

Spatial Data Infrastructures: The Vision for the Future and the Role of Government in Underpinning Future Land Administration Systems.

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ABSTRACT

An information-starved society is limited in its social and economic development. It follows that a society which is not geographically aware or "spatially enabled" is deprived of the ability to effectively plan. The need for accurate spatial information for planning and monitoring of present activities and ensuring sustainable future development has led to the concept and development of spatial data infrastructures. Spatial planning, made possible through a spatial data infrastructure, is a device for bringing, or augmenting order to the cultural landscape. In adopting this approach the institutional envelope in which the land administration agencies and co-ordination initiatives reside is being reshaped by the sharing of responsibilities between the private and public sectors and the re-engineering of the bureaucracy.

Key words and phrases: spatial data infrastructures; land administration; land tenure; Bathurst Declaration; government; public sector; economic reforms; cadastre; FIG.

INTRODUCTION

An information-starved society is limited in its social and economic development. It is responsibly claimed that more than 80% of government information has a geographic element. It follows that a society which is not geographically aware, or "spatially enabled", is deprived of the ability to develop a comprehensive socio-economic national development plan. How can any relational analysis be done if the relative positions of subject themes e.g. development proposals, heritage sites, population dispersal or land use determination are unknown?

Experience in many countries has demonstrated that the effective record of rights and responsibilities to land has suffered grievously from a divorce between the legal and the technical aspects of land records management. In addition, there is often a rift between its operations and effects as sought in legislation and the administrative offices of governments as realised in daily practice by landholders and stakeholders.

Technological advances in information acquisition techniques, the integration potential of electronic information layers, the decision support capability of relational

analysis and the ready access to property related information enhances the ability for land transactions to be both transparent and effective. The absence of rapid land related information discovery has historically impeded land administration.

However, effective land administration must be balanced against an efficient land market. The land market relates to values, titles, mortgages, tenure, rights and property tax. Land administration is concerned with land use, spatial planning, approvals and the regulatory system. Both the market and the administration which fuels it are supported by the technical capability of the cadastre which is recognised through land registers, maps, and land parcels which circumscribe the land rights of individuals, groups and the community. Constant vigilance and monitoring of social demands and expectations must concentrate on determining the suitability of the legal, technical and institutional framework controlling property ownership and the effectiveness and equity of government procedures for the administration of land. The ultimate goal is the effective utilisation and mobilisation of land as a valuable economic resource.

The absence of enriched and integrated information will ensure that duplication prevails, waste continues endemically and decision making is shallow and lacking in substantial factual consideration.

DEVELOPMENT OF STATE AND NATIONAL SPATIAL DATA INFRASTRUCTURES

In considering the development of spatial data infrastructures (SDI), it seems appropriate in the first instance to review the character of organisational linkages in order to recognise some of the pitfalls which they face. Organisational linkages are those unions of effort caused by at least two catalysts:

1. The inability of individuals or individual agencies to achieve discrete goals without the support of others, or
2. The inability of achieving a pan-agency objective without the sharing of individual agencies' resources.

The first could be seen perhaps as a business system - such as a national address file. The second encompasses more of an infrastructural approach and is therefore dependent upon widespread resource contribution like, perhaps, the assessment of sea warming or climate change on a global basis.

Spatial data infrastructures in the geomatics framework provide mechanisms for sharing georeferenced information. These mechanisms are conceptual, regional, political and economic. They seek out standards, attempt to rationalise technology, adopt access policies and create arrangements which cross-jurisdictional borders on a global, regional, national, jurisdictional and local level. They explore relationships within the public sector, between the public and private sector and between academia and industry.

One key element of a spatial data infrastructure is that it be “truly national, as opposed to federal” (Coleman, 1999). The creation of the Canadian Spatial Data Infrastructure (CSDI) and the Public Sector Mapping Agencies (PSMA) Australia

are clear examples of the need to ensure jurisdictional cooperation where federal direction is absent or lacking. This approach ensures that the framework has horizontal flexibility enabling the rapid use and transfer of information between governments in a collaborative approach. This concept, known locally as Spatial Information Partnering (SIP) is being implemented in New South Wales, Australia. This SIP concept provides a sector by sector 'whole-of- government' approach to gathering, sharing and presenting georeferenced information.

A case study of the application of the SIP model in New South Wales, Australia is the Public Safety Agency Sector (PSAS). The PSAS has developed a whole-of-government approach to georeferenced information use to meet specific sector requirements. The agencies involved are: NSW Ambulance, NSW Police Service, NSW Fire Brigade, NSW Rural Fire Service, and NSW State Emergency Services. To date the only barrier impeding success in this sector is a level of modest funding.

There are, of course, many potential barriers constraining the development of SDIs. These include the fragmentation of data, different mapping objectives, data sources, mapping units, time dimension, hierarchical structures, reliability, core datasets, understanding of cadastral concepts, data formatting, lack of political understanding, international accountability, defence/security, price of data, access, lack of operational coordination, and who funds data acquisition and maintenance. The writer regrets to say that this list is not exhaustive!

