Overview working sessions

Summary and Conclusions
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2nd International Workshop on 3D Cadastres

organized by FIG, EuroSDR and TU Delft
16-18 November 2011, Delft, The Netherlands

Contents

1.   Summary

This report provides a short summary of the second Workshop on 3D Cadastres hosted jointly by International Federation of Surveyors (FIG), the European Spatial Data Research Organization (EuroSDR) and TU Delft, held in 16-18 November 2011 at Delft University of Technology in Nederlands.

Following a successful 1st International Workshop on 3D Cadastres workshop in November 2001(see: http://www.gdmc.nl/events/3DCadastres2001) the second workshop emerge his existence from the need to evolve van "if "to "how "as expressed in the opening by Peter van Oosterom and make further progress with the subject. As 3D technology become from purely technical tool into a decision making tool in the hands of all stakeholders, 3D is now being used in a wide range of applications like architecture, communications, town planning, security, design and transport. The increasing popularity of 3D is necessitating the need for high definition data along with information on rights, use and value in complex spatial and/or legal situations. It is difficult to reflect the vertical dimension of the legal status of real estate objects, which may be important in current cadastres with most 3D relationships registered administratively, as an attribute of defined parcels, using condominium or strata title legislation.

Since Cadastres aims at registering legal status and property right associated to land, it needs to progress towards a better cadastral management as well and prevent registration complications in the future. Despite all research and progress during the last decade, still no country in the world has a true 3D cadastre, the functionality is always limited in some manner; e.g. only registering of volumetric parcels in the public registers, but not included in a 3D cadastral map, or limited to a specific type of object with ad hoc semi-3D solutions (e.g. for buildings or infrastructures). The aim of the Workshop on 3D Cadastres is to consider the 3D issue of cadastral registration in an international context. The objective of the workshop was to have a fruitful exchange of ideas and to address further the technical, organizational and legal aspects by providing best practices.

This workshop included participants from 41 countries, allowing a range of sectors to be represented including governmental, public sector, universities, consulting institutes etc…The workshop addressed in particular: land registrars (lawyers) for the institutional matters of law and regulation concerning 3D and for the registrative part of the cadastre; geodesists (surveyors) for the geometric part of the cadastre;ICT professionals for the ICT-tools to deliver support for the registration process; decisions makers who are confronted with cost-benefit aspects of implementing new solutions taking into account the specific circumstances of the country concerned.

Participants for the workshop were selected on the basis of geographical and legal context from countries which encountered the 3D problem and who are interested to discuss the issue in an international forum. The current status of 3D-Cadastres in a large number of countries was obtained via the FIG questionnaire (see: http://www.gdmc.nl/3DCadastres/participants and click on the individual country/state to see the completed questionnaire).

The workshop had two types of sessions (http://3dcadastres2011.nl/programme):

a) Plenary feedback sessions that allowed time for further discussions of points raised and sharing of ideas amongst country representatives.
b) Parallel working sessions: in order to make further progress and develop basic guidelines for the implementation of 3D Cadastres and to establish an operational framework for 3D Cadastres.

The working sessions have been grouped on specific themes of 3D Cadastres chaired by a number of experts able to elaborate on their subject and further provide feedback to the FIG Commission 3 (Spatial Information Management), FIG Commission 7 (Cadastre and Land Management) and EuroSDR. During the first two days of the workshop, issues related to legal framework of 3D cadastres, initial registration of 3D parcels, 3D data management and visualization, distribution and delivery of 3D parcels have been explored in separate discussions. On the third day a brief presentation was given to the all groups to assess progress and provide basic recommendations for the implementation of 3D cadastres (available on the workshop website http://3dcadastres2011.nl). A short summery that includes also remarks from plenary discussions is provided in following chapters of this report.

2   Reporting on results of working sessions

2.1   Working session 1: Legal framework for 3D Cadastres
(chaired by Hendrik Ploeger, The Netherlands)

The workshop was intended to identify the main topics concerning the legal aspects of 3D cadastres. As speaking about the legal aspects of 3D cadastres it is important to discern between the laws and regulations that deal with the land registration as such (legal principles of land registration), and the laws regarding land tenure (land law). More specific the latter refers to the legal instruments for the creation of 3D properties. In fact if a legal system does not provide the instruments to create 3D property, there is no need for a 3D cadastre at all. On the other hand a 3D Cadastre itself does not make 3D property rights possible.

