International Trends in Cadastral Reform

Tendencias Internacionales en Reforma Catastral

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ABSTRACT

In addressing the topic of international trends in cadastral reform, the paper overviews some of the current or recent projects or activities concerned with cadastral issues which have recently been undertaken by or involved the author. Even though a number of the projects focus on Australia, collectively they give some indication of current issues and trends worldwide in cadastral reform, both in developing and developed countries. The paper describes each project or activity briefly and then endeavours to identify one or two major issues or lessons arising from each project. The projects or activities discussed include:

- the activities of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors (FIG);
- the preparation of the FIG "Statement on the Cadastre";
- the justification of cadastral systems in developing countries;
- the incorporation of traditional or customary tenures in "Western" cadastral systems;
- the importance of focussing on cadastral processes vs cadastral components in cadastral reform;
- understanding cadastral maps;
- establishing and maintaining digital cadastral data bases;
- understanding the Australian cadastral system;
- establishing coordinated cadastres in Australia;
- the relationship of the cadastre to the spatial data infrastructure of a state or country;
- economic issues in cadastral reform;
- the role of the cadastre in managing cities; and
- the politics of cadastral and spatial information systems.

ABSTRACTO

Se alando el tema de "Tendencias Internacionales en Reforma Catastral", este articulo resume el contenido de algunos proyectos actuales o recientes que conciernen con asuntos de catastro, los cuales el autor a realizado o participado recientemente. Aunque algunos de los proyectos estan enfocados para Australia, en general dan nfasis a problemas comunes y tendencias que conciernen con reforma catastral en el mundo entero, en paises desarrollados y paises en v as de desarrollo. El articulo describe cada proyecto en forma resumida e intenta la identificacion de uno o dos problemas o lecciones originadas en cada proyecto. Los proyectos en discusion incluyen:

- las actividades de la Comision No. 7 (Catastro y Administracion de Tierras) de la Federacion International de Agrimensores (FIG);
- la preparacion de FIG "Declaracion Acerca del Catastro";
- la justificacion de sistemas de catastro en paises en v as de desarrollo;
- la incorporacion de tradiciones y heralditos concernientes con posesion de tierras en sistemas occidentales;
- la importancia en el enfoque correcto entre procesos y componentes en reformas catastrales;
1. INTRODUCTION

1.1 The last decade has seen a resurgence of interest in land tenure, land titling, cadastral and land administration systems in developing countries. This has occurred for many reasons with the main one being increased interest by the international organisations, such as the World Bank and the United Nations, as well as by individual country aid agencies, as part of the general trend for such organisations to increasingly move their focus to addressing national institutional and infrastructure issues.

1.2 At the same time influential publications and articles have increasingly promoted the importance of cadastral systems and land titling programs over the last decade. For example recent editions of the World Development Report published by The World Bank have recognised the importance of regularising land rights in support of poverty alleviation, promoting sustainable development, environmental management and improving financial systems.

1.3 There has also been a recognition at the 1992 United Nations Conference on Environment and Development (UNCED) or "Earth Summit" of the importance of cadastral, land and geographic information systems to environmental management and sustainable development. In addition the HABITAT II conference in Istanbul this year, termed the "City Summit", will also focus on cadastral related issues such as security of tenure and access to land.

1.4 As a result of this greater understanding of cadastral and land information systems, such systems are increasingly being seen as basic infrastructure supporting sustainable economic development and environmental management, especially in developed countries. This increased understanding has been supported by the increased quantification of the economic and social benefits of cadastral systems and land titling projects.

1.5 The last decade has also seen a dramatic growth in enabling technologies which have the ability of improving the efficiency and speed, and reducing the cost of establishing and maintaining cadastral systems. Some examples include improved information technologies for automating cadastral records (often seen as a part of land and geographic information systems), satellite position fixing (GPS), digital theodolites, computing and advances in photogrammetric mapping.

1.6 As a result of all this activity there has been a growing interest and understanding from researchers about cadastral and land information systems with the result that there is now a substantial body of knowledge on the subject. In addition there are now many conferences, workshops, professional activities, research papers, reports, books, newsletters and journals providing information in support of cadastral reform and related activities.

1.7 Last but not least, the dramatic changes in Eastern and Central Europe, with moves from command to market driven economies, and in Southern Africa with the overthrow of apartheid, have resulted in urgent demands by those countries for appropriate cadastral or land registration systems to support effective land markets which in turn support economic development. These demands have raised the awareness of the importance of cadastral and land information systems worldwide.
1.8 While most of the above activity has been focussed on developing countries and countries in transition from one system to another, there has been an equal commitment to cadastral reform in the developed world in such countries as Australia often as part of micro-economic reform. For over a decade Australia has seen a series of cadastral reform conferences, the establishment of coordinated cadastres and digital cadastral data bases, and general moves to improve the operation of land markets and the underlying cadastral processes.

