Representing 3D data in a cadastral database – Queensland Case

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ABSTRACT

Urban environments have seen the growth of infrastructure and buildings above and below the ground due to limited availability of urban land. Cadastral jurisdictions have traditionally represented properties as a closed polygon with associated registered rights: termed as two-dimensional (2D) cadastre. Modern cadastral jurisdictions are facing increasing pressure to register and represent properties above and below ground: termed as three-dimensional (3D) cadastre. The cadastre has traditionally been designed around properties on the surface of the land, called base parcels, which has made the storage and representation of 3D data in a 2D database very challenging.

It is important to understand the general complexities of a 3D cadastre as well as particular 3D related needs within each cadastral jurisdiction. There are Institutional issues such as 3D specific legislation, policy, standards; and technical guidelines; Operational issues such as registration of 3D properties and their interaction with current 2D properties; and Technical issues such as 3D parcel construction; 3D validation; 3D data capture and storage; and 3D data representation. This paper focuses on the Operational and Technical issues to identify and discuss the problems faced by the cadastral jurisdiction of Queensland and propose possible solutions to improve the storage and representation of 3D cadastral data in the existing digital cadastral database.

Queensland cadastre allows the registration of all mathematical 3D shapes and differentiates between building and volumetric shapes in the plan representation on the paper. This has given rise to complex examples of 3D shapes registered in Queensland cadastre; however, the digital cadastral database does not store 3D geometry data. Currently, the paper plan is the legal document for the geometrical data, while the records stored digitally in the Titles Office are the legal record of rights. The digital cadastral database (DCDB) models the real world cadastral situation and connects to other databases to provide a comprehensive search and visualisation facility for surveyors conducting field surveys as well as the Department to update and maintain records of cadastral transactions. The Electronic Access to Registry Lodgement (EARL) project is in its second phase, where legal paper plan data are converted to digital records and stored in the database; however, in the last phase of the project, the legal document will be the electronic record. This has created a push for the electronic lodgement as well as the DCDB to be capable of storing, visualising and manipulating accurate legal records of 3D data. Additionally, as the cadastral data is being used by other stakeholders for their various applications, the DCDB is required to be capable of GIS operations such as neighbourhood or locality searches, intersections, buffers or other spatial analysis.

There are two possible solutions identified and deliberated in this paper. First, the 3D objects could be stored in a special repository which is outside the main cadastral database, but is linked to the base parcel through parcel identifiers. The advantage is that the existing data structure is not disturbed and is easier to effect a database transition. The disadvantage is that the repository will not be able to support 3D searches and spatial analysis; and the effects on the 3D property when the underlying base parcel undergoes a transaction need to consistently

well-defined. The second solution is to include all parcels (2D or 3D) in the one data base, and it is suggested that the method identified in the newly developed ISO standard called Land Administration Domain Model (LADM) (ISO19152 2012) be adopted. The advantages are that all GIS functions will be possible, and the relationships between parcels and other information classes will be consistent. The disadvantage is that significant time and resources need to be allocated to build and modify the model to suit particular jurisdictional requirements. In order to facilitate either of these options, the Open GIS Consortium (OGC) which is currently managing LandXML should ideally create explicit classes which will support 3D geometries. The advantage is that the requirements of an electronic legal record will be satisfied and surveyors will be able to lodge electronic plans with 3D data. By contrast, the current LandXML does not have explicit classes for 3D faces or solids.

This paper provides a background on the current cadastral situation in Queensland with emphasis on 3D cadastre, builds on the current research, and proposes two possible scenarios which can be developed to provide an independent or combined solution for a full 3D cadastral implementation that can be used by any cadastral jurisdiction.

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