Questionnaire 3D-Cadastres: status September 2014 Cyprus

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 homogeneous[1] 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).

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[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.

	Cyprus Status 2014	Cyprus Expectations 2018
1.1. Are all 3D parcels (3D spatial units in LADM terminology) constrained to be within one surface 2D parcel?	Yes	Yes
1.2. Are 2D and/or 3D ambulatory[2] boundaries permitted?	No	No
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	No
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)?	n/a	
1.4. Are disconnected parts of a single 3D parcel allowed?	Yes	Yes
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).?	No	No
1.6. Are curved surfaces to bound the 3D parcels allowed?	No	No
1.7. Must the curved surfaces (if allowed) be cylindrical sections, or any other constraint?	n/a	n/a
1.8. Any other constraints – e.g. all surfaces must be horizontal or vertical?	No	No
1.9. Is there legislation (law and/or regulations) for 3D descriptions of parcels? If so please, mention law and article(s).	The Cyprus Immovable Property (Tenure Registration and Valuation) Law, Cap 224 deals with horizontal (strata) division of immovable property (appartments). The Cyprus Immovable Property (Tenure Registration and Valuation) Law, Cap 224, article 5 specifies that "Private ownership of any land shall	

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[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.

	extend to the surface and to the substance of the earth beneath the surface and to the space above the surface, reasonably necessary for the enjoyment thereof, but not extend to minerals".	
1.10. Is the legal text available in original language?	Yes	Yes
1.11. Is the legal text (relevant part) available in English translation?		
1.12. Do you have example descriptions of typical 3D parcels; either 'prototype' or 'operational'?	In case of apartments a special drawing plan indicates the boundaries of the apartment units. These special plans are made in 2D (for each floor level).	
1.13. Is there a formal model for the 3D parcels (UML style); e.g. based on ISO TC211 series (especially LADM, ISO 19152)?	No	Not decided yet.
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?	Not as 3D parcel. They are considered however as immovable property. The Cyprus Immovable Property (Tenure Registration and Valuation) Law, Cap 224, article 5 specifies that "immovable property includes land, buildings, springs, wells, water,.."	
1.15. Are legally restricted spaces, above or below, such as polluted areas considered as 3D parcels?	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 the maximum allowed height of constructions is specified in planning zones plans)	
1.17. Any other geometric issues related to 3D parcels?		

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)	The passage/channelling easement is registered in most of the cases. The network is shown on the cadastral plan in 2D form. There are cases where the symbol on the cadastral plan distinguishes the underground from the on-ground network.	
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?	(a) Yes (b) Yes (c) no (d) Yes	
2.3. Does the jurisdiction have private networks? If so please, mention law and article(s).	The utility networks are mainly owned by semi-governmental organizations. Nowadays there is a trend to privatize them.	
2.4. If so, are they registered as 3D property parcels (spatial units)?		
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).	The Cyprus Immovable Property (Tenure Registration and Valuation) Law, Cap 224, article 11-15	
2.6. Is the text of laws and regulations (relevant part) available in English translation?		
2.7. Do you have example descriptions of typical 3D parcels (spatial units) for networks; either 'prototype' or 'operational'?	Yes but in 2D form.	
2.8. If the network (legal) objects break at the surface parcel, how do you deal with intersecting networks or vertically parallel networks?	The networks are shown in 2D form on the cadastral plans with symbols that could be different in case of underground utilities.	

2.9. Any other geometric issues related to the registration of networks?		

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	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,..)	More common are apartment units	
3.3. Does the jurisdiction have construction/building units? If so please, mention law and article(s).	Cyprus Immovable Property (Tenure Registration and Valuation) Law, Cap 224, article 38.	
3.4. Is the legal text available in original language?	Yes	
3.5. Is the legal text (relevant part) available in English translation?		
3.6. Do you have example descriptions of typical 3D parcels; either 'prototype' or 'operational'?		
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?	Typically the unit is defined to the middle of the walls/ceilings, in case of common walls, and to the outer boundary of the wall, in case of external walls.	
3.8. Is common property inside the building registered? If so, how?	Yes , common property is shown on the special cadastral plan and it is registered	
3.9. Who owns the common property inside the building?	All apartment owners, in shares, based on the value of each apartment.	
3.10. Who owns the land on which the apartment is built?	All apartment owners, in shares, based on the value of each apartment.	
3.11. Do you allow sub-division of apartments or apartment blocks?	The division of apartments is done based on the building permit. The apartments could be sub-divided but this needs permission by the appropriate authority.	
3.12. Can the land on which the building is built be sub-divided or sold or mortgaged without the consent of	No	