1.9 This paper reviews a range of activities and projects which have involved the author over the last few years, in both developed and developing countries, which give some indication of the breadth of interest and activity currently being undertaken in cadastral reform. It is recognised that this is a very small segment of current cadastral reform research albeit it is considered representative of the activities of the FIG, and those of many developing countries and many countries in the English speaking world. Such a review is considered useful recognising that this is the opening paper in the cadastral seminar which will accompany the 63rd Permanent Committee of the FIG in Buenos Airies, the first such FIG meeting in South America.

2. REVIEW OF CADASTRAL ACTIVITIES AND PROJECTS

2.1 The activities of Commission 7 (Cadastre and Land Management) of the FIG

2.1.1 Commission 7 has a tradition of being very active, based around the Commission's annual meetings. The Mission of Commission 7 is to promote international goodwill, cooperation and understanding in issues of cadastre and land management. As set out in its Terms of Reference the Commission is responsible for:

- land management and administration;
- cadastral reform, multi-purpose cadastres, parcel-based land information systems and computerisation of cadastral records;
- cadastral surveying and mapping;
- land titling, land tenure, land law and land registration;
- urban and rural land consolidation with emphasis on environmental and economic issues;
- national and international boundaries; and
- land and marine resource management.

2.1.2 The Commission hosts annual meetings, sponsors associated professional meetings, participates in a range of activities and operates three working groups as follows:

   Working Group 7.1 - Modern Cadastres (Chairperson: Mr Jörg Kaufmann, Switzerland)

   Working Group 7.2 - Cadastral Systems in Developing Countries (Chairperson: Mr Tommysterberg, Sweden)

   Working Group 7.3 - Land Management (Chairperson: Dr Paul Munro-Faure, United Kingdom)

Each Working Group hosts an open seminar at one of the Commission's annual meetings reporting on their work. The proceedings of each seminar are published with the proceedings of last years seminar hosted by Working Group 7.1 in Delft on Modern Cadastres currently available.

2.1.3 Most of its activities are centred around the annual meetings with all activities leading up to the FIG Congress every four years. Annual Meetings are hosted by a member country. The last few annual meetings have been hosted by France, Switzerland, the United Kingdom, Canada and The Netherlands, with this year's meeting to be hosted by Hungary and next year's by Malaysia. Annual meetings are timed to fit in with FIG Permanent Committee meetings
2.1.4 The annual meetings focus on the following activities:

- review the cadastral and land management systems in the host country
- run an open seminar for local surveyors directed at the activities of one of the Working Groups
- progress work of Working Groups
- review cadastral activities and issues worldwide
- develop an international network of persons interested or involved in cadastral matters

2.1.5 Key activities over the past couple of years include preparation of the "Statement on the Cadastre", involvement in United Nations activities in Australia, Africa, Eastern Europe and Italy, and sponsoring a range of seminars and meetings. The Commission organises cadastral seminars or programs in conferences associated with FIG Permanent Committee meetings and in activities such as a cadastral workshop in Salvador, Brazil last year. This year the Commission will assist in organising a UN cadastral experts meeting in Jakarta, will be hosted by the Greek Government to review the Hellenic cadastre and will be involved in activities associated with the UN HABITAT II conference or "City Summit" in Istanbul. As a result of the successful cadastral workshop in Brazil, the FIG and Commission 7 have been asked to run a similar workshop in Rio de Janeiro in 1997.

2.2 Statement on the Cadastre

2.2.1 Even though Commission 7, which is responsible for cadastral and land management, has been very strong and active for several decades, there has always been some confusion and different interpretations about what is a cadastre and the role of surveyors in the operation of cadastral systems. This confusion was also shared by many administrations in many countries. As a result the FIG requested Commission 7 in 1992 to prepare a "Statement on the Cadastre" and to describe the role of the surveyor in the establishment, operation and management of cadastral systems. Commission 7 established a working group with a broad representation from Western Europe, North America, Australasia and Asia. After extensive consultation the Statement (FIG, 1995) was adopted by the FIG in 1995 and has subsequently been translated into six languages. The definition and supporting description of cadastral activities has been well received worldwide.

2.2.2 The Statement defines a Cadastre as a parcel based and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, and ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyancing), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection. Cadastral Reform is concerned with the improvement of cadastral systems.

2.2.3 An important aspect of the Statement is that it considers the wide socio-economic role of the cadastre, not just the technical aspects of cadastral systems. It links the cadastre to land management, environmental protection, the operation of land markets and economic development. The Statement comprises three parts; the main Statement, a summary designed for senior bureaucrats and politicians and a simple diagram depicting the cadastral concept.

2.3 Justification of cadastral systems in developing countries

2.3.1 An examination of the justification of cadastral systems in developing countries was undertaken while the author spent a period with the Land Tenure Service of the Food and Agriculture Organisation (FAO) of the UN in 1995 (Williamson, 1995a and 1995b).
2.3.2 The research confirmed that cadastral systems are not ends in themselves and support effective land markets, increased agricultural productivity, sustainable economic development, environmental management, political stability and social justice, although it is absolutely essential that each cadastral system is designed appropriately to serve the needs of the individual country.

