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**SDIs in Australia-Jurisdictional Partnering**

**Don Grant**

Professorial Fellow, Department of Geomatics, University of Melbourne, Victoria, Australia  
former Chairman of the Public Sector Mapping Agencies, Australia (PSMA)  
Email: dongrant@ozemail.com.au

**Steve Jacoby**

Director Land Information Group, Land Victoria, Department of Natural Resources &  
Environment, Victoria, Australia  
Deputy Chairman of the Public Sector Mapping Agencies, Australia (PSMA)  
Email: steve.jacoby@nre.vic.gov.au

**Abstract**

This paper initially describes the national organisational framework in Australia as the transition from analogue to digital land information took place. It gives a brief account of the political changes, which led to a shift of power at the federal level and the organizational changes which resulted from the adoption of micro and macro economic initiatives during the 90's. It briefly considers the growing relevance of, and dependence on, large-scale data and the subsequent jurisdictional relationships which have developed as a result. These relationships are between the national, state and local jurisdictions to ensure effective acquisition and maintenance of spatial data sets and with the private sector for much of the value adding and emerging applications. It describes the methodology of a state/provincial approach in building a comprehensive spatial information system in partnership with local government and the manner in which eight state/provinces were brought together to create a national SDI. Both approaches offer some innovations, which, while experimental and time consuming, have brought significant success to all parties as the jurisdictions move towards eGovernment. The difficulties of bringing and holding the Australian jurisdictions together are described, as is the continuous process of structural evolution. The paper concludes with a summary of the lessons learned and the success factors identified for an effective national and state SDI.

**Background**

The first serious attempts to expand and co-ordinate the mapping databases of Australia were initially made by the War Cabinet<sup>1</sup> in early 1945 when it created the National Mapping Council (NMC). The NMC was an initiative made towards the end of World War II to meet the projected land development, which was to take place in the wake of returning servicemen taking up land for agriculture and the many national projects, which had waited for the cessation of hostilities. The Council was focussed on the creation of an extensive mapping base for state and national development and driven by the desire to avoid duplication and make up for six years of lost time. The creation of the Council was not without difficulty and little formal coordination of the States' efforts was attempted while an uncomfortable rivalry was to remain a feature of relations between the Commonwealth's principal civilian and mapping organizations throughout the 1950's and 1960's, which was resolved only in the late 1980's.

In the late 1970's and early 80's, all jurisdictions in Australia and New Zealand were faced with similar administrative and technical issues associated with their computerised land information

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<sup>1</sup> Until after the war the Army remained the only agency in Australia systematically engaged in topographical mapping. For much of the 1960s, 1970s and 1980s the Royal Australian Survey Corps was the leading player within Australia (and regularly overseas) in surveying for mapping purposes.

databases. This highlighted the need to develop a national approach to land information management by means of a coordinating body. The Australian New Zealand Land Information Council (ANZLIC) brought together senior land information management executives from the Australian Territories, States and Commonwealth and New Zealand to coordinate the collection and transfer of land-related information across and between the different levels of government; and to promote information to assist decision-making processes.

The key objective of the Council was to promote and develop a cost-effective national strategy to facilitate the exchange of land information. The vision of the ANZLIC was, and remains, to ensure that Australia and New Zealand have the relevant land and geographic information required to support economic growth, and support their social and environmental interests.

To achieve this, ANZLIC provides a national focus for strategic spatial information initiatives; a strategic organisational framework; a spatial data infrastructure for Australia; and better decision-making processes.

ANZLIC was to provide the structure and the guidelines, the Commonwealth to provide the administrative support and the data was to be provided by the States, collated through ANZLIC, to create a national infrastructure. One of the major objectives of the ANZLIC was to remove the random collation of spatial information collected at national, regional and local level. However, initially there were few guidelines in place to ensure quality control or consistency of formatting. Therefore, the issue for ANZLIC was/is to determine what is required of the jurisdictions and their datasets and encourages consistent and workable guidelines to meet national requirements.

By coordinating a national approach, ANZLIC hoped to remove excessive costs of data collection, inefficiencies of data collection, confusion and decision making based on poor information. By establishing a much more comprehensive and efficient approach, Australia and New Zealand's ability to compete in the international marketplace should also be improved. ANZLIC believes that New Zealand and Australia will benefit from better management of spatial information through assisting the community to define, establish and implement the national spatial infrastructure.

