Questionnaire 3D-Cadastres: status November 2010

Sweden

This questionnaire is an activity of the FIG working group 3D-Cadastres 2010-2014. The purpose of the survey is to make a world-wide inventory of the status of 3D-Cadastres at this moment (fall 2010) and the plans/expectations for the near future (2014). By sharing this information, it should be possible to improve cooperation, learn from each other and support future developments. For more information on the FIG working group on 3D-Cadastres see the website of this working group www.gdmc.nl/3DCadastres. Now a few notes and suggestions, which should be helpful when completing the questionnaire:

- In this questionnaire the concept of 3D-Cadastres with 3D parcels is intended in the broadest possible sense. However, what exactly is (or could be) a 3D parcel is dependent on the legal and organizational context in the specific country (state, province). 3D parcels include land and water spaces, both above and below surface.
- A more formal definition: A 3D parcel is defined as the spatial unit against which (one or more) unique and homogeneous[1] rights (e.g. ownership right or land use right), responsibilities or restrictions are associated to the whole entity, as included in a Land Administration system.
- As the definition above is quite abstract, it is tried in the questions below to be more specific and real world situations are used. Also two example sets of partial/preliminary answers are included from Australia, Queensland and The Netherlands, to support the questions and to be of help when formulation the answers for your jurisdiction.
- A 3D parcel is a 'legal object' describing a part of the space. Often there is a relationship with a real world/physical object, which can also be described in 3D. Please be aware of the difference between these two types of objects and that the focus in the context of 3D-Cadastres is on 3D parcels (spaces of legal objects).
- If a certain question is not relevant or if you have no clue what to respond, do not spend any time on this (and leave the field blank).

[1] Homogenous means that the same combination of rights equally apply within the whole 3D spatial unit. Unique means that this is the largest spatial unit for which this is true. Making the unit any larger would result in the combination of rights not being homogenous. Making the unit smaller would result in at least 2 neighbour 3D parcels with the same combinations of rights.

1. General/applicable 3D real-world situations

This part of the questionnaire refers to the applicable 3D real-world situations to be registered by 3D parcels. It also addressed the types of 3D geometries, which are considered to be valid 3D representations for these parcels.

	Sweden 2010	Sweden 2014
1.1. Are all 3D parcels constrained to be within one surface (2D) parcel?	No, they can stretch over or under other parcels / 3D property	We do not think there will be any major changes in legislation and database technology until 2014. We are currently working on developing our central cadastral and storage facilities towards a more object orientated environment, but it is not likely to have all parts implemented in 2014.
1.2. Are ambulatory[2] boundaries permitted?	No, boundaries are fixed.	
1.3. Is it allowed to have 3D parcels not related to physical constructs or objects?" (e.g. airspace, subsurface volumes)	No, 3D property formation may take place only if the property unit is intended to contain a building or other facility or part of the same.	
1.4. Are disconnected parts of a single 3D parcel allowed?	Yes (the same as for 2D parcels).	
1.5. Limitation – e.g. must the 3D parcel be described by a boundary definition?	No. The building or facility that the 3D parcel contains can be the norm for the location of the boundary, but if there are no natural boundaries, and/or construction details (e.g. a wall) X/Y/Z Coordinates can be used to indicate the location of the	

[2] An ambulatory boundary is a boundary of a land parcel which follows the movements of a natural feature such as a river. Its position determined at points of time (when a survey is carried out), but between such "fixes", the definition of the property is the position of the real world natural feature.

	boundary. It is always allowed to use coordinates to indicate a boundary, even if we normally do not use that method for boundaries in buildings.	
1.6. Are curved surfaces to bound the 3D parcels allowed?	Yes, if the boundary follows the construction that the 3D parcel contains	
1.7. Must the curved surfaces (if allowed) be cylindrical sections, or any other constraint?	No, no restrictions.	
1.8. Any other constraints – e.g. all surfaces must be horizontal or vertical?	No.	
1.9. Is there generic legislation (law and/or regulations) for 3D descriptions of parcels? If so please, mention law and article(s).	No.	
1.10. Is the legal text available in original language?	n/a	
1.11. Is the legal text (relevant part) available in English translation?	n/a	
1.12. Do you have example descriptions of typical 3D parcels; either 'prototype' or 'operational'?	We have descriptions in Swedish.	
1.13. Is there a formal model for the 3D parcels (UML style); e.g. based on ISO TC211 series?	Some basic, non public, UML models describing 3D property exist. We are currently working on improving them.	
1.14. Are natural resources (groundwater, mining rights) considered as 3D parcels?	No.	
1.15. Are polluted areas considered as 3D parcels (as legal restrictions are associated to these spaces: above and below surface)?	No.	
1.16. Are spatial plans considered as 3D parcels (as rights or restrictions are related to them)? Sometimes also called spatial development plans, zoning plans or physical plans (land use, urban, regional, environmental,...)	No, however, property regulation plans can be illustrated in 3D.	
1.17. Any other geometric issues?		