2.3.3 Cadastral reform should focus on the key processes which are associated with adjudicating, transferring and sub-dividing land rights, not just the concept of a cadastre or the individual activities of title registration or cadastral surveying.

2.3.4 There is a vast array of legal, technical, administrative and institutional options available in designing and establishing an appropriate cadastral system, and providing a continuum of forms of the cadastre ranging from the very simple to the very sophisticated. Such flexibility allows cadastres to record a continuum of land tenure arrangements from private and individual land rights through to communal land rights, as well as having the ability to accommodate traditional or customary land rights.

2.3.5 The success of a cadastral system is not dependent on its legal or technical sophistication, but whether it protects land rights adequately and permits those rights to be traded (where appropriate) efficiently, simply, quickly, securely and at low cost. However if the resources are not available to keep the cadastral system up-to-date then there is little justification for its establishment.

2.4 Incorporating traditional or customary tenures in a "western" cadastral system

2.4.1 A research project was recently completed to investigate the problems, deficiencies and issues involved in applying "western" cadastral and land information systems in jurisdictions operating customary or traditional tenures. Ms Mele Rakai, a Fijian surveyor, and Dr Dozie Ezigbalike, a former Nigerian surveyor, were involved in the project. Mele Rakai received the FIG Student Prize for her publication describing her work. Several publications document the research (Rakai and Williamson, 1994 and 1995, and Rakai et al 1993) culminating in a report for the FAO of the United Nations (Ezigbalike et al, 1995).

2.4.2 The research recognises that the land information system (LIS) and cadastre concepts have been primarily developed to serve the land market and land administration needs of countries using a Western-styled land tenure system where individual land rights are the norm. However many countries where customary land holdings exist, or predominate, also wish to establish cadastral and land information systems to better manage their land resources and promote economic development.

2.4.3 Incorporating customary land tenure into an LIS or cadastre raises issues of economic, social, institutional and technical significance. Cadastral and land registration systems in most cases are still too specific to Western culture to be applied to customary land tenure without cultural costs. Due to the complexity of customary land tenure relationships, there are major expenses in incorporating such rights, restrictions and responsibilities. The cost-benefit of such initiatives from the point of view of the traditional landholders must be questioned.

2.4.5 A major problem is that the rules of customary land tenure are usually not precisely defined and depend or rely on recollections and opinions, relying on goodwill and kinship among the members of the community for their operation. They are usually flexible, being interpreted to suit changing social conditions. With the air of certainty associated with computerised information, customary tenure rules could lose their flexibility thereby disadvantage future generations.

2.4.6 The cadastral concept has been developed for Western conditions where land is divided into parcels, with unique identifiers for cross referencing. Typically lands held under customary tenures are not so defined. They are also not homogenous; rather they differ between places.
Customary land tenure concepts do not have direct equivalents in English (and other European languages) and are therefore regarded as complex, unclear and uncertain. Because of these conceptual difficulties, they seem not to lend themselves easily to computerisation.

2.4.7 The most critical concern regarding social and cultural issues is that a clear distinction must be made between what needs to be recorded and what would be desirable to have recorded. It may be that only those features of customary tenures that contain some incentives for development should be included into an LIS. Another possible social cost of incorporating customary land tenure into an LIS or cadastre could be the reduced dependency of the traditional society on the elders for information on land matters.

2.4.8 The question must be asked is if this will result in an unintentional but gradual and imperceptible process of converting communally-oriented customary land tenures into capitalist-oriented western land tenure systems, and if so is this desirable? If it is the intention of either developing or developed countries with customary land tenures to increase the commercialisation of the associated traditional agricultural industry, and enter the property market, then those countries will need to be aware of the possibility that the realisation of these aspirations may conflict with their existing traditional systems and values, and potentially create friction within the traditional society.

2.5 Cadastral processes vs cadastral components

2.5.1 A great deal of the literature on cadastral and land registration systems concentrates on the legal, institutional and administrative aspects of particular systems. Unfortunately very little attention has been given to an arguably much more important aspect of cadastral systems - the cadastral processes. Simply cadastral and land registration systems are not ends in themselves. Their primary purpose is to support efficient land markets where land rights can be bought, sold, mortgaged and leased efficiently, securely and at low cost. The technical or legal sophistication of a cadastral system is immaterial - the big question is whether the system works.

2.5.2 In reviewing cadastral systems, it is important to concentrate on examining the efficiency of the three key cadastral processes of land transfer, mutation (subdivision or consolidation) and initial adjudication of land rights. Once the existing cadastral processes have been fully understood, it is possible to identify bottlenecks and inefficiencies. It is then possible to re-engineer the cadastral process to meet the specific needs of the country or jurisdiction.

2.5.3 Of interest the United Nations will be sponsoring a meeting of cadastral experts in March this year in Jakarta which will have representatives of about 15-20 countries. Commission 7 of the FIG is providing technical support to the meeting. The primary focus of the meeting will be to review the three cadastral processes mentioned above within each country and to identify major bottlenecks and difficulties. The meeting will then endeavour to identify successful initiatives and models such that a range of desirable cadastral options and guidelines can be developed.