ANZLIC developed a model for the ASDI comprised of the customary four key components and proposed that by better management of spatial information it would achieve:

- an increased understanding of the importance for having good, consistent information readily available;
- a better understanding for the need to manage information in a consistent, multi-purpose usage form;
- better and wider scale access to the information for a broad range of users; and
- wider understanding of important and relevant information, appropriate standards, who is responsible for collection of data, to what precision and what the priorities are for that information.

In its early years ANZLIC served the land information community well by bringing an awareness of the emerging complexity and the need for coordination of an expanding land related information base. However, it remained generally focussed on the former functions and mind set of the NMC and did not greatly influence the formerly peripheral, but rapidly expanding, land related databases of disciplines outside the traditional mapping and surveying base. Indeed, by the mid 90s ANZLIC had become somewhat irrelevant. Nevertheless the ANZLIC staff had done an excellent job in producing world-class policy documents. These are still used as valuable sources in many quarters.

However, by this time, considerable organisational turbulence had occurred within the Commonwealth and State bureaucracies and institutional structures were undergoing major changes. These changes were outside the usual management and technical impacts to which the historic mapping and surveying organizations had become accustomed. A major sea change was the emerging shift in the respective positions of government and the private sector in the creation, maintenance and delivery of, what started to be called, “spatial information”. In general terms, these changes or reforms included the:

- division of government services into policy, regulatory and service provision roles;
- withdrawal of government from direct commercial activities in an effort to meet community expectation and demands; and
- corporatisation and privatization of certain government activities, normally as a result of the move of government out of the commercial sphere.

This situation, like most public sector management waves, had major impacts on structures and individuals. Like most bureaucratic initiatives it took some time to slow the momentum before over achievement destroyed the original objectives. In the face of these considerable changes, ANZLIC entered a phase of self-assessment to ensure its original goals were still relevant and achievable. The concepts had been developed, policy papers had been circulated and many meetings for industry and government had been held. The national stakeholders were waiting to see a result, a direction and a product.

### **National Spatial Data Infrastructure-Public Sector Mapping Agencies (PSMA)**

In 1993, in response to a public tender placed by the Australian Bureau of Statistics (ABS) for a complete large-scale digital mapbase to support the National census, a consortium known as the Public Sector Mapping Agencies (PSMA) was formed. Consisting of the mapping agencies from each State and Territory as well as the Commonwealth, PSMA was successful in developing a single format, multi resolution dataset of the best available topographic and cadastral information.

As mentioned earlier one of the major challenges faced by the PSMA was to overcome the inconsistencies between the various datasets. Data description tables were adopted to characterise PSMA data by jurisdiction, highlight differences between data, indicate compliance with ABS requirements, and provide the Client with a working specification upon which to design the mapping system. The States and Territories did not hold their data in the same system, format or specification, and not all jurisdictions held equivalent map coverage. This created a complex situation and highlighted the need to identify a uniform national approach to the collection and storage of digital data.

As the lead agency, the New South Wales Surveyor-General’s Department examined and documented all the disparate specifications and defined one common specification. Guidelines were set for the dataset, which varied in scale from 1:500 in the urban, more built up areas where detail was required, through to 1:250 000 scale for remote areas where population density was very low. Another of the major challenges of the PSMA was to coordinate data delivery according to the strict schedule set by the ABS, coping with changes to the schedule, sorting out technical difficulties and maintaining liaison between all the organisations involved. The orchestration of nine agencies providing spatial data of varying quality and completeness, over the entire Australian landscape, was a major logistical and even psychological undertaking.

The success of the project attracted other users and value adders for this unique dataset and this highlighted some deficiencies in the institutional arrangements for PSMA. The national achievement by the PSMA created an unquenchable thirst for national spatial information. This demand, in turn, was impacted by the change in relationship between the public and the private

sectors due to the micro economic reforms, which had challenged traditional public administration in the 90's. Each jurisdiction had its own version and extent of the applications of these micro economic pressures. Each was influenced by its political mores, its current ideology, the influence of the current management doctrine and the level of risk it was prepared to bear. The degree of user-pays, the level of outsourcing, the extent of service competition, shared asset ownership, private sector funded infrastructure, public sector marketing and cost recovery varied as to each jurisdiction.

