Chapter 10: BIM for Facilitation of Land Administration Systems in Australia

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Introduction
With the introduction of the concept of 3D Cadastre and extensive efforts in this area, currently there is a shift from 2D land information management systems to 3D (Stoter & Oosterom, 2006). Research in the context of 3D Cadastre highlights the important role of 3D information about the legal aspects of a parcel (or building) for analysis, as well as visualisation purposes.

This facilitates an efficient management of land/building in the complex environments such as urban context beyond the capabilities of 2D systems. However, currently, the process of land administration in Australia is based on 2D land parcels (Kalantari, Rajabifard, Wallace, & Williamson, 2008) and the input of many processes is still 2D data. As an example, the subdivision plan (which contains Rights, Responsibilities, and Restrictions as legal entities to be submitted for title issuance) for a complex building (with multiple ownerships) is extracted from architectural plans, which in the majority of cases are 2D CAD files (SurveyorsBoard, 2000).

Building Information Model (BIM), on the other hand, is a fast-growing technology and a promising development in the Architecture, Engineering, Construction and Facility Management (AEC/FM) industry. It is considered as the extension of CAD (Karimi & Akinci, 2010 pp 11), and allows for the development of an N dimensional (nD) virtual model of the facility (e.g. building) by involving many stakeholders (e.g. constructors, surveyors, owners, etc.) to simulate its planning, design, construction and operations/management (Azhar, Nadeem, Mok, & Leung, 2008) throughout its lifecycle (Succar, 2009) (See figure 1).
BIM is three dimensional, data rich and intelligent. The key benefit of BIM is that as a knowledge base, it represents the geometry and semantics of different physical and non-physical aspects of a building (e.g. spaces, units, structural, mechanical, electrical, plumbing, gas and utility systems, scheduling, costing, etc.) in 3D and detailed so that it can be queried and visualised. This enables fast access to reliable information about the building (Zhang, Arayici, Wu, Abbott, & Aouad, 2009) for a variety of applications.

Figure 1: BIM Process Lifecycle (adopted from Pautasso, 2012)

The data about a building stored in the BIM is always consistent and up-to-date throughout its lifecycle. Because of its value, BIM is currently being mandated by many governments around the globe. As an example, Singapore will be fully adopting BIM by 2016 (BuildingSMART, 2012). However, despite the slow rate of adoption of BIM in Australia – 6-16% BIM utilisation will be achieved by 2016 (BuildingSMART, 2012) – significant outcomes in the near future seem promising.

Identification and visualisation of legal information (RRRs) related to a land parcel or a building can be very complex as they exist at different levels of abstraction. However, there is a close relationship between legal objects
and physical objects as discussed by Aien et al. (2011). These relationships may include:

a) The legal entity is as the same as the physical object itself – or aggregation of number of physical objects or subset of one (e.g. the column as common property).

b) The legal entity can be an extension of physical object (e.g. the balcony which the legal object can be extracted from the physical object).

c) The legal entity is bounded by a number of physical objects (e.g. rooms, or units).

d) Legal object is not related to physical object.

Figure 2: Building Information Model as a new component in Butterfly diagram (Original from Williamson, Enemark, Wallace, & Rajabifard, 2010)

In this way, for the cases (a) to (c), BIM can be considered as a useful technology to facilitate processes in land information management (especially in the complex, dense, and vertically extended urban environment). By being utilised as important input (an up-to-date extensive
3D repository of physical and non-physical information about buildings) to this process, within the context of national, state, or local Spatial Data Infrastructure (SDI). BIM can provide rich information about different physical aspects of the building (e.g. their geometry as well as their relationships) (see figure 2).

With utilisation of BIM in this process, experts can extract legal information from this reliable source by not only considering the architectural aspects of the building but its structure, wiring and cables, pipes, and other systems, which are integrated into a single data repository. Many of these can result in complexity in the analysis and visualisation of ownerships, common properties, or even conflicts as there is a strong interrelationship between these objects – both semantically and physically.

Introducing BIM to Australian land information management brings new benefits in the context of 3D Cadastre research. Its utilisation – instead of 2D architectural plans – will result in avoiding many inconsistencies caused by estimation and creation of 3D information from 2D systems; and a better and more efficient extraction of RRRs and their visualisation within the process of land information management. However, this introduction brings a range of challenges such as institutional, technical, and legal to the process that must be resolved.

This research aims to integrate BIM information as part of SDI in the country at its different levels, which as figure 2 illustrates, facilitating the land management and support sustainable development. For this purpose, this research looks into the integration at data level, which establishes the ground for further integration at higher levels (e.g. processes).

The main findings at this stage include the identification of the main differences between BIM and general geospatial domain data models (in terms of semantics, geometry, and levels of details) currently being used (e.g. CityGML, GML, and LandXML), extraction of criteria for effective integration, and the review and evaluation of existing approaches for this integration.

In the next step of this research, the currently developing approach for the integration will be implemented and tested using a case study. Future directions after successful integration of BIM with National SDI at data level include:
• integration of BIM within the context of SDI at process level using SDI’s Service Oriented Architecture structure
• integration of BIM with 3D City Models in order to create an environment for more complex RRR analyses such as taxation based on the ‘view’ from the apartment, or underground or air resource restrictions, etc.
• testing and validating this integration in the context of an Australian national land administration system.

References


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