of fully automated cadastral environments, improved decentralised methods of governance and ensuring markedly improved service delivery of future cadastral systems to the users. The key requirement is how to use the forces for change to strategically transform cadastral systems.

In the next paper by Silva (University of Lisboa, Portugal) and Stubkjær (Aalborg University, Denmark) a review of methodologies used in research on cadastral systems is presented. The main purpose of this paper is to contribute to the acceptance of research methodologies needed for cadastral development, and thereby enhance theory in the cadastral domain. An additional motivation is the fact that the methodologies used for research should be considered in the education of geodetic surveyors. To our knowledge, this is the first review of this nature. The paper deals with a complex and pertinent issue that needs to be addressed if future researchers are to produce results that are based on some general accepted communality of approach

and discipline. It becomes apparent that cadastre management will have to relate to neighbouring fields of knowledge in a more substantial way, in order to gain recognition as a discipline in its own right.

The next two papers are of a more technical nature. Lu and Shih (National Chiao-Tung University, Taiwan) present a paper on Parcel boundary identification and Fradkin and Doystsher (Technion—Israel Institute of Technology) give a contribution on the analytical reconstruction of parcel boundaries. In both papers methods are presented to reconstruct boundaries from existing cadastral maps. This is a complex process, because the geometric quality of the maps is not optimal in all cases. This is one of the reasons for the creation of inconsistencies with the real location of boundaries in the field. Good reconstruction methods are a requirement, because of the legal validity of the maps (together with source documents originally made up in the field). This type of reconstruction is not available in standard GIS software and thus has to be developed as an add-on. Both approaches have been tested and have proven to be workable and efficient. It is plausible that both methods can be used in many other countries with large sets of existing cadastral paper maps of poor quality, which will likely be computerised in the near future.

The paper by Bittner and Frank is also related to the quality of cadastral data, but now from the perspective of maintenance of 'correctness'. A formal model of correctness in a cadastre is presented. 'Correctness' entails maintaining the correspondence between the valid legal situation and the contents of cadastral databases. A modern version of the language of situation calculus is applied to model changes by named actions and events. Transaction of ownership on a parcel between two persons is used to develop and implement a model for correctness. This model helps to support a better understanding of cases in which incorrectness can occur in cadastral systems.

Morad's (Kingston University, United Kingdom) paper on British Standard 7666 as a framework for geocoding land and property information in the United Kingdom seems to be a little outside the scope of the theme 'cadastral systems'. But here information supply from property databases in a value adding chains comes in. The use of British Standard 7666 in practice is analysed and appraised.

3. First special issue on cadastral systems in CEUS?

Now that the first special issue on 'cadastral systems' has a successor (and more are expected) we do need to set one thing straight: the first special issue was not really the first special issue of CEUS on cadastral systems. Many years ago there was already a special issue on this topic (MacDonald Barr & Mayer, 1984). Readers are encouraged to obtain this copy from the library and see for themselves how much or how little progress has been made. Reading this old copy of CEUS some interesting resemblances with the current situation can be found, as well as the inevitable differences consequent upon progress in the intervining years. One of the resemblances is that the guest editors, MacDonald Barr and D. David Moyer, also noticed the lack of uniform terminology (as we did in our first special issue). Further, it was also a double issue, just as the more recent special issue, and the problems described were

related to the difficult organisational setting of cadastral systems (many organisations, offices, departments involved in using and updating the system). Also two decades ago there was an important gap between the graphic/geometric and the administrative component of the systems. It should be noted however, that computer graphics devices were not of course as common as today. Also, the DBMSs did not offer support for spatial data management as is usually the case today. One final resemblance is that cadastral registrations do not inhabit an isolated island, but are surrounded by other registrations: for example topographic mapping is treated in both the historic and recent special issues.

Now coming to the noticeable differences between the historic special issue and the more recent special issues, among others: the systems were called 'land records systems', the main focus was local government, and all authors originated from North America. In the current special issue the authors are from all over the world and there is a lot of attention to development and implementation of cadastral systems in developing countries. In the timeframe of the historic special issue, CEUS was the membership journal of URISA and the special issue was the result of the URISA's Land Records SIG formed in 1983 (today there exits a specific URISA[1] journal). The papers in the historic special issue were organised in four categories: (1) design of land records systems intended for different major users, (2) developing (implementing) integrated land records systems, (3) data sources and standards and (4) organising the land records curriculum. These topics can also be recognised in the recent special issues and perhaps even one or two categories should be added—such as theoretical (methodological) aspects of cadastral systems. However, we decide not to group the papers in this way.

One remarkable statement from the historic special issue is the vision of integrated (including spatial and non-spatial aspects and serving many users) multipurpose land records systems. Though looking back at the historic version, the guest editors must admit that sometimes the progress in our field observable between the historic and the current special issue is not that clear. One thing is obvious: today there are some truly integrated cadastral systems in operation. Despite all technical and organisational problems which are solved and new problems that remain to be solved. A vision has become reality and lots more work remains to be done.

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Once again, the guest editors would like to take this opportunity to thank all the authors and reviewers for their efforts. From the side of the guest editors it has been a pleasure and a very informative job in which again a lot was learned about all kinds of cadastral systems *world-wide*. In order to enable further progress in the

[1] Harlan Onsrud, current editor-in-chief of URISA Journal, a quarterly peer-reviewed publication of the Urban and Regional Information Systems Association, ISSN 1045-8077 (the year 2002 corresponds to volume 14).

future, we keep encouraging potential authors to contact the guest editors in case they want to submit to the third, fouth and so on special issues!

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Chrit Lemmen
International Institute for Geo-Information Science and Earth Observation (ITC),
Hengelosestraat 99,
PO Box 6,
7500 AA Enschede,
The Netherlands

Cadastre and Public Registers Agency,
Land Information and Geodesy,
PO Box 9046,
NL-7300 GH Apeldoorn,
The Netherlands
E-mail address: lemmen@itc.nl

Peter van Oosterom
Department of Geodesy,
Faculty of Civil Engineering and Geosciences,
Delft University of Technology,
Thijsseweg 11,
2629 JA Delft,
The Netherlands