The mathematics or "horse trading" of sharing returns between jurisdictions based on formula previously not considered within government and the marketing approach of a commodity not previously the subject of market forces were discussed at length and challenged much previous government practice. Considerable courage and optimism were needed to continue dealing with a new and aggressive commercial community, thirsty to tap the money turbines of the PSMA spatial information reservoir. The subject of spatial data marketing was new to society - PSMA drew the blueprint and reassured the many clients all would be well. Value-adding on a national scale was a new concept and the PSMA was still wrestling internally to resolve competing ownership claims and the unknown extent of corporate or jurisdictional liability was frightening. This breaking of new ground led to an independent Management and Structural review in 1997, which recommended the consortium be restructured into a Government owned company limited by shares. The joint shareholders were to be the Governments themselves. On 20 June 2001 this recommendation was implemented and PSMA Australia was incorporated as a company marking a major development in the maturing of Australia's SDI. This evolution of PSMA Australia as a legal entity was considered essential if national spatial products, derived from State and Territory jurisdictions, were to become accessible to a wider market.

Perhaps the key product envisaged by PSMA, previously unrealised, was a National cadastral mapbase. Consisting of every current land parcel in Australia, in a single format, on a common datum, a prototype product called *Cad-Lite* was created by PSMA in October 2000. The second version was released in October 2001 and the third version in August 2002.

*Cad-Lite* consists of 10.2 million polygons representing every land parcel in Australia. The attributes of each polygon consist of a State and Local Government identifier as well as a unique land parcel identifier, which provides a linkage to other information in each State and Territory SDI. PSMA remains committed to releasing *Cad-Lite* annually.

PSMA, in conjunction with other interested stakeholders is actively pursuing the creation of other National spatial products derived from best available data including a Geocoded National Address File which has drawn interest from the ABS, Australia Post, the Electoral Commissions of Australia and Telstra (our largest telecommunications company).

### **State Spatial Data Infrastructure (SDI) – Cadastral Theme**

Australia consists of eight jurisdictions (six States and two Territories), with Victoria being the smallest of the mainland States. At 227,420 km<sup>2</sup> (just over half the size of California) it accounts for only 3% of the country's area, but with a population of 4.8 million is Australia's second most populous State.

Having dealt briefly with the attempts to create some national direction, coverage and integration it is appropriate to consider the relationship between the PSMA and one of the national constituent parts- the State of Victoria- and the local government authorities, which comprise that State.

In 1993 a major geospatial information requirements study was done in Victoria. This study identified serious gaps and impediments to the creation of these framework datasets at the State level. This is best illustrated, and follows on from the discussion on the PSMA *Cad-Lite*, by examining in detail the requirements that were identified for the most important dataset, the cadastral mapbase. The characteristics required of this dataset were:

- an authoritative State wide coverage of the distribution of land units in the State, with standards for accuracy, quality and data transfer;
- clear, current, and correct identification of both parcel and property land units;
- supporting land unit attributes, eg area and dimensions, with other attributes accessible via linkages to various agency databases;
- centralised data set maintenance and the communication of updates to land unit boundaries, unit identifiers and related attributes;
- support for the communication of land information between agencies; and,
- the ability to perform topologic (spatial) analyses.

A major challenge emerged from the detailed specification for the digital cadastral database. In order to fulfil the requirements of users, it was recommended that the database must include a representation of all properties attributed by their ‘street address’ and ‘Council (Local Government) property number’. This dataset must also include proposed development applications to compliment the record of approved land parcels as issued by the Land Titles Office.

Whilst Land Victoria, the State Government agency responsible for this dataset, had ready access to approved legal land parcels via the Land Titles Office, it did not have access to proposed developments as these were part of the up-stream planning process managed independently by each of the State’s 78 Local Governments. Nor did the State have access to authoritative information about properties including street addresses, which are also created by Local Government.

