Snapshot of SDI Development in Australia: Models, Partnerships and Lead Agencies Advancing Implementation

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ABSTRACT

Australia is entering a new era for spatial data infrastructure (SDI) demonstrated by the unification of prime sectors of the spatial information industry and a renewed Government focus on spatial information. A spatial information stock take is required to review progress to date and evaluate current directions. SDI is deemed essential for the provision of services to support modern society’s information needs and can be considered in the same manner as other public service infrastructure such as roads and utilities.

This paper will evaluate progress since the release of ANZLIC’s (1996) model for a SDI for Australia and New Zealand, identify the agencies driving SDI in Australia and will highlight key initiatives contributing to the ASDI development. Selected countries with advanced National Spatial Data Infrastructure (NSDI) programs will also be discussed in relation to developments of the SDI model within Australia.

The paper contributes to research conducted by the Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne on SDI and to a new project being undertaken to develop a methodology to map the complex nature of the institutional arrangements and partnerships that support NSDI with particular focus on the ASDI.

KEYWORDS: Spatial Data Infrastructure, Partnerships, Institutional Frameworks, Administration of Spatial Information, Spatial Information Industry
INTRODUCTION

A nation’s spatial data infrastructure (SDI) is acknowledged as an important economic resource and an essential base for sustainable development of modern society (Wiberg, 2002). SDI can be understood as an umbrella of policies, standards and procedures under which organisations and technologies interact to foster more efficient use, management and production of spatial data (Ryttersgaard, 2001). Australia’s Commonwealth, State and Territory governments have responded to this growing need to coordinate the collection and transfer of land related information between the different government levels through lead agencies established to implement the Australian Spatial Data Infrastructure (ASDI) (Clarke, 2001).

This paper will evaluate the progress of SDI development in Australia since the release of ANZLIC’s (1996) model, identify the agencies driving SDI in Australia and will highlight key initiatives contributing to the ASDI. Selected National Spatial Data Infrastructure (NSDI) programs will also be discussed in relation to development in Australia.

CONCEPTS AND COMPONENTS OF SDI

The concept of SDI remains very much an innovation, even among experts in the field there are still doubts regarding the nature and identity of SDI (Barr, 1999; Rajabifard et al., 2000a). Numerous researchers and government agencies have described the nature of SDI in various definitions and contexts (European Commission, 1995; Masser, 1998; Department of Natural Resources (QLD), 1999; Land Victoria, 1999). While these definitions provide a useful basis for understanding SDI, individually they are inadequate to describe the complexity and dynamic nature of SDI and ultimately restrict future development (Chan et al. 2001).

The hierarchical nature of SDI as documented by Rajabifard et al. (2000a; 2000b; 2000c) is well established in describing relationships between the administrative/political levels. Rajabifard et al. (2000a) published two views representing the nature of the SDI hierarchy namely: the umbrella view - in which SDI at a higher level encompasses all SDIs at a lower level, and the building block view - where a level of SDI such as the state-level, supports the SDI levels above (i.e. national, regional) with their spatial data needs. The SDI hierarchy concept is very useful to describe the complex vertical and horizontal relationships between the political/administrative levels. Of most interest is the partnerships that occur within and between the levels of the hierarchy that facilitate data sharing and the flow of information throughout the SDI system (Warnest et al., 2002).

Many models of SDI have been published and adopted throughout the world such as United States’ NSDI (FGDC, 1997), the Dutch National Geographic Information Infrastructure (Van Loenen and Kok, 2002), Asia-Pacific SDI (Holland et al., 2001) and the ASDI which will be discussed later in this paper. Many of the models possess common components and attributes that will be summarised as:

- DATA A central component of a SDI is the data itself. SDI models identify several datasets deemed fundamental. ANZLIC (1996), in the context of their vision for SDI for Australia and New Zealand, defines a fundamental dataset as ‘a dataset required by more than one government agency and where consistent national coverage is required in order for the agencies to achieve their objectives’. The Federal Geographic Data Committee (FGDC), the coordinating body for geographic information across the United States, has adopted a framework approach that consists of seven themes of digital geographic data that are commonly used (FGDC, 2001). The Victorian Government through Land Victoria has adopted a similar approach with the Victorian Geospatial Information Strategy that identifies eight fundamental datasets for Victoria: Geodetic Control; Cadastral (Property); Address; Administrative; Transportation; Elevation (and Bathymetry); Hydrology; and Ortho-imagery. Address is in addition to the framework employed by the FGDC (Jacoby et al., 2001a).

Whatever the definition of fundamental, some datasets are recognised as essential for every SDI. Primarily that of geodetic control, which provides spatial reference that ensures all positions conform to well defined horizontal and vertical datums and to a known quality for all datasets incorporated into the SDI (Ryttersgaard, 2001). To ensure appropriate use of the spatial information, there is a need for comprehensive instructions on the potential and limitations of data and user-friendly and efficient access and distribution systems.
• **PEOPLE** Includes the users, administrators and custodians of spatial data and also value-added resellers. Users can be corporate, small or large business or individuals, public or private. The users of SDI can be identified from the many applications which include (Ryttersgaard, 2001):
  - Cadastral projects, Land management
  - Transportation infrastructure
  - Health monitoring programs, Socio-economic issues
  - Monitoring of environmental issues, Environmental impact assessment
  - Conservation projects, Natural resource management
  - Statistical analyses

The now broad application of SDI beyond the traditional mapping and land administration role means users and administrators of spatial information have very different qualifications and professional backgrounds.

• **INSTITUTIONAL FRAMEWORK** Includes the administration, coordination, policy and legislation components of an SDI. The institutional framework is reliant on successful partnerships and communication between agencies within and between jurisdictions.

• **TECHNOLOGY** Consists of the access and distribution networks, clearinghouse and other means for getting the spatial information or datasets to the users. Technology also involves the acquisition, storage, integration, maintenance, and enhancement of spatial data.

• **STANDARDS** