

Questionnaire 3D-Cadastres: status September 2014 Sweden



This questionnaire is an activity of the FIG working group 3D-Cadastres 2014-2018. The purpose of the survey is to make a world-wide inventory of the status of 3D-Cadastres at this moment and the plans/expectations for the near future (2018). By sharing this information, it should be possible to improve cooperation, learn from each other and support future developments. This is the second time that the questionnaire on 3D-Cadastres is conducted by the FIG working group on 3D-Cadastres. The first time was in 2010 in order to document the status in 2010 and expectations back then for 2014. The responses have been analysed (van Oosterom et al. 2011, Karki 2013). For more information on the FIG working group on 3D-Cadastres see the website www.gdmc.nl/3DCadastres. Now a few notes and suggestions, which should be helpful when completing the questionnaire:

- The conceptual model used as background for the 3D Cadastres questionnaire is the ISO 19152 standard (ISO, 2012): the Land Administration Domain Model (LADM).
- In this questionnaire the concept of 3D-Cadastres with 3D parcels (or 3D spatial units in LADM terminology) 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 homogeneous¹ rights (e.g. ownership right, lease or other 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 to be more specific and real world situations are used. Many examples with partial/preliminary answers from 2010 are available on-line at <http://www.gdmc.nl/3DCadastres/participants/>. Inspecting some of the completed 2010 questionnaires from different other countries might 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 spaces of the legal objects and not the registration of the physical objects as such.
- 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).
- The questionnaire has been prepared by a mixed Australian (Rod Thompson/Sudarshan Karki)/Dutch (Jantien Stoter/Hendrik Ploeger/Christiaan Lemmen/Peter van Oosterom) team. The questionnaire is grouped in the number of blocks. This has no meaning in the sense of priority and it is often the case that a question could belong to multiple blocks. Please do not feel disturbed by this.
- Similar to the Questionnaire 3D-Cadastres, the completed forms will be made available on website of FIG working group on 3D Cadastres.
- Please complete this questionnaire before *1 October 2014* and send it to P.J.M.vanOosterom@tudelft.nl (or Peter van Oosterom, TU Delft, OTB, P.O. Box 5030, 2600 GA Delft, The Netherlands).

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.

	Status 2014	Expectations 2018
1.1. Are all 3D parcels (3D spatial units in LADM terminology) constrained to be within one surface 2D parcel?	No, 3D parcels are independent of 2D parcels. Can e.g. stretch over two 2D parcels.	No change.
1.2. Are 2D and/or 3D ambulatory ² boundaries permitted?	No. The boundaries are fixed.	No change.
1.3.a. Is it allowed to have 3D parcels (spatial units) not related to physical constructs or objects? (e.g. airspace, subsurface volumes)	No. However, the building can be constructed after the formation of the 3D parcel	No change.
1.3.b. If 1.3.a positive: approximately what proportion of new 3D parcels (spatial units) would involve such cases (not related to physical object)?		
1.4. Are disconnected parts of a single 3D parcel allowed?	Yes, multiple volumes can exist.	No change.
1.5. Spatial limitation – e.g. must the 3D parcel be related to a closed volume or is it allowed to have ‘open’ or unbounded 3D parcels (e.g. towards the sky).?	Spatial limitation is mandatory. No “open space” allowed.	No change.
1.6. Are curved surfaces to bound the 3D parcels allowed?	Yes.	No change.
1.7. Must the curved surfaces (if allowed) be cylindrical sections, or any other constraint?	Free geometry is allowed.	No change.
1.8. Any other constraints – e.g. all surfaces must be horizontal or vertical?	Free geometry is allowed.	No change.
1.9. Is there legislation (law and/or regulations) for 3D descriptions of parcels? If so please, mention law and	No specific legal descriptions, but instructions in regulations exist.	No change.

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.

article(s).	(Förordning för Fastighetsregister) [Real Property Register Ordinance] .	
1.10. Is the legal text available in original language?	Yes, but the text has not been updated in recent years.	No change.
1.11. Is the legal text (relevant part) available in English translation?	Yes, but the text has not been updated in recent years.	No change.
1.12. Do you have example descriptions of typical 3D parcels; either 'prototype' or 'operational'?	Yes, but the text has not been updated in recent years.	No change.
1.13. Is there a formal model for the 3D parcels (UML style); e.g. based on ISO TC211 series (especially LADM, ISO 19152)?	LADM is used conceptually, but no "real" implementation has been achieved yet.	Difficult to estimate.
1.14. Are natural resources (groundwater, mining rights) shown in your land administration? If yes, are they considered as 3D parcels (spatial units) with RRRs attached?	Rights (water and mining rights, etc. are shown in the land administration. They are not considered 3D parcels.	No change.
1.15. Are legally restricted spaces, above or below, such as polluted areas considered as 3D parcels?	No	No change
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, they are not considered 3D parcels. However, more and more plans can contain information on e.g. building heights, etc. Municipal zoning plans may contain 3D information on e.g. common areas.	No change.
1.17. Any other geometric issues related to 3D parcels?	No.	