Achievement of outcomes

In the past ten years the progress in the legal field has been limited. There is a lack of legal research and the absence of common rules and common terminology is clear. E.g. there is no clear definition of "3D cadastre". This makes it difficult to compare solutions and develop guidelines. Of course a complication is that each system of land law has its historical and social-cultural background

Recommendations

- Legal specialists should be involved in the research on and development of 3D cadastre: land law specialists and academics (including planning law, buildings law); registrars and other professionals involved in land transactions (public notaries, conveyancing, solicitors …).

- With respect to the absence of a common terminology and common legal rules, semantic interoperability might be a solution. By that we might have a common terminology in terms of interoperability which described the words and make connection between them.
- Research should not be restricted to the "legal cadastre". 3D plays an important role in the multipurpose cadastre; e.g. planning. Combination with data in other registrations might be an issue from the perspective of legal interoperability (e.g. is a spatial unit in building registration the same as a property unit?).Case studies will provide best practises and can constitute a basis for development of legal guidelines.
- Members of the working session made the recommendation to create a sub working group (SWG) on legal aspects of the FIG 3D Cadastres Working Group, which would also involve legal specialists and professionals. Further research could be based on a questionnaire that focuses on legal aspects, starting from the UNECE questionnaire and guidelines on real property units and identifiers (published in 2004).

Workshop evaluation

The main conclusion of the working session is that we need more research on the legal aspects.

There is a need for more clear and precise guidelines in order to attract legal aspect to become involved. Law can be changed and adapted to user needs. Awareness and demand are therefore very important to put in motion the legal aspect.

2.2 Working session 2: Initial registration of 3D parcels
(chaired by Rod Thompson, Australia)

The working session focused on the various ways in which a 3D parcel comes into existence within a cadastre, and whether there are significant differences from the 2D cases. As land in urban areas becomes more valuable, there is a trend towards subdivision in 3D (for example, units in a high-rise building). This means that at some point in time, instead of thinking about rights to an area of land, we start considering rights to a volume of space. There may in fact be no physical "real world" change (if construction has not started), but a change of legal definition occurs from 2D to 3D.

Cases or situations of (initial) registration of 3Dparcels/properties were compared between countries, based on the experience of the participants. The actual legal and technical techniques used to effect this creation of 3D entities varies from jurisdiction to jurisdiction (Van Oosterom, Stoter, Ploeger, Thompson and Karki 2011), and the issues likewise vary. The degree to which authorities use a spatial database to administer or record their cadastre also varies.

Achievement of outcomes

1. To what extent should a link exist between (property) rights and physical objects? ("right before building")

• Normally a property must exist (be registered) before one can get e.g. a mortgage.

• In Australia (Queensland) the increasing use of 'volumetric descriptions' as opposed to 'building plans' appears to be mainly a local phenomenon.

2. What is the relationship between 2D (surface) parcels and 3D properties/parcels above or below?

• In some jurisdictions the 3D 'objects' are split up (con: expensive; pro: better defined).

• In others the 3D objects remain a single entity (possibly with easements attached to the 2D parcels).

3. Is initial registration of 3D parcels different from 2D?

• In most countries 3D parcels always have a relationship with surface parcels. In rare cases (e.g. Queensland, Australia) the registration of 3D is identical to the 2D situation).

4. Can building models be used? (To supplement /become 3D parcel complexes)?

• Participants can see possibilities to use the building models to do this and some experiments to investigate the feasibility are taking place.

• The process is not likely to become fully automatic. Responsible parties (e.g. surveyors) should be involved and be aware of changes ('as built' compared to the plans) and take appropriate actions.

• Validation of plans is problematic, often restricted to visual and 'calculator based' checks.

5. Is the owner of a 2D parcel inconvenienced or restricted in future dealings due to (say) a tunnel below his property?

• Normally servitudes show up (or can be made visible by combining data sources) in the cadastral map.