The framework of an SDI is built by coordinating the activities of relevant organisations. The Federal Geographic Data Committee (1997) describes two approaches:

- firstly, identify a starting point for sharing geographic base information. This enables organisations/bodies to add unique information for business needs – value added reselling.
- secondly, establishment of the framework to provide a starting point for a database and the data generalised from it. This provides organisations with current and consistent data for decision making.

To ensure the development of a successful infrastructure there are a number of issues to be considered. These were identified by the Federal Geographic Data Committee (1997) as:

1. Sharing data;
2. Sharing and formalising of responsibilities;
3. Sharing the cost of commitment;
4. Sharing of benefit and cost recovery;
5. Shared decision making;
6. Incentives;
7. Benefits to organisations beyond the initial partnership, thus ensuring framework development;
8. Known quality of data being shared;
9. Data stewardship; and
10. Commitment to supporting the ongoing program.

In addition to this list, the author believes it is essential for a champion, or a leader, someone who will not give up in the face of prolonged adversity or criticism to build an SDI and constantly review the relevance of such an initiative.

INFLUENCES ON EXISTING AND FUTURE SPATIAL DATA INFRASTRUCTURES

There are several factors that have influenced the development of existing and future spatial data infrastructures. For example, in a country such as Australia where there is a high economic dependency on land related activities such as mining, farming, forestry and tourism, there is a need for accurate, widespread geographic information. This ensures efficient planning of present day activities and of future sustainable development practices – it enables the community to address, inline with Agenda 21 objectives, issues such as vegetation management, population growth and native title administration.

Individual users have in the past collected their own relevant information needed at national, jurisdictional, local or project level which has resulted in well documented expensive duplication of data that are highly inconsistent and cannot be used across jurisdictional boundaries. Using such data makes it impossible to make rapid, sound and comprehensive decisions. A major influence, or a driving force over the last decade or more in any initiative of responsible government has been the dogma of the cost benefit study. No criticism of sound fiscal management is implied but the complexity of the spatial information industry has been more than many Treasury officials can, or in some cases wish, to comprehend. Accordingly, the universal economic benefits extolled by reputable economists have been for some years ignored whilst the readily understood and centuries old concept of bottom line bookkeeping has remained in favour with those same Treasury officials. Perhaps it is only fair to say that there has been a language difficulty on both sides and that the chasm of misunderstanding between technocrats and bureaucrats has until recently been impossible to bridge.

An example of such a cost benefit study into the value of existing land and geographic data infrastructure was commissioned by the Australia New Zealand Land Information Council (ANZLIC) in 1994. It revealed that for every dollar invested in producing land and geographic data, four dollars of benefit was generated within the economy (Price Waterhouse, 1995). In 1990, a similar survey was conducted by Price Waterhouse Urwick into the actual benefit of land and geographic data in New South Wales. It concluded that for every dollar invested in the capture of the cadastral data, there was nine dollars of benefit. Similar cost benefits have been predicted in the other states and territories of Australia and in other countries.

The 1995 study for Australia also revealed that the existing infrastructure for supplying spatial data has provided information to users at a much lower cost than any alternative. If the existing infrastructure had not been in place, and users had been forced to meet their data requirements from other sources, the cost was projected at nearly six times higher. Between the period 1989-94, the five years prior to the study, it was estimated that use of already established infrastructure for supplying data has saved nearly \$5billion in Australia, much of which has been re-invested to generate additional economic activity.

These favourable projections point to a bright future, yet mechanisms still need to be put in place to derive maximum benefit from the cadastral and topographic data sets and the emerging utility and environmental layers. The success or otherwise of the spatial information age depends as much upon the effective management of this data as upon the acceptance of SIS technology in the wider community.

The benefits of the provision of fundamental data sets have been distributed across a broad spectrum of economic activities ranging from the operation of electricity, gas and water utilities to the development of projects involving agriculture, mining and environmental management. These benefits have been identified by Price Waterhouse Urwick (1995) as:

- improved business and strategic planning;
- increased productivity;
- the development of new business opportunities;
- improved scheduling and coordination of investment projects; and
- improvements in the utilisation, pricing, maintenance and disposal of fixed assets.

In the recent and continuing era of fiscal restraint, government support and investment in the digital capture of land related information has been dependent upon developing a strong business case. Consequently, a proposal to complete the survey network and accelerate the digital capture of the cadastre for New South Wales depended upon an aggressive campaign to sell the concept and cost justification based upon favourable financial analyses performed by respected private sector financial consultants. As a result, AUD\$30 million was invested in 1991 by the government to complete the project. In July 1996, eighteen months after the completion of that capture, revenues of about AUD\$20 million had been realised and additional benefits, arising from avoided costs, in the order of AUD\$35 million were calculated. These figures represent only five years of a fifteen year cost/benefit period and returns had already exceeded predictions. The business of spatial information capture had proved capable of withstanding financial scrutiny.