2. Infrastructure/utility networks

This refers to the situation where an infrastructure network is considered to be defined within the land administration. 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.

	Status 2014	Expectations 2018
2.1. Do you register networks as an entity in the land administration? (e.g. subterranean conduit networks)	Yes (Wrong answer 2010)	No change.
2.2. If so, then (a) can the network structure be viewed graphically in the land administration? (b) can the network structure be traced in the database(s)? (c) are networks registered by means of a cadastral identifier (such as a 'parcel number')? (d) are RRRs and parties attached to these network objects?	See above. When we do, then: a) Yes. b) Yes c) Yes d) Yes	No change.
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.	No change.
2.4. If so, are they registered as 3D property parcels (spatial units)?	Yes. We sometimes register large e.g. road tunnels as 3D property. They are also regulated through other legislation, e.g. Utility Easements Act. In 3D property formation the RRR boundaries shall match the physical entities. Can be viewed as 2D only, with special text and visualisation for 3D parcel.	No change.

2.5. Is the text of relevant laws or regulations (question 2.3) available in original language? If so, give references to relevant document(s).	Yes. E.g. Real Property Formation act Real property Register Act	
2.6. Is the text of laws and regulations (relevant part) available in English translation?	Yes, but the text has not been updated in recent years.	Difficult to estimate
2.7. Do you have example descriptions of typical 3D parcels (spatial units) for networks; either 'prototype' or 'operational'?	Yes, but not in English.	No change.
2.8. If the network (legal) objects break at the surface parcel, how do you deal with intersecting networks or vertically parallel networks?	We do not register legal objects as networks.	No change.
2.9. Any other geometric issues related to the registration of networks?	No	

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”.

	Status 2014	Expectations 2018
3.1. Do you register 3D construction/building units?	Yes. We reg. 3D property units which shall consist of a building (or part of a building)	
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,...)	Equally important. Apartment units are slightly more common than other 3D 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 the text has not been updated in recent years.	
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? Is it mentioned in any legislation or is it the convention?	Ownership apartments consist of a volume and the area necessary to allow practical use of the apartment, e.g. to hammer in nails in the wall. Other general constructions have normally in the middle of the common wall as boundary or the outside of the wall	

	(surface).	
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.	
3.10. Who owns the land on which the apartment is built?	The apartment owners own the land through shares in a joint property unit for the building. See 3.9.	
3.11. Do you allow sub-division of apartments or apartment blocks?	Yes	
3.12. Can the land on which the building is built be sub-divided or sold or mortgaged without the consent of majority of the apartment owners?	No. The land is owned by the owners through their shares in the joint property unit. See 3.9.	
3.13. What is the numbering convention for apartments (please specify in terms of cadastral parcel as well as street addressing)	The apartment number consists of 4 digits. The first two specify the floor no. and the last two the location on the floor. The entrance floor starts with 10. Upper floors are 1, 12 etc., and lower floors are 09, 08 etc.	
3.14. Any other geometric issues?		

4. X/Y Coordinates

	Status 2014	Expectations 2018
4.1. Do the plans of survey guarantee X/Y coordinates? (and are they relative or in an absolute spatial reference system?)	X/Y coordinates are defined in the survey documents. Both national and relative coordinates exist, depending on new or older measurements. The relative coordinates are converted into nat. coordinates.	National surveyed coordinates are used with new property formation.
4.2. Are the cadastral database coordinates authoritative?	No. Only informative information.	No change.
4.3. If not, what is the authoritative source of X/Y coordinates?	The legal property formation documents are authoritative.	No change.
4.4. Do you have parcels defined by the walls of a building (with no recorded geometry)?	Yes	No change.
4.5. What is the spatial reference system for X/Y Coordinates?	EPSG 3006	
4.6. Any other X/Y coordinate issues?	Older parcels are often measured in local reference systems, but shown with transformed into (not legally valid) coordinates on the index map. See 4.1.	No change.