2.6 Understanding cadastral maps

2.6.1 At first glance cadastral maps are one of the more simple and straightforward components or outcomes from a cadastral system. However on closer scrutiny cadastral maps are one of the more complex and least understood components. There are very few cadastral mapping systems which are the same. Each has its own special aspects and specifications. These differences are due to historical development, legal controls, technological sophistication, institutional structures, economic aspects and the needs of the different users. It is very difficult, if not impossible, to understand the characteristics and functions of a cadastral map without understanding the respective cadastral systems.

2.6.2 As a result of this complexity Professor Stig Enemark (the Chairperson of Commission 2
(Education), FIG) from Aalborg University, Denmark, and the author undertook a joint research project in 1995 titled "Understanding cadastral maps" (Williamson and Enemark, 1995). While the research focussed on the Danish and Australian cadastral systems, the findings have more general relevance. The Danish system is a typical "old world" European system which had its history in land taxation. The Australian systems could be considered "new world" systems which have been more heavily influenced by land market considerations. Even though the Danish and Australian cadastral systems are very similar, understanding the characteristics and functions of cadastral maps in the two systems remains difficult.

2.6.3 The study discusses the different characteristics of cadastral maps which have been designed for different users or functions as follows:

- accuracy of the cadastral map
- completeness of the cadastral map
- digital requirement
- requirement for other spatial detail
- role in boundary determination
- accuracy of supporting cadastral surveys

2.6.4 The study then considered the requirement for these characteristics for the following functions or uses of cadastral maps:

- land markets and land registration
- land tax and land valuation
- utilities management
- urban land management
- rural land management
- multi-purpose applications

2.6.5 An important conclusion is that in establishing a digital cadastral data base (DCDB), computerisation of the cadastral maps in general cannot be justified for land registration or land market reasons. Therefore computerisation of the cadastral map requires the support of other users both financially and institutionally.

2.6.6 Computerisation of cadastral maps is often a controversial issue. Since title registration systems or land markets do not require digital cadastral maps to operate, the responsible organisations often do not wish to move in this direction. However it is often the land registration systems which control or have significant political influence over the cadastral survey and mapping systems. In such cases there is sometimes conflict because the cadastral mapping authority wishes to develop a digital system in response to external pressure from other users. This raises a range of technical, institutional, financial and political issues.

2.6.7 The major conclusions from the paper are that the creation and maintenance of multi-purpose digital cadastral maps is a difficult and complex task. This complexity arises to a large degree because the characteristics of a cadastral map designed to serve traditional land markets or land registration purposes are quite different from the characteristics of a modern multi-purpose cadastral map.

2.7 Establishing and maintaining Digital Cadastral Data Bases (DCDB)

2.7.1 In 1995 the Australian and New Zealand Land Information Council (ANZLIC) organised a workshop to determine the most important research issues in the establishment and maintenance of land and geographic information systems. Over 20 key research issues were identified with the most urgent and most important being the establishment and maintenance of digital cadastral data bases. This included issues concerned with both their upgrading and updating.
2.7.2 The last two decades have seen a move to establish complete cadastral maps in support of land management, land administration and local government administration in every state of Australia. This has necessitated projects to provide a unique parcel identifier for every land parcel. The major trend over the last decade however, has been to convert these cadastral maps to digital form and thereby create digital cadastral databases. Most states of Australia are now well advanced in creating digital cadastral databases or have completed them.

2.7.3 The introduction of CAD/CAM, AM/FM and LIS/GIS, together with metrication, was the major driving force behind development of state-wide DCDBs over the last 20 years or so.

2.7.4 The DCDB is now recognised as one of the major core spatial data sets maintained by government. They are managed in each state by a government organisation which has responsibility for standards, access, updating and upgrading processes, and pricing policies. The DCDBs have usually been created by digitising the best available cadastral map. The emphasis in Australia is now on maintenance and upgrading of DCDBs rather than creation.

2.7.5 Maintenance however has been a pressing issue in Australia (and many other developed countries) for nearly a decade. There has been considerable research into the problems, issues and solutions during this period with some of the research documented in Hesse and Williamson (1993) and Wan and Williamson (1994a, 1994b, 1994c and 1994d). Much of the research centres on the upgrading and updating of digitised DCDBs in each state and jurisdiction.

2.7.6 One of the interesting outcomes from this research is that during the 1970s and 1980s the establishment of DCDBs was very much provider driven (ie by the state surveying and mapping organisations). However during the 1990s this has changed dramatically to being user driven (and particularly by utilities and local government). But more importantly the demands and requirements of the users are significantly different to those of the providers. As knowledge in land and geographic information systems increases, the full potential of the DCDB is being increasingly recognised by users. As users are trying to exploit the DCDB, they are demanding more from it with the result that they are asking for changes and improvements in terms of improved topology, improved access, provision of metadata, improved data quality, improved accuracy and increased attributes.

2.7.7 The research suggests however that user satisfaction of the DCDB does not depend solely on the features and accuracy of the DCDB. The political environment and institutional arrangements play an important part in the successful operation of the DCDB. In general the main user requirements are completeness, currency, data integrity, content, accuracy, quality of delivery, metadata and ease of access.