2. Infrastructure/utility networks

This refers to the situation where an infrastructure network is considered to be defined within the cadastre. For example in some jurisdictions, an underground network might be privately constructed for the purpose of leasing space in it for other organisations to run cabling. In this case, a network, or part of that network may be considered to be a real estate object.

	Sweden 2010	Sweden 2014
2.1. Do you register network parcels? (e.g. subterranean conduit networks)	No. We have no need doing so. The networks are regulated through other rights, e.g. Utility easements.	
2.2. If so, can the network structure be traced in the database(s)?	n/a	
2.3. Does the jurisdiction have private networks? If so please, mention law and article(s).	We have private overhead and underground cable networks, but they are not registered as 3D, but regulated through rights, mostly Utility easements.	
2.4. If so, are they registered as 3D property parcels?	No	
2.5. Is the legal text available in original language? If so, give references to relevant document(s).	Yes.	
2.6. Is the legal text (relevant part) available in English translation?	Some 3D legislation is translated into English	
2.7. Do you have example descriptions of typical 3D parcels for networks; either ‘prototype’ or ‘operational’?	No.	
2.8. If the network (legal) objects break at the surface parcel, how do you deal with intersecting networks or vertically parallel networks?	The DCDB does not record legal objects as a network.	
2.9. Any other geometric issues?		

3. Construction/building units

This refers to 3D properties that are related to constructions and apartment (condominium) buildings. The individual units are often defined by the actual walls and structure of a building, rather than by metes and bounds. E.g. “unit 5 on level 6 of … building”.

	Sweden 2010	Sweden 2014
3.1. Do you register 3D construction/building units?	Yes.	
3.2. If so, what are the most important types? E.g. apartment units, or also other buildings or even more general constructions (infra related; such as bridge, tunnel or even other, such as windmills,..)	Different types of use exist. In the cadastral register the 3D properties are divided into the types rock cavity, bridge, building, tunnel, other facility and apartment units	
3.3. Does the jurisdiction have construction/building units? If so please, mention law and article(s).	All 3D property units must contain a building or other facility or part of the same, Swedish Real Property Formation Act, Chapter 3, Section 1a.	
3.4. Is the legal text available in original language?	Yes.	
3.5. Is the legal text (relevant part) available in English translation?	Some 3D legislation is translated into English, but not including the recent amendments from 1 May 2009.	
3.6. Do you have example descriptions of typical 3D parcels; either ‘prototype’ or ‘operational’?	Lantmäteriet, (Swedish mapping, cadastral and land registration authority) has examples in Swedish.	
3.7. What would be typical 3D boundaries in an apartment complex: middle of the wall and floor/ceiling, or walls, floors/ceiling as neutral/shared 3D space?	This is decided in the individual case, but typically for apartment units the walls/ceilings will be shared 3D space, except for the surfaces, which will be included in the apartment units.	
3.8. Is common property inside the building registered? If so, how?	Yes, for apartment units the common	

	property usually forms a joint property unit, which is registered with a cadastral number. They can also remain within the residual property unit from which the apartment units was subdivided and the apartments units must be given the right to use the residual property for different purposes.	
3.9. Who owns the common property inside the building?	If it is a joint property unit, it will belong jointly to the apartment units property units. If it remains within the residual property unit, the apartments units must be given the right to use the residual property for different purposes.	
3.10. Who owns the land on which the apartment is built?	See answer to question 3.9.	
3.11. Any other geometric issues?		