5. Z Coordinates/height representation

	Status 2014	Expectations 2018
5.1. Are the Z coordinates of 3D parcels relative to local ground?	They can be relative to local ground, but normally not. 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.	No change.
5.2. Are Z coordinates reduced to a standard datum (absolute)? If so, what is the spatial reference system for the Z coordinate?	See 5.1.	
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.	No change.
5.4. Is the earth surface (height) explicitly stored (in the DCDB or other accessible register)?	No	No change.
5.5. What is the source of elevation for the 2D surface parcel?	Surface elevations are not recorded in the DCDB. (Unsure of question)	
5.6. Any other Z coordinate issues?	The actual floor no (of condominiums) can be registered, e.g. “the property is located on the 3 rd floor of the building”.	No change.

6. Temporal Issues

	Status 2014	Expectations 2018
6.1. Are temporal limits part of the definition of a parcel (2D or 3D)?	No	No change.
6.2. Are moving parcels allowed?	No	No change.
6.3. Are there any limitations on the range of temporal limits? (e.g. only on 3D apartments).	Not relevant	
6.4. Are there any attempt to integrate 3D space and temporal representations, into a single 4D space/time representation?	No	No change.
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?	Not relevant	No change.
6.6. Any other temporal issues?	No	

7. Rights, Restrictions and Responsibilities

	Status 2014	Expectations 2018
7.1. Range of RRR on 3D parcels.	Same as for 2D property.	
7.2. Are there any limitations on the range of rights related to 3D spatial units? (e.g. subterranean parcels must be owned by Govt).	No	No change.
7.3. Are there any limitations on the range of restrictions or responsibilities related to 3D spatial units? (i.e. currently in use and related to 2D spatial units, but that would not be applicable to 3D).	No	No change.
7.4. Are there RRRs that are only allowed in 3D (and not valid for 2D)	No	No change.
7.5. Is there specific legislation (laws, regulations) defining 3D RRR types? If so, provide details, e.g. references to documents/ articles.	No, part of “normal” property law and regulations	No change.
7.6. Can 3D sub-surface/above-surface parcel be owned by someone other than the person owning the land parcel?	Yes	No change.
7.7. What applications do you foresee for 3D land administration?	More effective use of buildings (ownership and different industry in the same building) and other constructions (tunnels, etc.). Use of digital terrain models in property formation procedure.	No change.
7.8. Are the administrative source documents (source of RRRs) title or deed based?	Mainly title based.	
7.9 Who is responsible for the correctness of the specified 3D boundaries in spatial source documents (which authority)?	Same as by 2D property formation, i.e. Lantmäteriet (Swedish mapping, cadastral and land registration authority) or the (limited number of)	No change.

	municipalities having permission to conduct property formation. The property owner supplies drawings, etc. They are reviewed by the authority and used as source for legal decisions.	
7.10. Is registration of 3D parcels done inside the cadastral mapping agency, the land registry or elsewhere?	Inside the cadastral mapping agency and the land registry are integrated within the same organisation: Lantmäteriet (Swedish mapping, cadastral and land registration authority). Some large municipalities are responsible for their own property formation, under supervision by Lantmäteriet.	No change.
7.11. Are 3D registrations handled by the same organisation that handles traditional (2D) land administration?	Yes	No change.
7.12. Do you supply paper-based titles or deeds or proof of ownership? If yes, does this contain depictions of the 2D or 3D parcel?	The deed of purchase is paper based, but registered digitally and on paper in our systems. The Swedish mortgages are digital.	No change.
7.13. Any other RRR issues?	No	

8. DCDB (The Cadastral Database)

	Status 2014	Expectations 2018
8.0. Is database schema LADM based?	No. Using the LADM is not a prioritised action at the moment due to other development.	Difficult to say.
8.1. Does the DCDB contain representation of 3D parcels (in any form)?	Yes.	No change.
8.2. If so, how are they represented (in the DCDB)?	By textual information, e.g. "3D property"	No change.
8.3. If so, how are they presented on cadastral "maps" (including screen presentations)?	By dotted lines, special surface texture and text (e.g. "\1:32\"). Different from 2D presentation.	No change.
8.4. Are there possibilities to store geometry of 3D parcels in the DCDB?	No	No change.
8.5. Is it possible to manage a 3D topological structure in the DCDB?	No	No change.
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?	Same as for 2D, since 3D is only stored as 2D extension (X and Y coordinates)	No change.
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 is shown.	No change.
8.8. What Spatial DBMS software do you use? Any 3D capabilities included and used?	OS/390 ROSAM Oracle ArcCadastre BANKIR (own developed software). No 3D capabilities.	Some development is expected.
8.9. Do you have any validation rules for 3D representation in the database?	No. The same rules as for 2D (topology, no gaps, etc.)	
8.10. What (GIS/CAD)	ArcCadastre	