2.7.8 It should be recognised, however, that the development of an efficient land market based on a complete cadastre does not require a DCDB, and in many cases an emphasis on the creation of a DCDB will slow down the land titling process, especially in developing countries. Put simply, a land registration system does not need a DCDB, but a DCDB which is required by utilities and other users does require the full support of a land registration system to function. This dichotomy has caused an institutional dilemma both in Australia and overseas. It has resulted in more and more land titles offices and surveying and mapping organisations coming together, or at least accepting a common mission.

2.7.9 It can be stated with confidence that the vast majority of countries aspire to have complete cadastral systems in support of efficient land markets and systems to manage land resources and the environment. However, while many would like digital cadastral maps, it is only the developed countries that have been able to justify and technologically support digital cadastral maps (or DCDBs).

2.8 Understanding the Australian cadastral system

2.8.1 Much has been written about various aspects of the individual cadastral systems in
Australia. Traditionally the focus has been on reviewing the cadastral survey system or the land registration system in one of the states or territories. However it is not usually acknowledged that Australia has eight different cadastral systems since land laws are the responsibility of each state and territory, with the differences being very significant in some cases. For example the cadastral survey systems vary from fully coordinated systems to systems based on isolated surveys where coordinates are neither used nor shown on survey plans. In the case of the land registration systems, there are still states that have a significant proportion of deeds registration, even after 150 years of the Torrens system of title registration. At the same time some systems permit adverse possession while others do not. One result is that some systems require a land parcel to be re-surveyed for virtually every land transfer, while others do not. These aspects significantly affect the structure and operation of the cadastral system in each state.

2.8.2 The free land market in Australia is fundamental to economic development and the creation of wealth, and supports environmental management, sustainable development and a relatively high standard of living. The Australian cadastral system in turn is essential infrastructure in support of this land market. While the Australian cadastral system supports a very secure land transfer system, it should not be seen as an ideal system of automatic relevance to other countries, however a study of the Australian system is very informative for any country undertaking cadastral reform. In many respects it is an expensive system designed specifically to support the land market and the individual land owner. It was not designed as part of a wider land administration system albeit it has increasingly developed such a role.

2.8.3 The Australian cadastral system derives many of its principles and concepts from English Common Law. It has married the system of land transfer under English Common Law with the needs of a vast developing country. As a result a land registration system, a cadastral surveying system and a land surveying profession have developed which to a large degree are unique to Australia.

2.8.4 A major difference between the Australian cadastral system and its European counterparts is that the Australian system is derived from individual surveys of individual parcels for individual owners in support of the legal land transfer system. It is not derived from a complete cadastral record of all land parcels as shown on a cadastral map having its genesis in a land taxation system, which is the case with most European systems.

2.8.5 Australia is almost unique worldwide in having its land registration systems centralised in one office in the capital city in each State. This imposes enormous pressures on the systems due to the maintenance of a very large number of records stored in one location, however it has initiated a major thrust towards computerisation.

2.8.6 The primary focus within the Australian cadastral system is on individual transfers of individual parcels between individual people in support of the land transfer system. This means that in order to develop a state-wide cadastral system in the Australian States, all the individual parcels have to be tied together to form one map. As a result the overall system is developed from the "part to the whole" as distinct from the normal surveying practice of going from the "whole to the part", however this is indicative of the way the states were settled and developed.

2.8.7 The complexity of the system, coupled with centralised land registries, has been a major impetus for Australia to computerise land titles. As a result, all states have moved to introduce a system of computerised land titles where there is no longer a paper record but the title is held in digital form in a computer which is state guaranteed. This move to computerised titles is also facilitating the development of state-wide land information systems. Such computerisation now allows the systems to be decentralised by information technology.

2.8.8 In summary the cadastral systems found in the Australian states have been developed to serve the specific needs of a vast developing nation over the last two hundred years. As a result, the Australian cadastral systems are unique and cannot be readily transferred to other
countries in total, but this must be said of every system in the world. However there are many aspects of the Australian system, such as the world renowned Torrens system of title registration, that are transferable to some degree and have been adopted by many countries worldwide, but great care must be taken. In particular it is important to consider which Torrens system is used as a model!

2.8.9 Due to the inherent wealth of Australia, relatively expensive and complex cadastral systems have been allowed to evolve in the individual States. However, it is important to note that these systems work well and underpin a secure land transfer system supporting a very active and effective land market.

2.9 Establishing coordinated cadastres in Australia

2.9.1 The last decade or so has seen considerable attention given to introducing cadastral survey systems using coordinates as distinct from a system based on "isolated" surveys, which was the system in each state for over 150 years after settlement. The Australian Capital Territory has operated a sophisticated cadastral survey system for much of this century and states such as South Australia and New South Wales have been introducing coordinated cadastres for the past decade. The state with the second largest number of land parcels, Victoria, is currently investigating the introduction of a coordinated cadastre (Williamson and Hunter, 1996).