However, it should be recognised that whereas the cost benefit studies were both useful in securing budget allocations and supported by results, subsequent reaction from users resulted in considerable duplication both within and without government. Indeed, the growing recognition that unreasonable financial returns to the government could result in a denial of land related information to all levels of the community and business led to a rethink of access policies in general and spatial information in particular. The rethinking has been protracted in some quarters. Conventional wisdom suggests that considerable benefits flow from a developed SDI. These include:

1. The availability of fundamental datasets, thus enabling the full potential of geospatial information technologies to be realised;
2. Recognition and management of spatial data as a national resource;
3. Setting of common standards for efficient data collection, storage, distribution and use;

4. The development of a consultative framework with the user community determining specifications, priorities for fundamental datasets, and avoiding duplication;
 5. Reduction in costs through removal of duplication in data collection;
 6. Consistent cross-jurisdictional decision making;
 7. Improved customer satisfaction through the development of quality datasets;
 8. More timely and efficient development of applications because datasets already exist;
 9. Access to experienced technical information and people;
 10. Reduction in developmental effort by using framework data standards, standardised data, guidelines and tools; and
 11. Removal of problems created by conflicting data.
- (Federal Geographic Data Committee, 1997).

These benefits will only emerge when appropriate performance protocols are in place. These include a number of strategies dealing with privacy, distribution, maintenance and the sharing of information. However the one issue which, if not resolved, will bedevil the supply and interchange of spatial information is a universally accepted **access** policy. There is little argument among suppliers and users, certainly in the more enlightened parts of the world, that price should not be an impediment to reasonable access. This presupposes that the economic benefits are recognised by Treasury officials. This state of affairs, or fiscal mindshift as described earlier, is often difficult to achieve.

Due to the cost of generating, maintaining and integrating data, it is difficult for any organisation to meet the specific needs of every client. Many organisations need the same fundamental datasets for business and therefore use valuable resources collecting the same information. Additionally, if issues cross jurisdictional boundaries, it is often difficult to find consistent existing applicable datasets. An effective SDI overcomes these issues by providing a reliable standardised source of fundamental datasets plus metadata that permits users to compare and contrast datasets.

By creating an infrastructure and relevant linkages, positive results can emerge. Using these methods we establish clear responsibility for data maintenance and upgrade, reduce duplication and improve analysis. Decision making processes are developed for federal, state and local governments, and valuable information is created for academic institutions, the private sector and the community. Throughout this environment, there is a general community expectation for the public sector to play a coordinating role in developing the spatial data infrastructures and for governments to instigate survey and mapping programs “for public good.”

THE ROLE OF GOVERNMENT IN THE DEVELOPMENT OF SPATIAL DATA INFRASTRUCTURES

When administrative machinery is relatively mature, as in most Western developed countries, there is a spatial hierarchy of land configuration, of administration parcellation, of census statistics and of most other activities which are performed to bring a level of service delivery and amenity to society. This hierarchy usually has, as its lowest common denominator, the land parcel or occupation unit, be it measured accurately or be it part of a primitive but relevant fiscal cadastre, which is used for,

say, residential, commercial or agricultural purposes. It is to this parcel or occupation unit that attribution of a unique identifier, population, cultural assets, land-use, economic value, improvements or the like can be made. In a vertical sense this parcel is connected and flows, through an aggregation process, to many areas of government administration. For instance, the parcel-population connection becomes the enumeration or census collector block for statistical purposes, the parcel aggregation becomes, on the one hand, a suburb or village, then a district or local government area. On the other hand, the aggregation of parcels or population may be seen in terms of education districts or power distribution sectors.

The relationship or ratio of space and population can be used as a density criterion for funding disbursements for say road construction or water reticulation. The parcel may well be unique as a sole entity but when aggregated with others it takes on a different hue depending upon, or in, which local government area, administrative unit or utility distribution sector that aggregation finds itself. For instance, the adoption of a land registration process is likely to bring a degree of certainty to property interests. The registration process, however, should be seen as simply one more attribute to the subject parcel like shape and value. On its own, registration of a land parcel will achieve little within the land administration envelope. In a vacuum of sound land administrative process there is little chance of any orderly or formal development arising from the land registration process alone. However without a clear record of land rights relevant to each parcel of land, effective national land use planning at other than the concept level will prove difficult.

This whole process of social, cultural and economic interplay is the result of human intervention within the natural environment. It has at one level been the result of centuries of behavioural evolution and, more recently, the result of spatial planning. Spatial planning is the mechanism of bringing, or augmenting, order to the cultural landscape. It is the imposition, through legal and administrative process, of change to that landscape. It attracts a regime of fiscal implications ranging from property taxation to the transfer of development rights for financial consideration. It operates within an envelope of administrative and bureaucratic approvals brought to bear on the applicant or subject land through a chain of authority usually delegated from the highest national level.

In an environment where order, in the sense of modern civic administration, is absent there is usually a paucity of data about land and the human-land relationship in the many facets of jurisdictional endeavour. However, data on its own is not usually helpful. It is the aggregation of bits of data into information and the transformation of information into intelligence which allows decisions to be made. It is the experience of making these decisions and the analysis of the results of these decisions which positions society to improve on this decision-making process. A suitable schema for this concept is shown in Figure 1.

