The role cadastral data modelling in e-Land administration

This paper describes the importance of cadastral data modelling in data management as well as coordination among subsystems in an e-LA

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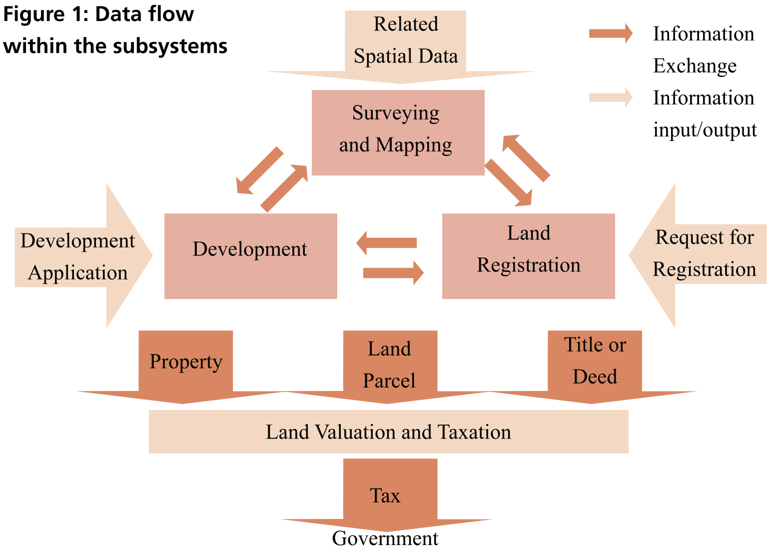
Land administration systems evolved from a focus on core functions of regulating land and property development, land use controls, land taxation and disputes (Dale & McLaughlin, 1999) to an integrated land management paradigm designed to support sustainable development (Enemark et al., 2005).

In the new land management paradigm, the core functions of land administration remain organized around three sets of agencies responsible for surveying and mapping, land registration, and land valuation (Dale & McLaughlin, 1999). These agencies are encouraged to take up new opportunities for better management of diverse internal approaches and overall delivery of LAS policy. Also the unique institutional, economic, legal and technical settings of each country or jurisdiction are recognized.

In Australia, the diversity of agencies leads land administration to diversification of services and functions to mange real property. For example the land registry places emphasis on the holding and the registration of private rights, restrictions and responsibilities on property parcels. At the same time the land development subsystem is concerned with use restrictions imposed through zoning mechanisms. Taxation and valuation focus on the economic function of the real property.

Although these processes seem to be independent, each is generally applied to the real estate parcels and moreover they, and other systems such as utility supply, can be all related together. For example, local governments supply property details to the extent of their local government areas; the water utilities prepare proposed plans of their area of interest. On ground identification is provided by surveyors through development plans which are added to the property data set. The land taxation office requires the change of property use as well as the property owner to calculate the revenue and tax for specific purposes. Ideally, these activities require exchange of information among the subsystems; in the digital world, they should not duplicate information but should use each others' data sets as a resource and as an input for their own database (Figure 1).

Figure 1: Data flow within the subsystems



Each subsystem has specific functions and services. These specific functions or services directly impact on their databases. For example a register of title or deeds normally contains a record of the attributes associated with each parcel: its owner, the interests held and description of land. In an open registry, functions and services include providing this information to the public. In valuation and taxation systems several techniques for estimating the value of the property may be used; each technique serves different purposes and makes different assumptions. For land use planning and land development control, the organization needs various datasets as well as various functionalities for analysis and decision making. The unique perspective of each agency causes it to implement specific functionalities to deliver its services and to develop different data structure.

To meet government needs for up-to-date, complete and comprehensive information, e-LA intends to treat the data and services of each of the agencies holistically, by improving data management and coordination. Cadastral data modelling is one idea offered to implement to this strategy.

Cadastral data modelling is particularly important in the domain of land management that relates to land administration and land markets. The modelling of a cadastral system has received special attention focused on the International Joint FIG Commission 7 and COST Action G9 Workshop on Standardization in the Cadastral Domain in 2004. The next two sections discuss importance of cadastral data modelling in data management and coordination among subsystems.

Cadastral data modelling and data management

The core of cadastral domain model developed in the European context includes (Oosterom et al., 2004) :

- The subject: group ownership with non-defined membership
- The rights: the recognition of types of non-formal and informal rights
- The object: units other than accurate and established units

Cadastral data refers to all data related to these three components in the subsystems. Studies show that data management of land administration systems is one of the major cost items. Figures of between 50 and 75 percent of related total costs are quoted. The data component includes items such as data modelling, database design, data capture, and data exchange (Roux, 2004), and data catalogue.