majority of the apartment owners?		
3.13. What is the numbering convention for apartments (please specify in terms of cadastral parcel as well as street addressing)	The (registered) apartments get a unique registration number within the Town area (quarter). The parcels, on which the apartment stands on, get a unique parcel number which appears on the cadastral plan. The apartments also get a street address for which the municipalities are responsible.	
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?)	"Yes" for the new plans prepared as a result of a resurvey project, which are in an absolute spatial reference system. "No" for the first cadastral plans prepared between 1904 and 1928.	
4.2. Are the cadastral database coordinates authoritative?	"Yes" for the new plans prepared as a result of a resurvey project. "No" for the first cadastral plans prepared between 1904 and 1928.	
4.3. If not, what is the authoritative source of X/Y coordinates?	The cadastral plans.	
4.4. Do you have parcels defined by the walls of a building (with no recorded geometry)?	No.	
4.5. What is the spatial reference system for X/Y Coordinates?	Cyprus Geodetic Reference System (1993) (WGS 84, Local Transverse Mercator).	
4.6. Any other X/Y coordinate issues?		

5. Z Coordinates/height representation

	Status 2014	Expectations 2018
5.1. Are the Z coordinates of 3D parcels relative to local ground?	No	
5.2. Are Z coordinates reduced to a standard datum (absolute)? If so, what is the spatial reference system for the Z coordinate?	No	
5.3. In principle possible to store both relative and absolute Z coordinate?	No	
5.4. Is the earth surface (height) explicitly stored (in the DCDB or other accessible register)?	No. DTM is stored in topographical database which can overlay with DCDB.	
5.5. What is the source of elevation for the 2D surface parcel?	n/a	
5.6. Any other Z coordinate issues?		

6. Temporal Issues

	Status 2014	Expectations 2018
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).	No	
6.4. Are there any attempt to integrate 3D space and temporal representations, into a single 4D space/time representation?	No	
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

	Status 2014	Expectations 2018
7.1. Range of RRR on 3D parcels.	The Cyprus Immovable Property (Tenure Registration and Valuation) Law, Cap 224, article 5 specifies that "Private ownership of any land shall extend to the surface and to the substance of the earth beneath the surface and to the space above the surface, reasonably necessary for the enjoyment thereof, but not extend to minerals". The above law and other laws define the RRR of properties including apartments (ownership, mortgage, lease etc…)	
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).	See 7.1 above	
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	
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?	See 7.1 above.	
7.7. What applications do you foresee for 3D land administration?		
7.8. Are the administrative source documents (source of RRRs) title or deed based?	Title based.	
7.9 Who is responsible for the correctness of the specified 3D boundaries in spatial source documents (which authority)?	The Department of Lands and Surveys (DLS) based on the plans approved by Local Authorities and/or the Town Planning and Housing	

	Department.	
7.10. Is registration of 3D parcels done inside the cadastral mapping agency, the land registry or elsewhere?	Inside.	
7.11. Are 3D registrations handled by the same organisation that handles traditional (2D) land administration?	Yes.	
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?	Paper-based titles. It refers to the special plan showing each floor.	
7.13. Any other RRR issues?		

8. DCDB (The Cadastral Database)

	Status 2014	Expectations 2018
8.0. Is database schema LADM based?	No	
8.1. Does the DCDB contain representation of 3D parcels (in any form)?	No	
8.2. If so, how are they represented (in the DCDB)?	n/a	
8.3. If so, how are they presented on cadastral "maps" (including screen presentations)?	n/a	
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?	n/a	
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?	No	
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,..)?	n/a	
8.8. What Spatial DBMS software do you use? Any 3D capabilities included and used?	ArcStom, ArcSDE/Oracle	
8.9. Do you have any validation rules for 3D representation in the database?	No	
8.10. What (GIS/CAD) software is used for updating, editing, analysis, and visualization of the cadastral data? Any 3D capabilities included and used?	ArcInfo and ArcGIS. 3D capabilities are not used. CAD software is used for special plans of apartment floor (2D).	
8.11. What web software is used for remote data access/distribution and visualization? Any 3D capabilities included and used?	ArcIMS, ArcGISServer	
8.12. Is your DCDB organised as Multi-Layers or Object Oriented or some other data model?	Multi-layers	
8.13. How do you query 3D objects in your DCDB?	n/a	
8.14. Is it possible to query neighbourhood parcels to a 3D object, vertically as well as horizontally?	No	