Further examination showed that the State’s SDI has a significant dependence upon Local Government as the responsible authority for the creation of other land information (i.e. addresses, road names, suburb and locality definitions) or for the timely notification of approvals relating to the changing status of land information (e.g. proposed land developments, approvals and certifications in the cadastral database). As a key user of this data, Local Government is also able to play a major role in shaping the entire SDI and providing feedback on its effectiveness.

Of the technical reforms introduced to the cadastral mapbase, the inclusion of ‘property’ and ‘parcel’ as entities and the establishment of three key linkages: street address; Council (Local Government) property number; and, a standard parcel identifier have been significant. It is these linkages or ‘foreign keys’ that provide the connectivity between the cadastral mapbase and ‘other’ business information held in Local Governments’ and other users’ databases. Ensuring that these linkages function correctly requires the relationships between the main entities (parcel and property) to be correctly understood and managed. The following brief description of land parcels and properties expands on how this important inter relationship operates in Victoria.

***Land Parcels*** - The land parcel in the Victorian cadastral system (as in most Torrens registration of title systems) is typically the smallest land unit capable of transfer and is often used as the basic spatial unit in land information systems. A significant advantage in using the land parcel as the basic spatial unit is that they are usually very accurately described through the cadastral survey requirements of the Torrens system for the purposes of title registration. Victoria’s land parcels are described by a lot number referenced to a plan. Basic land tenure is either freehold or Crown, with a land title typically referring to one or more freehold land parcels.

Another major advantage in basing a land information system on land parcels is that the Land Titles Office becomes the primary source for virtually all changes that occur in the system through the processes of subdivision and consolidation of parcels. All Australian digital cadastral mapbases depend upon ready access to, and supply of parcel change information from their respective Land Titles Offices. This is essential to maintain the current status of the cadastral map. A recognised drawback is that the Titles Office rarely has knowledge about proposed developments, which are critically important to developers, planners, Local Government, utilities and the local community.

**Properties** - A property describes land under common occupation particularly for the purposes of rating, billing or habitation. Properties, rather than land parcels are used predominantly as the basic record by Local Governments, utilities (water, power, telecommunications), postal and electoral authorities.

Whilst there is a strong correlation between parcels and properties, the relationship may be 'many to many'. A typical urban configuration would see a direct correlation between the parcel and property (in Victoria, with its highly urbanised population approximately 75% of its land records would be in this 'one to one' form.

A common example of where many parcels make up one property occurs in more rural areas, typically with farms. The reverse (many properties on one parcel) is a less frequent occurrence; an example may be a shopping centre, owned by a developer, which has numerous tenants or occupants. In these cases, typical in cities and central business districts the relationships between land parcels and properties can become complex.

By including 'parcel' and 'property' as entities in the cadastral mapbase and ensuring the (sometimes complex) relationships that exist between them could be managed, Land Victoria had significantly improved the database's capability. But it is important to note that this was only a technical reform, which created an improved data structure. The real challenge was how to populate that database with quality parcel and property information and ensure its effective maintenance. This resulted in the PIP, which commenced in 1997.

### **The Property Information Project (PIP)**

The objectives of the Property Information Project (PIP) were to establish a common geospatial infrastructure between Local and State Government based around the digital cadastral mapbase. The outcome planned from PIP was to completely map for the first time all of Victoria's properties, to store these spatially in the cadastral mapbase together with their relationships to land parcels. This would be done in alliance with the State's 78 Local Governments over an initial two-year period. This establishment phase was planned to transition into an on-going maintenance regime, which would be secured by a data exchange agreement between the State and each of the Local Governments.

Land Victoria's proposal was a simple one: the State would provide funding (approximately US\$3M State wide) to match or reconcile the Council's rating database with the cadastral mapbase - creating the property layer; each Council would be allowed use of the mapbase at no charge and Land Victoria would provide the Council with a fully maintained copy of the cadastral mapbase at a frequency to be agreed. In return, Council was asked to agree to: adopt one version of the cadastral mapbase (Land Victoria's); allow key property information owned by Council to be incorporated into the mapbase; and provide Land Victoria with early advice of all proposed plans of subdivision and changes to property information (for example, new street addresses) to fuel the maintenance process at the earliest possible stage.

The most important characteristic of the project was that local governments involvement was to be voluntary. From Land Victoria's perspective, this was also PIP's greatest risk. Without legislative support, the success of the project depended upon Councils agreeing to join and remain in the project based solely on the project's merits.