software is used for updating, editing, analysis, and visualization of the cadastral data? Any 3D capabilities included and used?	No 3D capabilities included. A number of municipalities update the index map for their region. They may use other software.	
8.11. What web software is used for remote data access/distribution and visualization? Any 3D capabilities included and used?	Different software is used. No 3D capabilities.	
8.12. Is your DCDB organised as Multi-Layers or Object Oriented or some other data model?	Multi-Layers.	Lantmäteriet (Swedish mapping, cadastral and land registration authority) is working on moving its information to an object orientated environment.
8.13. How do you query 3D objects in your DCDB?	By query 3D objects by area (e.g. municipality) and/or type of 3D property, e.g. ownership apartments.	No change.
8.14. Is it possible to query neighbourhood parcels to a 3D object, vertically as well as horizontally?	No	No change.
8.15. Any other DCDB issues?	No	

9. Plans of Survey (including field sketches)

	Status 2014	Expectations 2018
9.1. Do the survey plans carry 3D parcel representations?	Yes.	No change.
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. The specific use on specific levels/floors and properties. Presented by using different colours.	No change.
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.	No specific legislations, but general instructions stating that it should be possible to see the difference between 2D and 3D are given in the Real Property Register Ordinance (SFS 2000:308). Lantmäteriet (Swedish mapping, cadastral and land registration authority) has issued guidelines for the capture and documentation of 3D.	No change.
9.4. Is sketch level allowed (low geometric quality, but in principle enough to indicate the 3D object)?	The survey plan shall be of sufficient geometric quality to identify boundaries. 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	No change.
9.5. Is it possible to define a 3D parcel by referring to other 3D real world objects/ topography (and not specifying coordinates)?	Yes, e.g. by referring to floors.	No change.

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....?	Attached to legal documents as pdf for registration in textual part of the real property register. Submitted to digital index map in own developed file format.	No change.
9.7. Are the 3D parcels somehow checked for spatial validity; e.g. volume is closed, does not overlap with neighbour volume (and also no unwanted 3D gaps)?	We do not register volumes.	No change.
9.8. Do you have examples of (prototype or production) 3D survey plans available?	Yes, Lantmäteriet (Swedish mapping, cadastral and land registration authority) have examples.	No change.
9.9. Are any reference objects visible on the survey plan (e.g. real buildings, roads, that is 3D topography)?	Yes. Buildings, roads, etc.	No change.
9.10. What form of 3D data acquisition is used (CAD, terrestrial surveying, sketches, stereo/oblique images, laser scanning,...)?	CAD plans supplied by the entrepreneurs. Cadastral surveys are sometimes done, but not frequently.	No change.
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: <i>Trossen</i> and <i>ArcCadastre</i> No 3D capabilities included.	No change.
9.12. Can 3D parcels be subdivided, consolidated or nullified?	Yes. Same as for 2D property formation.	No change.
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)	No change.

	has produced guidelines concerning data collection and registratorm.	
9.14. Are the surveyors required to undertake a field survey for 3D cadastral data?	No. We seldom survey 3D property.	No change.
9.15. Are building construction plans used to compile 3D cadastral information for apartments?	Yes, construction plans and textual descriptions.	No change.
9.16. Is 2D/3D field survey done by private licensed surveyors or by government surveyors?	Government or municipal surveyors depending on location in Sweden	No change.
9.17. Are plans of survey created for each new 2D/3D parcel or are they updated in an index map or a cadastral database.	Plans of survey are created for each 2D/3D parcel, which is used to update the cadastral index map.	No change.
9.18. Do you show dimensions or isometric views of 3D parcels on survey plans (do you also store this in a database)	Yes, on survey plans, but not in our databases.	No change.
9.19. Any other survey plan issues?	No	

10. Dissemination of 3D Cadastral information

	Status 2014	Expectations 2018
10.1. Is there a general purpose web-based dissemination of 2D cadastral (graphical or text) information (e.g. a portal for the public or for professionals)? If yes, does it include 3D data?	Yes. It includes 3D property.	No change.
10.2. Are specific file formats or standards used to distribute 3D Cadastral information? (e.g. LandXML, CityGML, BIM/IFC, 3D pdf,...)	Mainly XML ÖFF (own developed format)	Possibly only XML.
10.3. Are there specific cartographic styling rules for representing 3D cadastral plans, or to represent 3D cadastral objects on 2D cadastral maps?	Yes. By dotted lines, special surface texture and text (e.g. “1:32”).	No change.
10.4. Are there specific cartographic styling rules for 3D cadastral maps (models; e.g. as disseminated in 3D pdf)? If yes, are there 3D specific cartographic rules developed or being developed?	Same rules in the cadastral survey plan and the index map. Also see 10.3.	No change.
10.5. Is the 3D Cadastral information accessible in integrated manner with the 2D Cadastral information?	Yes.	No change.
10.6. Are there specific symbols on the 2D cadastral map (paper, digital or web-based) indicating the presence of 3D Cadastral objects (and in web-context perhaps even linked)?	Yes, see 10.3. Not indexed. Only possible to go via the textual part of the real property register.	No change.
10.7. Is the legal information (RRRs and Parties) available in integrated manner in dissemination portal with the 3D Cadastral objects? (even if source of legal data may be a different organization, but then use information infrastructure approach)	Yes.	No change.
10.8. Are 2D/3D cadastral data available to the general public or just to the relevant parties?	Available to the general public	No change.
10.9. Any other 3D cadastral information dissemination issues?	No	