4. X/Y Coordinates

	Sweden 2010	Sweden 2014
4.1. Do the plans of survey guarantee X/Y coordinates? (and are they relative or in an absolute spatial reference system?)	Survey plans are in a absolute spatial reference system	
4.2. Are the cadastral database coordinates authoritative?	No, the database coordinates are only informative and estimates (even if some coordinates are the same as in the survey documents).	
4.3. If not, what is the authoritative source of X/Y coordinates?	Survey documents are normally the authoritative source. However, an exception is when a boundary has been re-established by a real property formation procedure.	
4.4. Do you have parcels defined by the walls of a building (with no recorded geometry)?	Yes, mostly apartment units.	
4.5. What is the spatial reference system for X/Y Coordinates?	EPSG:3006 (=SWEREF 99)	
4.6. Any other X/Y coordinate issues?	The coordinates are sometimes in (older) survey documents given in a for the property unique reference system. A boundary marker can e.g. be defined as having X=1000, Y=1000.	

5. Z Coordinates/height representation

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	Sweden 2010	Sweden 2014
5.1. Are the Z coordinates of 3D parcels relative to local ground?	No. 3D property is registered in the same way as 2D property, adding the size of the area and relative height. For apartment units, only living area and floor number is registered.	
5.2. Are Z coordinates reduced to a standard datum (absolute)? If so, what is the spatial reference system for the Z coordinate?	n/a	
5.3. In principle possible to store both relative and absolute Z coordinate?	No. Only the relative height is registered. Z-coordinates can be used, but they are not registered in the cadastre.	
5.4. Is the earth surface (height) explicitly stored (in the DCDB or other accessible register)?	No.	
5.5. What is the source of elevation for the 2D surface parcel?	Surface elevations are not recorded in the DCDB.	
5.6. Any other Z coordinate issues?		

6. Temporal Issues

	Sweden 2010	Sweden 2014
6.1. Are temporal limits part of the definition of a parcel (2D or 3D)?	No.	
6.2. Are moving parcels allowed?	No.	
6.3. Are there any limitations on the range of temporal limits? (e.g. only on 3D apartments).	n/a	
6.4. Are there any attempt to integrate 3D space and temporal representations, into a single 4D space/time representation?	n/a	
6.5. In the case of tidal boundaries, what happens to the 3D ambulatory parcel if the 2D land parcel changes extent due to the movement of High Water Mark?	n/a	
6.6. Any other temporal issues?		

7. Rights, Restrictions and Responsibilities

	Sweden 2010	Sweden 2014
7.1. Range of RRR on 3D parcels.	Same as for 2D property.	
7.2. Are there any limitations on the range of rights? (e.g. subterranean parcels must be owned by Govt).	No.	
7.3. Any other RRR issues?		
7.4. Are there RRRs that are only allowed in 3D (and not valid for 2D)	No.	
7.5. Is there specific legislation (laws, regulations) defining 3D RRR types? If so, provide details, e.g. references to documents/ articles.	No.	
7.6. Can 3D sub-surface/above-surface parcel be owned by someone other that the person owning the land parcel?	Yes.	
7.7. What applications do you foresee for 3D cadastre?		

8. DCDB (The Cadastral Database)

	Sweden 2010	Sweden 2014
8.1. Does the DCDB contain representation of 3D parcels (in any form)?	Yes.	
8.2. If so, how are they represented (in the DCDB)?	3D properties are represented as 2D polygons. In rare occasions a 3D property, except apartments units, can be presented as a point, but is not recommended today.	
8.3. If so, how are they presented on cadastral "maps" (including screen presentations)?	The of 3D presentation differ from 2D presentation. The boundaries and surfaces have different layouts. The area of the 3D property unit is normally shaded.	
8.4. Are there possibilities to store geometry of 3D parcels in the DCDB?	No.	
8.5. Is it possible to manage a 3D topological structure in the DCDB?	No.	
8.6. Are constraints/rules defined for valid 3D objects (closed volume, no overlap, no gap in 3D)? What about rules for a mix of 2D and 3D representations?	3D property can stretch under or overlap 2D property and other 3D property.	
8.7. How can internal and external user query and visualize the 3D content supporting rotating, slicing, transparency, perspective (3D web/view service, 3D pdf documents,..)?	Only on a 2D map with a specific boundary layout and shading in shown.	
8.8. What Spatial DBMS software do you use? Any 3D capabilities included and used?	Oracle ESRI products Own developed software	
8.9. Do you have any validation rules for 3D representation in the database?	The same rules as for 2D (topology, no gaps, etc.)	
8.10. What (GIS/CAD) software is	*Autoka-PC* and	

