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Title: Managing the Records which underpin the Land Tenure System

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MANAGING THE RECORDS
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Introduction

Land ownership is a fundamental layer in the Spatial Data Infrastructure (SDI). Because of its accessibility, many attributes are located with respect to land boundaries and the geographic position of these attributes depends on the accuracy of the land ownership layer.

In Australia, cadastral surveys and the marking of land boundaries preceded geodetic surveys by over a hundred years and consequently, it was the only reference system available during this period. Parish maps (generally at a scale of two inches to the mile 1:31680) were compiled from the portion surveys. While they were not subject to any geodetic control and were intended to be used for administrative purposes, the parish map series became the basis for more general mapping as they were the only maps available.

Surveyors were also required to assess land at the time of initial subdivision and this assessment included details of improvements, vegetation, topography, soils and in some cases evidence of mineral deposits. So the early survey data (field books and plans) contains both dimensional information about parcel boundaries and valuable "base line" data about the country as it was at time of settlement.

Following the Second World War, comprehensive topographical mapping was carried out throughout Australia and in NSW the Parish map series was used to compile the cadastral layer for these maps. The old maps were enlarged to the new map scale and the cadastral boundaries traced through after fitting them as best as possible to fence lines and other data compiled from photogrammetry. At the time of compilation, this layer was not intended to be more than a general indication of the location of the boundaries with respect to the topography, and details were often omitted when they were likely to "clutter up" the topographical map.

The DCDB in NSW was initially built by digitising the cadastral boundaries shown on existing maps including those in the 1:25000 and 1:4000 topographical map series. Since then, considerable resources have been applied to update and upgrade the data set as new subdivisions are registered. It provides a broad coverage for the whole state, and has been a very useful administrative tool for many years. While it was never intended to be used as a framework for other data sets, because of its availability, it has become a de-facto GIS mapping framework. The situation in NSW is not unique for they have tended to follow the trends of other countries as mapping and GIS technology developed.

An understanding of the source data gives an insight into the problems of completeness and accuracy of the data set and the difficulty of updating it. Errors of over seven metres in position still exist in urban areas and there are no mechanisms in place to ensure that the data is complete or up to date.

Significant problems occur if data with a good positional accuracy is combined with data from the DCDB. The Global Positioning System (GPS) now provides a universal and relatively inexpensive and accurate method of locating data items, consequently there is an urgent need to build a numerical cadastral data base (NCDB) as a complete and comprehensive replacement for the DCDB. As the cadastral layer is the fundamental layer underpinning most GIS systems, it should be of a precision at least equal to that of the data in the other layers in the GIS.

Trends in Cadastral Surveying.

Historically, the regulations for cadastral surveys have been based on the measurement technology available at the time. In the 1880's after the theodolite became available, surveyors were required to use it and the standards required for angle determination were changed accordingly. Similar changes have been made to standards with respect to improvements in distance measuring techniques such as the introduction of the long steel band and the developments in electronic distance measurement (EDM). GPS has now opened the way for a completely different approach, for ***it now easier to measure a position accurately than it is to measure a distance***. This will inevitably force a move to a coordinate based cadastre from the existing "metes and bounds" system. Such a system fits well with GIS but it will requite a completely different approach by titling authorities and will require the building of a complete parcel network from the existing plans to effect the transition. Such a network can be used to replace the DCDB

Ideally, a numerical cadastral data base (NCDB) should be built directly from subdivision plan data and be automatically updated as new plans are accepted into the system. If structured appropriately, a NCDB will contain sufficient information to allow for the automation of most of the checking and charting processes for new plans and will produce coordinates of a precision similar to that of the cadastral surveys which are the basis for the plans. In other words, the coordinate data can be used to reestablish parcel corners on the ground to a similar accuracy that of a surveyor using the "metes and bounds data" from the cadastral plans. Most titling authorities are now storing digital data and coordinates from new surveys but few are addressing the task of capturing the necessary data from the previous subdivision plans.

Understanding the subdivision data set (plans and descriptions)

Many countries define boundaries by "metes and bounds" and have similar ways of displaying subdivision data in plan form. Their "land titles" are based mainly on the dimensions of each parcel and its location with respect to adjacent parcels. This information is documented in cadastral survey plans and legal descriptions and these records are usually kept and maintained by a Land Titling authority or by the Local Government Administration.

While most GIS managers appreciate limitations of a DCDB, it has generally been considered too complicated and costly to build the property ownership layer directly from source documents (the subdivision data). The reasons for this relate partly to the lack of systems for efficiently extracting relevant data and partly to the lack of understanding as to the structure and characteristics of this data.