• A complicating factor is the difference in accuracy between the 2D maps and the usually quite inaccurate location (in absolute terms) of constructions below the surface.

6. What processes needed/used to prevent encroachment in 3D?

• Best solution will be to go to full 3D spatial partitions.

• Until then the current "paper" checks have to do, but no 100% guarantees

7. Is digital submission of 3D geometry definition: in use, planned or considered desirable?

• Digital in the sense of using 'digital' documents like PDF is widespread (although "paper" thinking is also reported in combination with digital documents).

• Digital in the sense of submission of data that can be inserted directly into the cadastral database (without additional processing) is only in the experimental phase.

• Experiments are reported from Australia and The Netherlands

• Initial findings indicate that difficulties can be expected.

Workshop evaluation

Difficult to draw general conclusions or to propose 'final' solutions for initial registration.

In most countries the process of registration shares some comparable steps and procedures, but at the same time many 'local', sometimes subtle, variations exist.

The discussion after the presentation underlined once again the necessity to have a definition for 3D cadastral parcel to alleviate some of the confusion. Neutral terms such as spatial unit as defined in the LADM are to be recommended. As well a good progress will be made when formats like 3D PDF that now deliver data as layers would actually offer a link to source data and allow the user to use it accordable to his wishes.

2.3 Working session 3: 3D data management
(chaired by André Streilein, Switzerland)

The amount and use of three-dimensional data has drastically increased over the last couple of years. In recent years major progress in 3D Geographic Information Systems has been made on 3D data visualization. However, 3D data management and analysis such as querying, manipulation, 3D map overlay, 3D buffering have been largely neglected in spatial database systems and Geographic Information Systems.

Hence, current 3D data representations are quite suitable for visualization but rather inefficient for computation. In addition current 3D data models are often tailored to specific applications and simple 3D spatial objects only, resulting in a lack of ability of handling general and complex 3D spatial objects in a database context. Solutions imply the need for a tool to share and display this data.

Achievement of outcomes

The discussion on future requirements of 3D data management states clearly the conviction, that a hybrid solution for 3D and 2D data sets is mandatory, as well as the maintenance of history and time und the overall standardisation of 3D objects. It seemed also to be evident, that with entering the 'new' dimension an open discussion together with lawyer has to be initiated on a common terminology. The issue of data

fusion, the merging of data set from different origin and with different scale is getting more important. As more and more complex objects come up, the more primitives a necessary to describe the reality.

There is a need for quality assessment in 3D and for conflict management. Whereas queries in 3D are state-of-the-art, the creation of new 3D objects from this queries is not. And last but not least, the current basic 3D standards are not completely sufficient for cadastral purposes.

The identification of country specific similarities and differences of 3D data management leads to a clear statement, that there are almost no similarities, as the workflows as well as the (legal) specifications are too different.

For research tasks of 3D data management, the group proposed new <u>algorithms for 3D analysis as well as new algorithms for feature extraction and change detection. Spatial and temporal concepts have to be developed. The requirements of the users (or the legal restrictions) of 3D cadastre have to be prepared and research on new technologies and concepts for 3D structures should be accomplished.</u>

Recommendations

We need
- further development of existing systems AND thinking of new concepts/vision,
- further development in 3D data models and standards,
- and further development of common workflow (-"toolboxes").

Therefore we should create awareness for 3D cadastral issues and initiate research.

2.4 Working session 4: Visualization, distribution and delivery of 3D parcels
(chaired by Jacynthe Pouliot, Canada)

According to Friedman (2008) the "main goal of data visualization is to communicate information clearly and effectively through graphical means". Addressing visualization techniques require an investigation about data type, display mode, interaction style, analytic task and the data schema (Qin et al, 2003).

Achievement of outcomes

Internet and the Web have to be specially considered since 2D/3D displaying in browser is now offered be several parties. The use of 3D globes such Google Earth, Bing Map largely contribute to the democratization of spatial data to a huge public. Various categories of geotechnologies exist such as Geographic Information System (GIS), spatial database management system (S-DBMS), Computer Aided Design (CAD), computer graphics, virtual reality, video games, web-based browsers (based on 3D Globes or not), mobile device (like smartphone), or even simple viewer such Adobe Acrobat Reader (3D PDF).