2.9.2 The establishment of a coordinated cadastre generally means the adoption of an integrated approach to managing a state's cadastre and land market processes. This means that all the cadastral processes of land transfer, subdivision (and consolidation) and adjudication (conversion of Old System title to registered title) are fully integrated. Specifically activities associated with title registration, land transfer, cadastral surveying, maintenance of the State's Digital Cadastral Data Base (DCDB) and all associated quality assurance processes are fully integrated.

2.9.3 A coordinated cadastre is defined as a survey accurate graphic representation (or map) of all land parcels in the state. The coordinated cadastre would be the legal graphic definition of all interests in land in the state. It could be considered a "continuous" land title plan. An integral part of a coordinated cadastre is a reformed cadastral survey system where all cadastral surveys are based on the state coordinate system and which replaces the current "isolated" survey approach. Coordinates of boundary corners have the same weight in evidence as any other survey measurement, and are not given any greater legal significance. In digital or computerised form the graphic representation of the cadastre is a survey accurate DCDB.

2.9.4 Historically, land titles offices have shown a lack of interest in coordinated cadastres since the use of coordinates in cadastral surveying has traditionally been seen by them as adding nothing to the operation of the land titles system. Over the last decade, however, land titles offices have become increasingly concerned with the cost of checking cadastral survey plans, especially within the current environment of quality assurance, and also since licensed cadastral surveyors sign and take full responsibility for their work. Coordinated cadastres are one mechanism of reducing the cost of checking.

2.9.5 The primary justification for a coordinated cadastre comes from the need to support a DCDB for use outside the cadastral or land title area. This is being justified on improved efficiency in managing our man-made, physical and natural resources. However increasingly there is a belief that a DCDB based on a coordinated cadastre will provide more efficient land market processes, especially regarding the subdivision of land and the carrying out of cadastral surveys.

2.10 The relationship of the cadastre to a spatial data infrastructure of a state or country

2.10.1 Over the last decade, most states of Australia have introduced a program of allocating
unique parcel identifiers for every land parcel with the program either completed or nearing completion in every state. These programs have developed indexes linking unique parcel identifiers to other parcel identifiers used by valuation, local government or utilities organisations. The move to computerisation has been facilitated by the introduction of computerised land titles as well as the development of DCDBs in each State.

2.10.2 At the same time most states of Australia have established state Land Information Centres which are often separate from the state surveying and mapping organisations. However, these Land Information Centres are usually in the same government department as surveying and mapping activities. These Land Information Centres are usually responsible for data transfer standards, standards for metadata, quality assurance processes and strategic planning for the spatial data infrastructure. The state centres coordinate their activities nationally through the Australian and New Zealand Land Information Council. In Victoria the State DCDB and digital topographic data base are "owned" and managed by the Office of Geographic Data Coordination, not the Office of Surveyor General.

2.10.3 Increasingly the focus in each state is on the development of core spatial data sets which provide the basic infrastructure to support the use of spatial information across a broad range of areas ranging from emergency services through to environmental management. The core spatial data sets in each state include:

- digital cadastral database
- digital topographic database
- digital road network
- geodetic network
- administrative boundaries database
- geographic names database

2.10.4 Victorian, national and international experience indicates that the development of an accurate and up-to-date DCDB in a developed country is the most important component in the state's spatial data infrastructure and is essential to continued economic development and environmental management in a modern information society. However a DCDB does not necessarily support a coordinated cadastre due to its higher accuracy requirements unless it is survey accurate.

2.11 Economic issues in cadastral reform

2.11.1 International experience indicates that cadastral systems are essential for economic development and environmental management worldwide, in both developing and developed countries. It has been stated that a developing country can never reach the status of a developed country without having a cadastral system in place which supports an efficient land market which permits rights in land to be bought, sold, mortgaged and leased. As such the economic justification for cadastral systems in general is not in doubt (Williamson, 1995a).

2.11.3 Cadastral systems do not require DCDBs in order to operate efficiently and effectively, however there is increasing evidence that a coordinated cadastre will provide improved efficiencies to the land titles system and the supporting cadastral survey system, although cost-benefit studies have yet to confirm this in the Australian context. However increasingly many organisations and particularly utilities and local government authorities require a DCDB as an integral component of their land, geographic or utility information systems. As a result there is now very good economic justification for DCDBs in the Australasian context.

2.11.4 A recent GIS cost-benefit study undertaken for the Victorian Government has fully confirmed the economic justification of a DCDB in the Australian context. The study confirmed the establishment of logical links and spatial references to 50 data sets, both textual and mapped, which are used in conjunction with the DCDB to develop information products needed to support key government programs. In addition the DCDB is needed in the generation of 22
out of 61 spatial information products identified in government. This study gave a Benefit-Cost Ratio of about 3:1 (for discussion see Chan and Williamson, 1995a and 1995b).