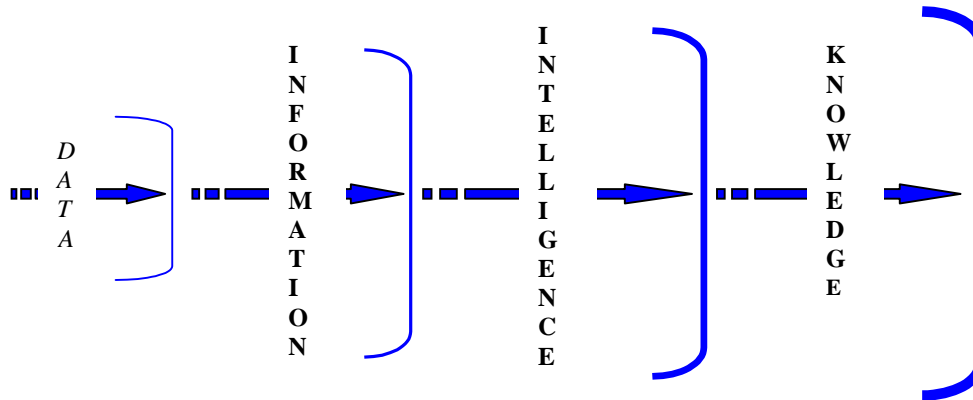


Figure 1 : Schematic Illustration of the Progression of Data into Knowledge

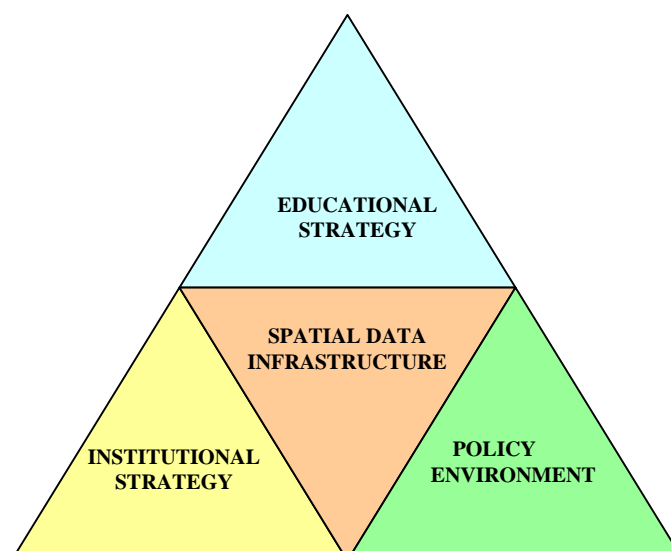
In most societies the citizen views government at all levels with suspicion. It is the responsibility of government to change that perception and that can only be done by performance coupled with good governance and transparency. This change will only come about if the institutions involved in the land administration process are seen as effective and equitable. The community link with the approval mechanism must bring comprehension, understanding and trust. At all costs, the individual or group rights or interests in land must be protected. Without this, little trust in the system or process of land administration can be anticipated - nor will there be any respect for the administrators, officials or institutions involved in the process. Accordingly, to achieve this trust, respect and faith in the land administration and development system, the reason for planning, and its implications must be made clear to the community.

To approach the issue of land administration in a structural sense it may be appropriate to consider the four components of:

- Spatial Data Infrastructure (SDI)
- Institutional Framework
- Policy Environment
- Education Strategy

The inter-linkage between these components is illustrated in Figure 2 and discussed in more detail below.

Figure 2 : Components in Spatial Planning servicing Land Administration.



Spatial Data Infrastructure

The role of spatial information in land administration is crucial. Poor information comes either from poor data, or poor data processing, or both. Defective information leads to defective decisions and greater risk in the management of the environment. The multi-purpose cadastre which is, more than anything else, an information system, must be handled with care and economy in a global sense. Much cadastral work throughout most countries in the past - and for that matter currently - has been of limited application, focusing on a narrow set of issues. The impact of technological development and the rebuilding of cadastres especially in central and eastern Europe has brought a new sense of urgency to cadastral re-engineering.

There are, in the contemporary view of spatial data infrastructures, components other than information which are necessary to make that information relevant and useable. The US National Spatial Data Infrastructure (NSDI) identifies these as being the institutional framework, technical standards, fundamental data sets and the clearing house concept.

Another more comprehensive approach, and perhaps appropriate at the sub-national level, is to expand these components as follows:

- Social Framework - community interfaces
- Technological Framework - delivery means
- Professional Framework - knowledge base
- Spatial Framework - coordinate system
- Quality Framework - procedures and standards
- Infrastructure Data - base-level public data

However, the essential ingredient is the existence of fundamental data sets. In the environment of spatial planning these datasets could be the:

- Geodetic/Survey Network
- Cadastral Framework
- Transportation System
- Administrative Overlay
- Nomenclature Register
- Census Data
- Topographic Detail

It is however recognised that in a developing nation such datasets, in their complete form, will be unavailable. Conversely, it should also be recognised that, from the point of view of escalating user demand, they are never complete in developed nations in that user demand will inevitably outstrip the supply of available information.