used for updating, editing, analysis, and visualization of the cadastral data? Any 3D capabilities included and used?	*ArcCadastre* (Swedish developed systems. *ArcCadastre* is developet together wit ESRI). A number of municipalities update the index map for their area. They might use other software.	
8.11. What web software is used for remote data access/distribution and visualization? Any 3D capabilities included and used?	3D property cannot be updated through remote data access outside Lantmäteriet (Swedish mapping, cadastral and land registration authority) It is not included in the software developed for remote updating the index map by the municipalities.	
8.12. Is your DCDB organised as Multi-Layers or Object Oriented or some other data model?	Multi Layer. However, Lantmäteriet (Swedish mapping, cadastral and land registration authority) is working on moving its information to an object orientated environment. It will probably not be complete in 2014.	
8.13. How do you query 3D objects in your DCDB?	Only horizontally (and vertically if they overlap).	
8.14. Is it possible to query neighbourhood parcels to a 3D object, vertically as well as horizontally?	Only horizontally (and vertically if they overlap).	
8.15. Any other DCDB issues?		

9. Plans of Survey (including field sketches)

	Sweden 2010	Sweden 2014
9.1. Do the survey plans carry 3D parcel representations?	Yes.	
9.2. If so, how are they represented?	Construction drawings in plan and height. The heights are relative to the building. Each floor is represented on a separate diagram.	
9.3. Is there specific legislation (regulations) describing the requirements for Plans of Survey in 3D? If so, please give link to the relevant documents.	General instructions stating that it should be possible to see the difference between 2D and 3D are given in the Real Property RegisterOrdinance (SFS 2000:308). Link: Real_Property_Register_Ordinance Lantmäteriet (Swedish mapping, cadastral and land registration authority) has issued guidelines for the capture and documentation of 3D.	
9.4. Is sketch level allowed (low geometric quality, but in principle enough to indicate the 3D object)?	In principle yes. A survey plan does not have to include coordinates (it can be shown in relation to existing boundaries), but the 3D property is registered with coordinates in the cadastre.	
9.5. Is it possible to define a 3D parcel by referring to other 3D real world objects/ topography (and not specifying coordinates)?		
9.6. In what format are the 3D parcels submitted for registration; attached to legal document in a single pdf (which has good 3D capabilities) or in an extension of (city)GML for 3D parcels, or….?	Own developed file formats are used.	
9.7. Are the 3D parcels somehow	We do not register	

checked for spatial validity; e.g. volume is closed, does not overlap with neighbour volume (and also no unwanted 3D gaps)?	volumes.	
9.8. Do you have examples of (prototype or production) 3D survey plans available?	Yes, Lantmäteriet,S(wedish mapping, cadastral and land registration authority) can provide examples.	
9.9. Are any reference objects visible on the survey plan (e.g. real buildings, roads, that is 3D topography)?	Yes.	
9.10. What form of 3D data acquisition is used (CAD, terrestrial surveying, sketches, stereo/oblique images, laser scanning,…)?	Terrestrial surveys and/or building construction plans.	
9.11. What software do you use for creating and processing survey plans? Any 3D capabilities included and used?	Lantmäteriet (Swedish mapping, cadastral and land registration authority) has developed software: *Autoca-PC*, *Trossen* and *ArcCadastre* (together with ESRI).	
9.12. Can 3D parcels be subdivided, consolidated or nullified?	Yes. Same as for 2D parcels.	
9.13. Is there any existing technical circular or directive to assist Surveyors in 3D data collection in the field?	Yes, Lantmäteriet (Swedish mapping, cadastral and land registration authority) has produced guidelines concerning data collection and registration.	
9.14. Any other survey plan issues?		

10. Other Issues

Please include any other issues that may be of interest in an international context. For example, in some foreign jurisdictions 3D parcels can only be separated by horizontal planes.

10.1. Country (State, Province)	Sweden
10.2. Your name, function/position and your organization	Jenny Paulsson, lecturer/PhD, Royal Institute of Technology (KTH) Jesper M. Paasch, researcher, Lantmäteriet, Swedish mapping, cadastral and land registration authority
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10.4. Other issues	