2.11.5 Another recent cost-benefit study was completed in 1995 for the Australian and New Zealand Land Information Council (ANZLIC) Over the period of 1989-94, over $1,100 million were expended in Australia in producing land and geographic data. Of this data, cadastral data was the most important type of product, consuming over 26% of the resources for data production. The cost of the next-best alternative of paper maps and field surveys was 3.8 times higher than existing sources of cadastral data. Significant cost savings of using the existing sources of digital cadastral data as compared with that of the next-best alternative were over $847 million. The cost savings to cost ratio for cadastral data Australia-wide was 2.8:1, excluding all other benefits such as the development of new areas of activities, the improved data storage and distribution, the improved targeting of resources, the improved project scheduling and co-ordination and the improved utilisation, pricing, maintenance and disposal of fixed capital assets.

2.11.6 While there is good economic justification to establish DCDBs to support LIS/GIS this is still an area which presents many difficulties technically and administratively. For example there is still no Western European country which has completed the establishment of a DCDB, albeit DCDBs are inevitable in the future. Simply to date there has not been sufficient cost-benefit for such an expensive and complex initiative. Therefore while there is very good justification for appropriate cadastral systems in developing countries, it is unlikely, considering all the technical and institutional difficulties, that DCDBs could be cost justified in most developing countries in the foreseeable future. The one exception may be the more urgent need for a digital base to a GIS in cities but even that objective is very difficult to achieve.

2.12 The role of the cadastre in managing cities

2.12.1 Cadastral systems, and particularly the cadastral maps which derive from them, are increasingly recognised as basic infrastructure supporting the operation of cities in both developed and developing countries.

2.12.2 There are four main justifications for cadastral systems in the cities of developing countries as confirmed in the United Nations HABITAT II Global Plan of Action to be discussed at the City Summit in Istanbul in June this year. The first concerns issues of access to land and security of tenure in providing sustainable shelter. The second relates to the ability of city authorities to know who owns what land, where it is and what it is worth. Without this information it is difficult, if not impossible, to operate equitable land taxation systems or to acquire land for public purposes. Thirdly without a cadastral system it will be difficult to operate a land market thereby severely restricting economic development in the city. And lastly without a reasonable cadastral or property map in a city it is very difficult if not impossible to manage utilities, infrastructure and services. Importantly this justification does not require DCDBs.

2.12.3 However in the developed industrialised countries, DCDBs are becoming essential as the basis of land and geographic information systems. Increasingly cities and many local government authorities are relying on this digital data for managing services, utilities, assets and infrastructure. One of the biggest issues in this regard is the mechanism for the provision of an up-to-date DCDB. This requires a land development process which updates the DCDB within the city to be closely tied to the operation of the land market and cadastral system. Since the cadastral system is usually a state or national authority, this often creates political and institutional problems with the city or municipal authority.

2.12.4 While most developing countries are still trying to develop complete cadastral maps in their cities, many of the newly industrialised developing countries are exploring the use of land and geographic information systems. However the use of this technology on such a large scale in developing countries presents many problems such as access to trained personnel, maintenance of the computer system, updating the digital data and justifying the cost of the
system considering the low cost of manual systems. In many cases the best approach may be to establish a pilot project such that the city administration gains experience in LIS/GIS while establishing an efficient manual system. An example of such an approach is the Thailand Land Titling Project (Williamson, 1990) and the City of Bangkok in Thailand (Williamson and Mathieson, 1992 and 1993).

2.13 The politics of spatial information systems

2.13.1 Historically in most countries the broad range of land administration and land management activities has developed in isolation or at best with weak linkages. The information revolution has put major pressures on these historical institutional structures and is causing dramatic change. This has been especially evident in the areas associated with the management of spatial information which incorporates cadastral, land and geographic information systems.

2.13.2 If most people were asked what had been the biggest change worldwide over the last decade, I suspect a great number would say the fall of communism and the major changes to political, social and economic structures in Eastern and Central Europe. There has however been an equally major change in the developed countries of the world over the same period, which has had as its basis micro-economic reform. The forces of micro-economic reform have imposed more changes on the operation and structure of western governments over the last five to ten years than any other major change since the restructuring which occurred at the end of the Second World War. These changes are having a dramatic effect on the way that spatial information systems are managed in western democracies. The major changes include:

- privatisation of a large number of government services and instrumentalities;
- deregulation of professions which are seen as operating "closed shops" and restrictive practices which limit economic development;
- major institutional reform with the trend of bringing spatial information activities together in one organisation;
- internationalisation causing more global thinking in the industry with an emphasis on export and wealth creation;
- downsizing in government as technology replaces people;
- governments adopting a risk management approach in managing spatial data, including cadastral systems;
- the impact of the information society on surveying and mapping industry is resulting in it being seen increasingly as part of IT industry;
- adoption of quality assurance and Total Quality Management practices
- cost recovery of government services.

These changes have had the result of reducing the size of the government sector dramatically while at the same time promoting the growth of the private sector.