Cadastral data must be able to be updated and kept current (Meyer, 2004). Although recent advantages in data capture technology make this easy, these initiatives are made in 'isolation' and no common view is formulated for the handling of cadastre and other related data. Consequently, the data sets cannot be easily integrated and shared because of the lack of harmonization between them. Further, no effective measures or supporting digital tools exist for the direct data access and propagation of updates between them in order to keep data sets up-to-date and in harmony (Radwan et al., 2005). The process of boundary data capture is an example of the problem. To gain maximum benefit from existing data, the building process should not only extract data from the documents and build the boundary network, but it should also analyze the data and provide a measure as to the reliability and accuracy of the computed coordinates. This opens the way for coordinates to be used more widely as the primary way for surveyors to convey instructions on how to locate the physical boundaries of a property (Elfick et al., 2005). If efficient and cost effective methods for capturing cadastral data including spatial and non-spatial data are realized in the cadastral data modelling, effective data management in e-LA is possible.

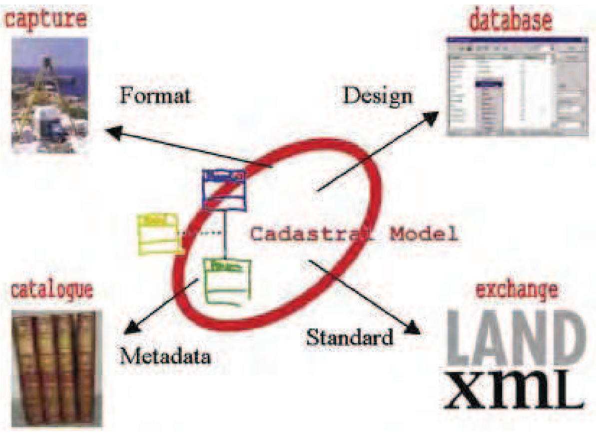


Figure 2: Role of cadastral data model in data management

The Cadastral database should join the attribute and spatial data and present them in an integrated portal, because attributes are as important as spatial information for decision support (Meyer, 2004). However the integrated portal does not necessarily allow attribute data and spatial data to be put together. They enable the user to access various distinct databases using a unique portal. Systems architecture design changed in response to the growing need to access data sets which were developed individually but simultaneously from various distinct databases within various divisions of large organization; these datasets increasingly have to be accessed at an integrated level (Vckouski, 1998). Introduction of new systems architecture facilitating access to cadastral databases whether spatial or non-spatial should be recognised in cadastral data modeling to achieve an e-LA.

Data must be standardized so that information can be shared across jurisdictional boundaries (Meyer, 2004). Therefore cadastral data needs to have its own exchange language to better communicate among various organisations. Because of the nature of cadastral data, especially in spatial context, a specific language is needed for cadastral objects and elements to permit exchange and migration of the data. Cadastral data modelling which understands specialised exchange language for cadastral data will facilitate exchange data among various subsystems.

Data will provide linkages to more detailed information that can be obtained from data producers (Meyer, 2004). The catalogue is a way to provide consistent descriptions about the cadastral data. The objective of the cadastral data catalogue is to develop a description of each object class, including a definition, a list of allowable attributes, and so on (Astke et al., 2004). An expanded cadastral data model including a data catalogue, facilitates data publication across a network.

Figure 2 illustrates the role of modelling data management. It formulates the proper way of capturing spatial and non-spatial cadastral data. Database design is based on data modelling. Data modelling is a conceptual level of modelling which underpins the design of logical and physical models of the database. The modelling component allows the data catalogue to fit metadata in the proper position whether it is separate or integrated with the other data. Also modelling introduces standards for the exchange and conversion of data among the various services for different organizations.

Cadastral data modelling and coordination among subsystems

An effective cadastral data model must describe what is fundamental to a business, not simply what appears as data. Entities should concentrate on areas of significance to the business.

The existing cadastral data models include the subject, the object and the rights associated with them. They follow a classic concept for the cadastral domain within land administration, based on historical arrangements made for land registration, surveying, building and maintaining the cadastre (Wallace & Williamson, 2004). However, to achieve e-LA, the model should also include the ICT based business processes among its subsystems.