In assessing the data content of any information system it is important to first understand the purpose and context under which the system has been built and maintained. Once an understanding of the system is established, decisions can be made on which sections of the data set should be extracted, how they should be captured and what items are of no further use. Cadastral plans of subdivision contain lot details, the outline of physical objects such as buildings, symbolic information illustrating fences etc., and notations as text data. The data includes the dimensions of polygons, traverse lines, offsets to structures etc.

Much of the dimensional and illustrative data on survey plans of subdivision has been included as evidence to the titling authority to show that the surveyor has adopted the correct location for the boundaries. This data is of little use after the plan has satisfied the scrutiny of the plan examiners and had been accepted for inclusion in the register.

Similarly, many of the notations are made up from standard phrases indicating that a particular right or encumbrance has been created according to an act or bylaw. There is no need to copy each notation verbatim. A better procedure is to capture the reference information and link it to an action code indicating the phrases used. This technique captures the meaning of the notation rather than simply copying the words used.

Building a NCDB from Source Documents

In general the plans of subdivision and documents kept within a land titles record system contain all the data necessary to build an NCDB. If the data is adequate for surveyors to reestablish boundaries, then it is adequate to build a numerical data set.

Over the last 20 years considerable research has been carried out to use the content and structure of subdivision plan data to directly build a Numerical Cadastre Data Base (NCDB). These techniques have been applied successfully in Australia as well as in other countries such as the Philippines and the USA.

The cost of building a new system varies a little depending on the quality of the records and the method of access. If we use the average cost per parcel from the current projects in Queensland as a general figure, then the cost of building a new system for NSW is less than the current annual amount being spent overall to maintain the DCDB in that state.

The maintenance costs of the existing DCDB are very high because of the work involved in adjusting all the dependent layers in the various databases each time the cadastral fabric is upgraded. As the coordinates within a NCDB are of “survey precision”, new additions can be fitted without the need to adjust the surrounding cadastral fabric. It is difficult to cost

the long term benefit to GIS managers of working with a stable cadastral framework, but it must be considerable.

As demonstrated in recent projects in the NT, Queensland and NSW, the key to any successful project is to select only on the essential data items, test the data at each phase of the processing, and only store data which has been thoroughly tested and verified. Because of the size and complexity the source data, if these principles are not rigorously followed, project costs will rapidly increase and the subsequent data set may become unmanageable.

The process used there has three main phases:

Data Entry, where selected data is captured from each plan, tested for internal consistency and then stored in a standard format.

Parcel Joining, where a cadastral network is created and the topology within each subdivision is set up.

Network Adjustment, which generates the final parcel coordinates after honouring all the topological constraints within the system.

The structure of the NCDB parcel network is made up from the accumulated cadastral survey and subdivision data. In order to provide a complete picture, information from all plans should be included in the system. Superceded old plans may contain data not replicated in later plans. They may also have boundaries of covenants, easements etc., which are still relevant and which can cut across the later subdivision network.
It is essential that any NCDB be complete and contain details as to the accuracy and reliability of each data item in order to fulfil its role as the definition of the land boundary network.

Future

The creation of an NCDB is the first step in the move to a coordinate based cadastral system which in turn opens the door to a complete revision of the land titling system.

Up to the present time, surveying procedures have been designed to locate and relocate boundaries during a time when measurement systems were relatively inexact. Consequently, considerable emphasis has been on the location and relocation of physical objects in relation to boundaries. The GPS can provide precise positioning and so obviate the need for reliance on physical objects such as occupations, monuments etc., to define the location of land boundaries. This in turn can allow a complete revision of the whole boundary definition process.

An NCDB can facilitate the whole titling process and provide an exact framework for all dependent layers in a GIS. Updating can be by digital lodgment of new subdivisions and the mathematical checking process can be largely automated.

In the 1860’s Australia introduced “Torrens Title” to replace the “Common Law” deeds system for land ownership. This was a fundamental change in direction as it provided a

single central registry and guarantee of title. A coordinate based system is the final stage in the reform process as it can in addition provide a “Guarantee of Land ”.

Conclusion

Cadastral boundaries are a fundamental layer underpinning most GIS systems and they should be of a quality and precision at least equal to that of the data in the other layers. The DCDB has been a very useful administrative tool for many years, but where it was built by digitizing cadastral maps it is incomplete, inaccurate and extremely expensive for all users to maintain and upgrade.

If the proper techniques are used, a complete and accurate cadastral layer (NCDB) can be built directly from the records within the Land Titles system. The overall cost of building such a system can be less than the annual amount spent by all government and local government users in maintaining and upgrading an existing DCDB.

GPS technology will inevitably require that we change from our existing “metes and bounds” system of boundary definition to a coordinate based system. The establishment of an NCDB is the first step in this transition,.

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