8.15. Any other DCDB issues?		

9. Plans of Survey (including field sketches)

	Status 2014	Expectations 2018
9.1. Do the survey plans carry 3D parcel representations?	No	
9.2. If so, how are they represented?	n/a	
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	
9.4. Is sketch level allowed (low geometric quality, but in principle enough to indicate the 3D object)?	2d special plans for each apartment floor.	
9.5. Is it possible to define a 3D parcel by referring to other 3D real world objects/ topography (and not specifying coordinates)?	Yes	
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….?	CAD files are used for the apartment floors	
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)?	No	
9.8. Do you have examples of (prototype or production) 3D survey plans available?	No	
9.9. Are any reference objects visible on the survey plan (e.g. real buildings, roads, that is 3D topography)?	No	
9.10. What form of 3D data acquisition is used (CAD, terrestrial surveying, sketches, stereo/oblique images, laser scanning,…)?	Terrestrial surveying and preparation of 2d plans	Stereo/oblique images and laser scanning.
9.11. What software do you use for creating and processing survey plans? Any 3D capabilities included and used?	Mainly LISCAD and ArcGIS. No 3D capabilities are used.	
9.12. Can 3D parcels be subdivided, consolidated or nullified?		
9.13. Is there any existing technical circular or directive to assist Surveyors in 3D data collection in the field?	No	
9.14. Are the surveyors required to undertake a field survey for 3D	No. The surveyors have specific instructions to carry	

cadastral data?	out horizontal (strata) divisions and provide 2d plans for each floor.	
9.15. Are building construction plans used to compile 3D cadastral information for apartments?	Only 2d plans for each floor.	
9.16. Is 2D/3D field survey done by private licensed surveyors or by government surveyors?	It is done by private licensed or government surveyors. The owner of the property has the option to choose.	
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.	Special plans for the horizontal division are created separately for each cadastral parcel	
9.18. Do you show dimensions or isometric views of 3D parcels on survey plans (do you also store this in a database)	No. The special plans are created on scale (usually 1:500)	
9.19. Any other survey plan issues?		

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, but it does not include 3D data.	
10.2. Are specific file formats or standards used to distribute 3D Cadastral information? (e.g. LandXML, CityGML, BIM/IFC, 3D pdf,…)	n/a	
10.3. Are there specific cartographic styling rules for representing 3D cadastral plans, or to represent 3D cadastral objects on 2D cadastral maps?	There are specific cartographic styling rules to represent 3D cadastral objects on 2D cadastral maps	
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?	No	
10.5. Is the 3D Cadastral information accessible in integrated manner with the 2D Cadastral information?	n/a	
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	
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	
10.8. Are 2D/3D cadastral data available to the general public or just to the relevant parties?	2D cadastral data are available to public.	
10.9. Any other 3D cadastral information dissemination issues?		

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?	There are parcels which are registered before 1946 which are very small (15 sq. m.). After 1946 there are limitations on the extent of the newly created parcels. Lots for example have a minimum extent of 520 sq.m. Agricultural parcels having water source have a minimum extent of 1338 sq.m., and with no water source 6689 sq.m. There are cases of wells which are registered and appear on the cadastral plan as a small circle. Apartments are registered as part of a horizontal division (could be as small as 30 sqm). There are also registered commercial shops which can also be a small room.	
11.2. What is the largest 2D and 3D parcel that is present allowed to be registered in the land administration?	There is no limitation. The biggest parcels are in the forest (state land).	
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,…)	Please see 11.1 above.	
11.4. How many 2D and 3D parcels do you currently have in your land administration?	There are 1.600.000 2d parcels (whole island). There are also 150000 registered units (apartments).	
11.5. Which year did you start registering 3D parcels in the land administration?	In 1980 the new law was introduced allowing the registration of apartments.	
11.6. What is the ratio of 3D parcels in rural vs. urban areas?	95% of apartments are in urban areas.	
11.7. Please specify names of cities or towns or suburbs or regions or locations where there are significant	Nicosia, Limassol, Larnaka, Pafos	

numbers of 3D parcels.		
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	(a) 9243 sq Km (b) 1.600.000 (c) 150.000 (registered) (d) 840.000 people	
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)?	90% are apartments.	
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).		
11.11. Any other interesting statistical fact(s)?		

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?	none
12.2. Same question, but now, which developments did go slower than expected?	none
12.3. If some (limited) form of 3D Land administration functionality has become available, what are the observed benefits? And for who?	
12.4. What are the (top-3) challenges of issues to be addressed to realize further 3D Land administration progress?	(a) Political decision (b) Technical approach for data capture (c) Data model design
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)	Cyprus
13.2. Your name, function/position and your organization	Dr Elikkos A. Elia Department of Land and Surveys
13.3. Contact details: address email, telephone	29 Michalacopoulou Str. 1455, Nicosia Cyprus Tel. + 357.22402890 Fax. + 357.22304858 E-mail: eelia@dls.moi.gov.cy
13.4. Other issues	

References

ISO 19152:2012 'Geographic information - Land Administration Domain Model (LADM), http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=51206

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