Notwithstanding, there is a need for considerable information if spatial planning is to have any respectability at all. Without an acceptable level of information the sophistication which spatial planning brings may well create uncertainty and confusion. If however, the introduction of spatial planning is accompanied with a planned and systematic increase in the information base, success is more likely. For instance, if an area of local government can be defined by aerial photography or

existing mapping, related to the ground, one can assume to some degree, the spatial coverage of that local government area. A rudimentary assessment of land use may then be made and the identification of various Zones, each with their own restraints and opportunities, may be achieved. It could be assumed that the local government area accepted on the photographic coverage indicates a level of community of interest and therefore an area of, perhaps, common electoral significance.

The extraction of data in enumeration or census block tables or from some form of reasonable deduction could provide a population estimate. The area of community of interest, population, physical terrain, transportation and geographical barriers can be used, for instance, as the basis for the determination of electoral districting. Assuming even a low level of sophisticated information, society now has –in the above scenario- access to basic land mass coverage, land use, potential development areas and population. This information base is the genesis for the development of a spatial planning task which should ultimately lead to national land use decision making.

Institutional Framework

The issue of an effective institutional framework, in the achievement of sound spatial planning, is of great significance. It is democracy at work. The choice as to the level at which decisions are made should be taken on the basis of how effective will the decision be, the perception of the subject society, and accordingly the trust which the community is prepared to have in the outcome. The choice will vary with delegation being made to the appropriate levels of administration by perhaps, tests of performance or a list of criteria met, or even an audit system, taking into account public opinion. It should be said that in a perfect world the delegation should be as extensive as possible within the likelihood of performance. However, all levels of government must be involved. This may require policy setting at national level; guidelines or model regulations, audit and monitoring principles at the nexus between national/regional level; and, implementation principles and task performance at the local level as illustrated in Figure 3.

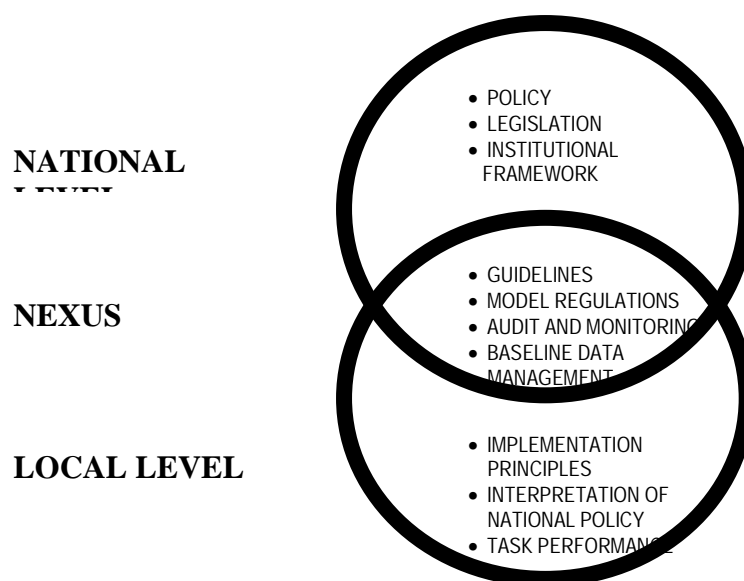
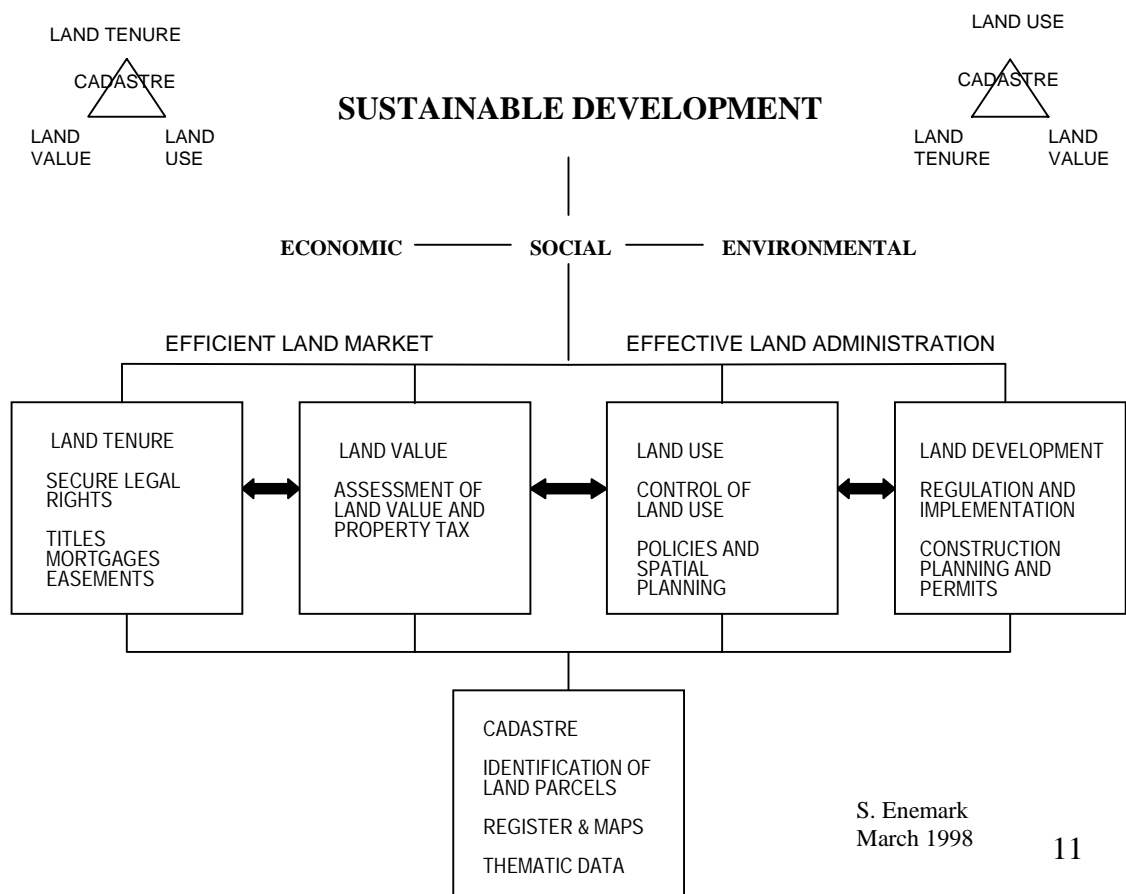