Rendering and highlighting techniques (Robinson 2006) are certainly methods to be investigated as well. How to use variables such as color, texture or depth to improve or ensure maximum visibility of 3D parcels and surrounding objects?

Talking about data distribution and data delivery, various solutions or approaches exist and several facets have to be considered when making decisions. The price and data accessibility are certainly on the top of these considerations. People are expecting that data and information are for free and available from everywhere.

Several categories of medium can be used to deliver spatial data; paper and file format (e.g. compact disc, portable key, internet) are certainly the main. If we admit that data are more and more digitized we could focus our investigation on digital data delivery approaches. It exist much file formats to support data exchange, we will not give a list here it will be too long. But formats are 2D or 3D, vector or raster, open or restricted, some mainly focus on the graphical aspects (e.g. X3D) some others integrate the semantic (e.g. CityGML), some are specifically designed for data exchange (e.g. Collada).

Recommendations

1. We have to take into consideration the categories of users but more important to focus on user's requirements. We are still missing user's requirement analysis. Remind that level of interaction have to be matched with user profile (need research).

3. Viewing the physical objects is easy (lot of 3D models) but viewing the legal objects is much more relevant, and challenging since we do not see the object (fiat object). We do not have to reinvent techniques about viewing 3D objects but try to better integrate concepts from 2D cartographic sciences and tools :

- BUT not to be limited by this!
- We have to be innovative on this point.

4. Having 3D representation (volumetric) of 3D parcels is not the main focus even though it is attractive when using advanced highlighting and rendering techniques. We thus strongly recommend having studies about applying/testing highlighting techniques to 3D parcels visualization.

5. Getting a 3D measure is not so trivial in a 3D environment and we would better use tools to help selecting and snapping the objects. The appropriate techniques will also depend on what kind of overlapping properties is to be visualized.

- Object that we can see compare to object that we do not see (e.g. Underground objects).
- We thus strongly recommend having studies about applying/testing highlighting techniques to 3D parcels.

Designers often fail to achieve a balance between design and function, creating gorgeous data visualizations which fail to serve their main purpose — to communicate information.

6. The Web mapping is a good solution to integrate various sources of data; it is important of having standards for storing and querying 3D data (strong relation with displaying.

7. Expand the open source and the development of 3D viewers like Adobe (accessible, reach large public) that allow the access to Information.

8. There is also interest in taking advantage of Crowd Sourcing; e.g. to open a contest about how should be displayed 3D parcels, and which graphical variables or interaction the general public is interested in

Workshop evaluation

- One difference between 2001 and 2011 is that 3D system visualization and delivery are more available and accessible, half of the participant already built 3D models.
- Conclusion from 2001 (in 2011 we still agree) : Multi purpose use of 3D data
- Spatial representation of 3D parcels rarely exists in cadastral system. Moreover we still have to get an agreement about what is a 3D parcel.

3.   Conclusions

The main outcomes of the second workshop evidence that the level of sophistication of each 3D cadastre will in the end be based on the user needs, land market requirements, legal framework, and technical possibilities, but a good framework will ease the communication and implementation of 3D cadastre. Semantics and the lack of a common definition for a 3D cadastre proved to be indeed a major impediment to make summarisations. A good idea would also be to provide more time, as the time allocated for the workings sessions are not enough to discuss all the agenda points.

The recommendations of the workshops sessions also clearly point out the importance of:

- Having an interoperate approach regarding data accessibility and sharing;
- User's requirement analysis;
- Definition of 3D cadastre parcel and the need for a kind of dictionary to explain the clear and unambiguous meaning of terms;
- An inventory of successful cases and encountered problems to provide support;
- To present the benefices of having 3D cadastre implemented for various stakeholders.

This report has been prepared for circulation between participants but is also intended as a resource for those interested in the workshop content but who were unable to attend.

4.   Acknowledgments