Huge efforts to improve land administration are focused in utilization of ICT like the electronic submission and processing of development applications, e-coveyancing, the digital lodgment of survey plans, online access to survey plan information and digital processing of title transactions as a mean of updating the database. A comprehensive e-LA needs to incorporate the requirements of all these processes in all subsystems in the cadastral data model For example, the electronic conveyancing system should be developed in conjunction with the land taxation subsystem and land registry subsystem to ensure that all land transfer requirements are met in one simple process. The tax systems rely on properties not parcels and they have a property identifier that links the title, local government and tax systems. They are interested in property price and land use. The descriptions of vacant land, residential property, industrial property, rural property and commercial property are crucial for many taxation regimes. Only some of that information can be accused from land registry.

An expanded cadastral data model which realises both land taxation and land registry requirements can facilitate the processes within an electronic conveyancing system.

Local governments independently gather data layers, like dog exercise reserves and sites, walking trails, location of recreation clubs like horse riding clubs, as well as open spaces within the local government boundaries. This sort of information is associated with land parcel and property layers which are not found in the digital cadastral database of a country or state.

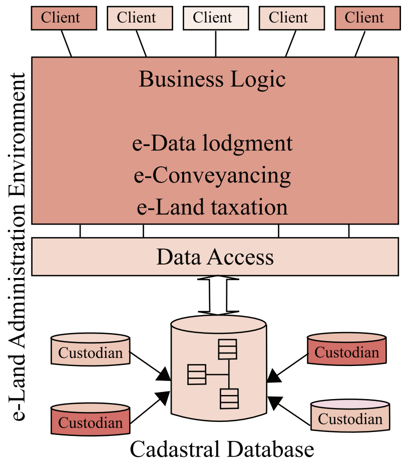


Figure 3: Role of cadastral data modeling in coordination among subsystems

An expanded cadastral data model which realises this kind of large scale and local land information can facilitate data flow among subsystems. It allows easy plug and play between local land information and cadastral database.

To achieve e-LA, cadastral data modelling is a basic step toward efficient service delivery (Figure 3), because data are defined in the context of business processes. It allows every single process in land administration subsystems to directly influence the core cadastre model. The modelling process should recognize the business processes to mirror them in the core cadastral model.

Conclusion

The paper reviewed the functions of land administration subsystems and revealed data flow and process among them. It described an e-LA concept and its goals, including holistic coordination among the subsystems and effective service delivery. It argued that the current cadastral data models are traditional and are based on the historical context of land administration and cadastres which need to be developed to fully realise e-LA. Cadastral data modelling was identified as playing a key role in e-LA especially for data management and coordination among subsystems.

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References

Astke, H., Mulholland, G. & Nyarady, R. (2004), 'Profile Definition for a Standardized Cadastral Model', Proceedings of Joint FIG Commission 7 and COST Action

G9 Workshop on Standardization in the Cadastral Domain, December 09-10, Bamberg, Germany.

Dale, P. & McLaughlin, J. (1999), Land Administration, Oxford University Press, New York.

Elfick, M., Hodson, T. & Wilkinson, C. (2005), 'Managing a Cadastral SDI Framework Built from Boundary Dimensions', Proceedings of FIG Working Week 2005 and GSDI-8, April 16-21, Cairo, Egypt.

Enemark, S., Williamson, I. & Wallace, J. 2005, 'Building Modern Land Administration Systems in Developed Economies'.

Meyer, N. V. (2004), Cadastral Core Data Draft Report – October 2004 Version 5.

Oosterom, P. v., Lemmen, C. & Molen, P. V. D. (2004), 'Remarks and Observations related to the further development of the Core Cadastral Domain Model', Proceedings of Joint FIG Commission 7 and COST Action G9 Workshop on Standardisation in the Cadastral Domain, December 09-10, Bamberg, Germany.

Radwan, M. M., Bishr, Y., Emara, B., Saleh, A. & Sabrah, R. (2005), 'Online Cadastre Portal Services in the Framework of e-Government to Support Real State Industry in Egypt', Proceedings of FIG Working Week 2005 and GSDI-8, Cairo, Egypt.

Roux, P. L. (2004), 'Extensible Models and Templates for Sustainable Land Information Management Intent and Purpose', Proceedings of Joint FIG Commission 7 and COST Action G9 Workshop on Standardisation in the Cadastral Domain, December 09-10, Bamberg, Germany.

Vckouski, A. (1998), Interoperable and distributed processing, Taylor and Francis, Padstow, Cornwall.

Wallace, J. & Williamson, I. (2004), 'Developing Cadastres to Service Complex Property Markets', Proceedings of Joint FIG Commission 7 and COST Action G9 Workshop on Standardisation in the Cadastral Domain, December 09-10, Bamberg, Germany.

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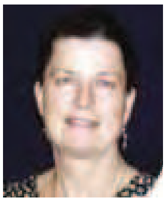

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