Figure 3 : Different roles of Government in an Integrated Planning Framework

The institutional framework of course goes outside the chain of authority of organisations involved directly in land administration. It includes the agencies to which development applications are referred. These could include the environment protection agencies, the utilities and the transportation authorities. Without their cooperation and harmonisation of activities the energy expended on spatial planning will be spent in vain. All the decisions made must be able to stand up to public scrutiny which will only flow from a situation where likely outcomes can be predicted and the process is transparent. This state of affairs leads to a situation of community trust. There is of course a natural tension between spatial planning which leads to effective land administration and development practices as distinct from the free market, market forces or ambitions of the investor. It is the very certainty which spatial development planning and a national land use policy brings which can counter the entrepreneurial environment in which the developer wishes to operate. There is a balance of development which must be sought and this can be achieved by a targeted and strategic interventionist role by government over and above the classical approach to spatial development planning. Objectives through which, say, economic development can be enhanced within the spatial planning process include:

- Innovative approaches to development through strategic intervention or regulation
- Creation of competitive and sustainable regional businesses
- Provision of adequate infrastructure to foster investment and jobs
- Responsive government service delivery
- Development of more diversified regional economies

Figure 4 : Land Administration and Management Arrangements for Sustainable Development



Spatial development planning can not be treated in isolation. It sits within an envelope of sustainable development and brings balance between the land market and the social, economic and environmental values of the community as shown in Figure 4.

Policy Environment

The policy environment is all pervasive. It flows from all levels of government and can be significantly affected by international influence like the current wave of micro economic reform initiatives or the influence of bodies like the International Monetary Fund (IMF), or the World Bank and Multilateral Investment Guarantee Agency. In the land development arena the impact can be felt from the global, national, regional and local levels.

There are of course other factors outside of global economics which create policy. The legislative body responsible for the development of legal machinery will attach financial initiatives or revenue generation to different processes like land development. These considerations need to compare the direct impact of policy with what would happen without government intervention. It must consider if the political decision ensures an equitable distribution of resources or outcomes, or if indeed there are traditional or social influences which will ensure that the policy will not achieve its objectives. Consideration must be given to the likelihood of the existing structures being able to deliver the service expected of the legislative direction. There must be a real awareness at the varying political levels as to the extent to which policy options are acceptable to stakeholders.

The success or otherwise of effective spatial planning relies on many factors within the policy environment and include the politics of Parliament which may favour success when the right electoral climate prevails. Legislation needs to be reviewed as a body of application from perhaps national laws which establish the taxation and financial incentive opportunities with appropriate statements about compliance with international protocols to the regulation making powers of regional authorities. Many examples exist where model by-laws or regulations flow from a basic law of, say, the Town Planning Act. In turn there are trade-offs, recreation space levies, rate holidays and the transference of building/land ratios between developers which can be exploited at local government level within a national or regional/local legal envelope.

Educational Strategy

The changes which are suggested above will not be readily adopted by all sectors of the community. Indeed there will be sectors of the community which will be hostile to such change which will, in some cases, be an interference or affront to certain practices of, among other things, cultural perception, financial gain and civic status. Just as there must be a major education program to build trust in, say, a land registration system, it is essential that a well planned and relevant education program of spatial development planning leading to a land administration program is undertaken. This program will range from the change awareness stage through to an understanding of the community benefits arising from an honest and transparent process. Extensive public participation is essential, even at the initial stages of

regulation development. The difficulty is of course to balance the ambitions of some communities, where the novelty of public input has not previously been available, and the pressure of rapid development which is a reality.