11. Statistical information

This part of the questionnaire refers to statistical information (and is most relevant for jurisdictions with parts of 3D Cadastre registration operational, but all are encouraged to complete this section, and especially the expectations for 2018).

	Status 2014	Expectations 2018
11.1. What is the smallest 2D and 3D parcel that is present/ allowed to be registered in the land administration?	Smallest 2D parcel: 0.2 m2. Smallest 3D parcel: 1 m2 (part of real property).	
11.2. What is the largest 2D and 3D parcel that is present allowed to be registered in the land administration?	No legal limits.	No change.
11.3. What is the typical (or average) size of 2D and 3D parcels which are registered in the land administration? Subdivide by nature of 3D parcel when relevant (e.g. related to building, apartment, airspace, tunnel,...)	No statistics available	
11.4. How many 2D and 3D parcels do you currently have in your land administration?	2D parcels: 3258911. 3D parcels: 870	
11.5. Which year did you start registering 3D parcels in the land administration?	2004 (3D parcels, excl. ownership apartments). 2009 (ownership apartments)	
11.6. What is the ratio of 3D parcels in rural vs. urban areas?	No statistics available	
11.7. Please specify names of cities or towns or suburbs or regions or locations where there are significant numbers of 3D parcels.	Stockholm Gothenburg Malmö Ownership apartments are more common in smaller cities than e.g. Stockholm	
11.8. Please provide the following data: (a) Size of jurisdiction in square kilometres (b) Current number of 2D parcels (c) Current number of 3D parcels (d) Current population	Stockholm municipality: a: 187 km2 b: 59333 c: 154 d: 905 000 Malmö municipality: a: 158 km2 b: 31467 c: 91 d: 315 000 Göteborg municipality: a: 463 km2 b: 69567	

	c: 55 d: 550000	
11.9. Approximately what are the proportions of various types of the 3D parcels (related to apartments, subsurface parking, subsurface shopping centres, bridges, tunnels, airspace, utility networks, etc)?	No statistics available for each city.	
11.10. Approximately what surface area of the jurisdiction is affected by 3D parcels (the total area of all the footprint of all 3D parcels).	No statistics available for each city.	
11.11. Any other interesting statistical fact(s)?	No	

12. Reflection

This section is only relevant in case also in 2010 the 3D cadastres questionnaire for your jurisdictions was completed (otherwise skip this section).

	Remarks
12.1. Compared to the 2010 expectations, which 3D land administration developments did go faster than expected?	Difficult to say, but large building projects are using 3D property formation for tunnels, garages, street overhang, etc. An example is the New Karolinska hospital in Stockholm.
12.2. Same question, but now, which developments did go slower than expected?	The restructuring towards object orientation of the real property register is not finished yet. The formation of ownership apartments has not accelerated as much as expected. Probably due to a well-functioning site-leasehold system in Sweden and the general economic crisis.
12.3. If some (limited) form of 3D Land administration functionality has become available, what are the observed benefits? And for who?	The benefit is easy access to information in the real property register. Although the GIS possibilities for e.g. analytical purposes are limited due to no full 3D (volume) registration.
12.4. What are the (top-3) challenges of issues to be addressed to realize further 3D Land administration progress?	• To further the formation of 3D properties. There is a lower number of 3D property than expected. • A governmental investigation has suggested creating 3D ownership apartments in existing tenancy apartments. That has to be addressed if decided.
12.5. Any other reflections?	

13. 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.

	Remarks
13.1. Country (State, Province)	Sweden
13.2. Your name, function/position and your organization	Peter Wiström, Per Sörbom and Jesper M. Paasch, Lantmäteriet, the Swedish mapping, cadastral and land registration authority. Jenny Paulsson, KTH Royal Institute of Technology.
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13.4. Other issues	

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