2.13.3 The one uncertainty in all these changes is politics. It can be argued that politics has affected the growth of land and geographic information systems and the management and organisation of the more traditional cadastral surveying and mapping activities more than any other factor. It is absolutely essential for the leaders of our industry to be politically astute. Simply the strong organisations stay strong because they are technically capable but also politically strong. Governments are only now just starting to understand the power and importance of spatial information. As a result governments are taking an increasing interest in our activities as we move increasingly into an information environment (Williamson 1992). Simply if our profession does not perform and show leadership in these increasingly important areas, we will lose our responsibility and influence in these areas as is happening in some states in Australia.

2.13.4 An example of the importance of spatial data is the Executive Order from the White House in Washington DC dated 11 April 1994 and signed by President Clinton which states that "Geographic information is critical to promote economic development, improve our stewardship
of natural resources and protect the environment.", and further "The National Performance Review has recommended that the executive branch develop, in cooperation with State, local and tribal governments, and the private sector, a coordinated National Spatial Data Infrastructure to support public and private sector applications of geospatial data ...".

2.13.5 During the same period governments have also dramatically changed their role. They are moving out of the business of surveying and mapping while at the same time moving into the business of managing and coordinating spatial information. The private sector is growing and becoming more diverse. Non traditional areas of the private sector are becoming very interested in spatial information and are moving aside the traditional surveyors to take control of the new opportunities and technologies. At the same time many universities are also keeping up with the changes, moving away from the traditional surveying and mapping focus to a spatial information focus as part of the growing influence of information science.

2.13.6 It is important that within this changing environment governments are aware of the significance of taking into account all land related data and particularly the two key areas of cadastral and natural resource data. The key individuals who coordinate land and geographic information systems must improve their understanding of the political processes and the processes of government. They must realise that it is essential to not only get a balance between the parcel and utility based interest groups and the environmental and natural resource based groups, but the importance of rising above these two interest groups to manage land and geographic data within one total policy for a state or jurisdiction. Such a policy is needed to serve the education, health, emergency services, police and other key areas of government which are increasingly using GIS. Australia has seen at great cost major institutional upheaval by not recognising the importance of this issue.

2.13.7 Over the last decade, our profession and industry have also changed to a very large extent, much of it influenced by politics. We have adopted new technologies, new activities and new business practices. We have also changed the names of our organisations and the names of the products we sell. There is no doubt that change will continue as will the influence of politics; it is not a period for the light-hearted. However this is a period of great opportunity for our profession and industry. The successful players will only be those who are far-sighted, entrepreneurial, aggressive, politically astute and prepared to make a good business case for all initiatives.

3. CONCLUSION

3.1 Without doubt cadastral issues are on the agenda worldwide. With the increased emphasis on strengthening infrastructure and institutions in developing countries, as part of micro-economic reform in developed countries and as a result of the major changes that have occurred in Eastern and Central Europe and Southern Africa, the world seems to have re-discovered the role and importance of cadastral systems.

3.2 The International Federation of Surveyors, together with its Commission 7 which is responsible for cadastre and land management, has been at the centre of many of these initiatives worldwide. It has produced a "Statement on the Cadastre" and been involved in cadastral related initiatives in Eastern and Western Europe, Asia, South East Asia, Africa and South America.

3.3 An important aspect of the involvement of the FIG in cadastral activities is that cadastral reform has been placed in a broad social, economic, environmental and political context, as distinct from the more traditional focus on technical issues. This has allowed the FIG to play an increasingly important role in assisting such organisations as the United Nations to address issues of poverty, environmental degradation, sustainable economic development and improving infrastructure in developing countries. At the same time the FIG has equally focused on improving cadastral and land information systems in developed countries with a particular focus on improved economic efficiency and development.
3.4 There are however important differences in the impetus for cadastral reform in developed and developing countries. In the developed world cadastral reform is being driven by micro-economic reform and advances in technology. The major thrust is the computerisation of the operation of the cadastre and the development of land and geographic information systems. A current key activity is the development of digital cadastral maps or DCDBs. It must be remembered however that these developments in the developed world are usually building on over one hundred years of efficient and complete cadastral systems supporting active land markets. These technological developments pre-suppose that there is a very substantial base of technical, institutional, legal, educational, research and economic infrastructure in place to support these initiatives.

3.5 Unfortunately much or most of this infrastructure is not in place in developing countries, nor do they have well established cadastral systems supporting active land markets. As a result cadastral reform in developing countries is usually being driven by the need to establish an efficient land market which allows land rights to be traded. Unfortunately many developing countries visit developed countries and see the high technology LIS/GIS trends and wish to duplicate them in their own countries. As a result it is very difficult, if not impossible, to establish such systems without an established cadastral system or the basic infrastructure. The result is that the land titling or cadastral initiative will either move too slowly or will collapse. The key to success is to move forward in an incremental manner, starting with a simple and appropriate system, often based on manual techniques, and to introduce technology slowly as the infrastructure improves to accommodate it.

3.6 This paper has attempted to give a brief overview of the cadastral related activities of the FIG and the cadastral reform activities and issues in both the developing and developed world. For obvious reasons the review is only a "snap shot" and does not mention many important other initiatives and activities, although it is hoped that it will give our South American colleagues a flavour of cadastral activity worldwide.

4. REFERENCES


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