The community participation level will vary due to the degree of government policy, the size of the project and the purpose of the development. A balance must be achieved between the development, society's expectations and the capacity of the existing infrastructure to cope with the proposal. Nevertheless, and no matter what the difficulties are, if undesirable practices of the past are not eradicated, if the expectations of the people - having been raised - are not met and if a level of certainty as to the development process is not readily apparent, no amount of bureaucratic proselytising will convince the people that change for the better has occurred. The educational process can be tortuous but it is essential.

In summary, there are two major benefits which a comprehensive and integrated spatial planning system and a national land use policy approach can provide. The first is a foundation for economic planning in that the relationship of land parcels, the use to which the land is put and the proprietary interests appurtenant to that land provide a means of achieving a sound fiscal base to meet social and community needs. The second benefit is effective decision-making in relation to the natural environment and the impact of development on that environment. This decision-making process is the result of the ability to assess the landscape in an holistic sense and by choosing the lens – be it political, social, cultural or economic – through which a view of that landscape can be taken.

Both benefits - the development of a sound fiscal base and effective decision making in relation to the environment - are achieved through a range of strategies. Of major importance, however, is the capture, maintenance, integration and dissemination of spatial information. The temptation in many countries in similar situations is to attach what seems to be simply new technologies to the agencies historically responsible for the provision of services such as urban planning, land registration, valuation, survey, utility delivery and natural resource assessment. Such an approach assumes that existing structures are still relevant in a time of major reform. Not only is it essential to question the relevance of technologies being offered on the world stage but it is vital to probe and assess the relevance of bureaucratic organisations. This assessment should consider the administrative structures, the products and functions of the land related agencies and the portfolio dispositions.

In short, international experience has shown that to assume that modern sophisticated technologies are but an augmentation to traditional practices and that historic agencies should be used as the engine room for change will result, at best, in inefficiencies and waste. Where agencies have evolved in isolation with limited purposes it is often necessary to disembowel several agencies to recreate an integrated and focussed institution. Any institutional re-structuring must be approached with a clear understanding of the power which often flows from the amalgamation of agencies. However, the bureaucracy in any part of the world has difficulty in coping with a changing environment and resists any loss of status or responsibility – no matter how logical the plan or change may be. Without complimentary policy and bureaucratic structural review, the significant advantages sought by developing countries, through the use of spatial development planning and a national land use policy approach, will be cosmetic, achieve no real momentum and

lead to frustration and disappointment. Without such a structural or institutional review the significant expense in the acquisition and use of current and emerging technologies will do little but satisfy the whims of technologists and fail to achieve national land administration improvement.

THE IMPLICATIONS OF SPATIAL DATA INFRASTRUCTURES ON FUTURE CADASTRAL AND LAND ADMINISTRATION SYSTEMS.

Robert Barr (1999¹) refers to the need for cooperation between the public and the private sectors to ensure the success of a national spatial data infrastructure – both have a role to play. Barr suggests that despite all the reforms introduced in the past 30 years there have not necessarily been significant changes to the way the public and the private sector operate. Accordingly, the private sector still has certain expectations of the role the public sector has to play which includes coordinating and/or building infrastructures. Therefore, there is still the expectation that it is the responsibility of governments to support the spatial data infrastructures. The level of support is the issue which continues to confound government agencies, the users and in particular the many Treasuries which have to respond to the many calls on funding for "public good."

It is this level of support and the role of each sector within it which both offers opportunities and creates obstacles between all parties and at all levels. The inherent difficulty of information ownership, custodianship, the technology for maintenance and the fusion of public and private sector information for e-commerce applications continues to obstruct access to georeferenced information. Despite these obstructions, enormous datasets are being created. In Australia, a national address file task is currently being scoped. The users are myriad and the value is significant but the contributors will be represented by over eight hundred local government authorities and eight State or Territory jurisdictions. The institutional linkages for this task alone are complex. There are undoubtedly many such large databases being built or under consideration.

The Vice-President of the United States of America, Al Gore, suggests that the majority of these huge databases of information have never fired a single neuron in a single human brain. Having made such a claim he then interestingly goes on to state that there is a direct correlation between the availability of information and knowledge, and a progressive society. Despite this understanding and wide acceptance, few people have access to the information as it is being squirrelled away in electronic silos of information, to use another analogy of Gore's. It has been estimated that the volume of these silos is increasing five fold, annually. Why is this highly valuable information never accessed? Are the linkages adequate? Are they relevant? Do they indeed exist? Recent initiatives in several countries have created data management strategies which offer the reality of internet enabled spatially referenced access to these Aladdin Caves of immeasurable information wealth.

Environmental issues are threatening the sustainable development, perhaps even the sustainable civilisation, of the world. There have been some excellent case studies which raise issues such as booming population and city size growing at a rate of approximately 50% every ten years. This sort of population explosion highlights the demand for an effective spatial information infrastructure. The availability of such a tool should enable smart business decisions to be made on issues such as town

planning, environmental monitoring, pollution, and deforestation. To develop an understanding of the impact of these issues and the outcomes of any development is important; particularly to aid organisations such as the World Bank and the International Monetary Fund, where grants and loans run to the order of hundreds of millions or even billions of dollars. The recent turmoil in the Balkans and the essential reconstruction of Kosovo and much of Yugoslavia could have relied heavily for its planning base on a national SDI - if it had been in place.