*Project Stages* – From the outset of PIP it was clear that effective communications between Land Victoria and the 78 Local Governments in the State would be essential to the project's success. A major commitment was made to face-to-face meetings in the first few months of the project, following up on a letter of introduction and a project 'kit' sent to each Council's Chief Executive Officer. A formal presentation was made to every Local Government Authority in the State between July and December 1997. The objective of this step was to establish a key contact in each Council and to seek Council's 'in principle' agreement to proceed to the next stage of the project.

A dedicated project team was established in Land Victoria and as each Council came into the project a 'liaison' officer from Land Victoria was assigned. As questions and issues began to emerge from the Councils about various aspects of the project, these were documented in 'Fact Sheets' and a regular newsletter was established to aid communications. A dedicated e-mail address was also established for PIP. The high level of communication developed in this introductory period remains a feature of the project today.

The first few stages were designed to present the project as a very low risk to Councils and to engender their support for PIP. By 'gating' the project in this manner, particularly in seeking 'in principle' agreement at a very early stage the objective was to gain senior endorsement as well as to highlight and address any barriers or issues that a Council may have with the project.

In the third stage Land Victoria funded a brief fact finding consultancy. This confidential study was designed to identify the current status of each Council with respect to its use of GIS and to try and ascertain its future directions. This analysis took between two days and a week to perform. The outcome of the study demonstrated a number of significant differences between Local Governments across the State beyond the obvious variations of geography, population or land use. In particular, major differences were found in the knowledge and understanding of GIS technology and the extent to which Local Government saw GIS being utilised in its future operations.

The analysis stage resulted in an excellent understanding of the priorities and technical capability of each Council. This information was used to design a program of works. The main focus of the works program was around the reconciliation of property and parcel information. This task to establish the property layer in the cadastral mapbase involves automatic matching of spatial records in the Council's rating database with attributes available in the cadastral mapbase. This would usually generate a match rate of between 50% and 80%. Refined automatic matching and manual record reconciliation would follow. The available funding typically enabled PIP to establish a 90% to 95% match rate at the end of the contracted works stage. Data may remain unmatched for a number of reasons with these unmatched records being identified as part of the PIP program and prioritised for further investigation. In many cases they may not be resolved without a title search or field examination, which may be scheduled as part of Council's other activities or dealt with if and when they arose as part of on going maintenance.

Data reconciliation was not the only task undertaken as part of the works program. Other activities that were undertaken include the allocation of addresses to properties for the first time,

the identification of Crown land and its inclusion in Council's rating database and the establishment of processes to aid the on-going maintenance of the cadastral mapbase.

It was not unusual for there to be several iterations of the proposed works program between Land Victoria and a Council. The final program also details the level of funding to be provided by Land Victoria and indicates how the works are to be completed. In many instances, the works programs were tailored to compliment tasks already underway within Council. In many cases, Councils indicated a preference to undertake aspects of the work themselves. Alternatively, Land Victoria would tender the work to a panel of private sector providers especially established as part of PIP.

Importantly, at this point, all works and their funding are specified in a contract to be executed by the State and the Council. This agreement explicitly details each party's tasks and responsibilities including the on-going supply of information from Council to Land Victoria and Land Victoria's provision of the updated cadastral mapbase back to each Council (schedules in the Contract to specify formats, frequencies, etc). The term of the agreement was three years. A number of Councils expressed concern on this point and sought significantly longer terms. In recognition of this, Land Victoria amended the agreement to a 'rolling three year term' to be renewed every 12 months.

***Progress to Date*** – All Councils had agreed 'in principle' to enter PIP by December 1998; the first Council to complete reconciliation works and enter maintenance took place in early 1999, approximately 20 months after the project's initialisation. At July 2002, 74 Councils have entered the maintenance phase and works programs are underway with all but three Councils out of the State's 78.

This participation rate (95%) achieved by PIP without legislative support is remarkable. It is hoped that the remaining three Councils will agree to enter the works program this calendar year. These Councils all have advanced GIS systems and the adoption of the PIP will require changes to established practices, presenting, arguably a more difficult business case.