In recent years, spatial data collection in Australia has become more focussed upon the States and Territories of Australia as the owners of existing land administration information and processes. This is in keeping with the emerging trend of the Commonwealth concentrating on policy development and coordination initiatives, removing itself from the folly of commercial trading and leaving operational issues to the States and Territories. Cadastral and topographic databases have traditionally been the responsibility of the government surveying and mapping agencies. Recent changes to the structure of the mapping organisations for Victoria, New South Wales and New Zealand also reflect the changing expectations of the public service.

In the future, the mapping requirements of the States, the Territories and the Defence Forces will probably be completed by a combination of in-house and private sector operators. This is a result of the micro-economic reforms currently in vogue- more particularly in relation to competition policy. Probably more important within government is the ground swell in the aggregation of formerly discrete agencies providing aspects of land administration. This in most cases results in a welding of the mapping agency and the land registration office in keeping with the philosophy espoused in Cadastre 2014. This has, in most cases, been accompanied by a whole of government attitude towards the acquisition and delivery of thematic or sector related datasets.

The approach involves the adoption of standard information management policies and procedures within all agencies which will result in efficiency and cost advantages through consolidation of information for better government decision making and business and community access. Changes to regional and national co-ordinating bodies and traditional government structures have also been accelerated by a growing realisation of the complexities of controlling and managing vast reservoirs of information.

CONCLUSION

The role of spatial information in land administration is crucial. The multi-purpose cadastre which is, more than anything else, an information system, must be handled with care and economy in a global sense. Much cadastral work throughout most countries in the past - and for that matter currently - has been of limited application, focusing on a narrow set of issues. This could well have been appropriate for the, then, level of land activity and the relevance and capability of technology. The concept of spatial data infrastructures has brought a new dimension to land administration and for that matter the scope of the cadastre.

One view is that the cadastre is the four dimensional spatial aggregation of all units of space-land, air and water- and the textual expression of all rights and obligations which can be attributed to those units. Another, from a Russian colleague involved

in local government in Moscow, is, perhaps because of an emphasis on utilities, that the cadastre is everything! There are of course other views. A spatial data infrastructure is not a cadastre. A spatial data infrastructure is certainly more than information. It is indeed the institutional framework, the technical standards, the distribution mechanisms, the people and the fundamental data sets. Without those data sets however there would be no need for the other pillars upon which the SDI is buttressed. There would be no fuel to give life to the beast.

Access to land related information has provided the means to administer land. Major mistakes have been made throughout history due to inadequate policy based often on poor information. These have resulted in social, community, and environmental stress since land and land use are inextricably linked to its peoples. Effective administration of land can avoid these mistakes for the future of our local and global society. Spatial data infrastructures will provide a tool to assist in that administrative process.

REFERENCES

ANZLIC (1998) "Spatial Data Infrastructure for Australia and New Zealand", Discussion Paper <<http://www.anzlic.org.au/anzdiscu.htm>>

Barr R (1999¹) I had a dream..., *GISEurope*, Issue 1, January.

Barr R (1999²) A private matter, *GISEurope*, Issue 2, February.

Coleman DJ (1999) Collaborative Approaches to building a Canadian Spatial Data Infrastructure, in *Proceedings for Cambridge Conference*, Cambridge, 19-23rd July 1999.

Federal Geographic Data Committee (1997) *Framework Introduction and Guide*, Washington, DC.

Gore A (unknown) *The Digital Earth Understanding our planet in the 21st Century*.

Grant D & Mooney D (1995) National Spatial Data Infrastructure, in *Conference for National Mapping Organisations*, Cambridge UK, 25 July – 1 August.

Grant DM and Mooney DJ (1997) The State and the Business of Spatial Information, in *Proc. CONSAS '97 Conference*, Durban, South Africa, August 1997.

Grant D (1998) Dancing of the Digits, in *Proceedings for 10th Annual Conference Spatial Information Research Centre*, Otago, New Zealand, 16-19 November 1998.

Mooney D & Grant D (1997) 'The Australian National Spatial Data Infrastructure', in *Framework for the World*, ed Rhind D, Pearson Professional Ltd, Cambridge, pp 187-201.

Price Waterhouse Urwick (1991) *A cost benefit Study into the provision of a State-wide Digital Primary Spatial Database*, Price Waterhouse Urwick.

Price Waterhouse (1995) *Australian Land and Geographic Data Infrastructure Benefits Study*, Economic Studies & Strategies Unit, Price Waterhouse.

Sorensen M (1999) Institutional Linkages for National and Regional GIS Management Issues, Opportunities and Challenges, in *Proceedings for Cambridge Conference*, Cambridge, 19-23rd July 1999.

United Nations (1992) *AGENDA 21: Programme of Action for Sustainable Development, Rio Declaration on Environment and Development; Statement of Forest Principles*, United Nations Department of Public Information, New York.