***Benefits of PIP to Local Government*** – The diversity of Local Government in Victoria with respect to GIS approach and implementation also results in a mix of benefits for Councils in adopting PIP. Clearly there are direct benefits for Local Government in the project. The most obvious relate to relief from State licence fees, monetary assistance with data reconciliation and on going maintenance of the cadastral mapbase.

Prior to the PIP initiative, Local Government was treated identically to any other prospective user or licensee of the State's cadastral mapbase. Licence fees for initial access were charged and for an average sized Council these would be around US\$30,000. Approximately one third of the State's Local Governments were not utilising the mapbase in any form – the initial licence fees were a major barrier to entry for many users. But there was also a degree of uncertainty amongst many Local Governments about the best way to introduce GIS. PIP provided a structured and well-supported approach that was seen by Councils as vendor independent and a lower risk path to GIS implementation.

PIP also brought some capital funding to assist mostly in the data reconciliation stage, which resulted in the establishment of the property layer. Based upon agreed recommendations in the works program between US\$10,000 and US\$25,000 was made available to Councils for these tasks. One of the Councils which has completed the reconciliation phase reported 'finding' 400 land parcels which were not included in their property database, which when amended, generated an additional US\$65,000 pa income for that particular Council (increasing their annual budget by 3%).

Beyond the establishment phase and particularly for half of the State's Local Government bodies, which were already involved in maintaining their own copy of the cadastral mapbase, the main benefit is in free on-going maintenance. Comparisons are difficult between Councils for reasons already cited, however, one metropolitan Council reported to have had reduced the labour allocated to cadastral data maintenance by 30 hours per month following the introduction of the full PIP maintenance regime. Numerous benefits were also identified during the consulting stage of PIP, which fall into the general categories of administration, decision-making, operations management and service delivery.

***Additional Benefits of PIP to State Government*** – In addition to PIP providing the means to populate the State's re-engineered cadastral mapbase and deliver a key component of Victoria's SDI, there are numerous other benefits to the State that are emerging. There are presently over 500 agencies and organisations using the State's cadastral mapbase. Many of them have a critical need for up to date property data, including planners, valuers, estate agents and other land professionals. Perhaps the most critical users of all are the State's emergency services (fire, police and ambulance), which utilise address data in their computer aided dispatch system. Clearly all of these users at the State level will benefit significantly from the current, secure, higher quality data generated by the project.

## **Conclusions**

The PSMA experiment has been an international success by any standards and reinforced by the URISA Board in Long Beach, California in 2001 after a presentation and discussion, when it was claimed that the vision and organization of the PSMA is a model to which the rest of the world aspires. PSMA Australia is not, and will not become, a competitor in the private sector. Instead, PSMA Australia will provide the link in the supply chain between government and industry to facilitate the development of fundamental, standards-compliant, client specific, national, geographic datasets.

Land Victoria's active participation in the development of SDI's at both the Local / State level through the PIP and at the State / National level through the PSMA is resulting in the establishment of a consistent SDI across all three levels of government. The careful adoption of standards, acquisition of data from source (often Local Government), controlled maintenance regimes and promulgation of that data into National products has led to an outcome in Victoria where 95% of Local Government Authorities are synchronised with the State and the Commonwealth Governments' spatial data.

Whilst other State Governments in Australia have provided cadastral data to PSMA to provide National coverage, as yet there is less coordinated linkage with Local Government in those States, which ensures a synchronised view of the cadastral mapbase between these three tiers of government, and their respective users. The experience in Victoria has shown that a common spatial infrastructure is possible but that the institutional arrangements necessary to establish effective linkages can take several years to implement.

The nature of the institutional arrangements may also vary considerably. At the Local/State Government level the PIP was established under a cooperative model without legislative support, whilst the PSMA solution, at the State/National level, involved the creation of a separate company (also without the need for legislation). Whilst the mechanisms involved in these two cases differ significantly they have the same goal - to ensure all participants are operating on a common set of spatial framework data.

The minimisation of data collection and maintenance costs through capturing data once, at the source (e.g. Local Government) and using it as widely as possible are self-evident. The strategic value in having Local, State and National decision makers looking at exactly the same information about land at the same time promises significantly more. Victoria's SDI investments will hopefully allow it to take this next step.

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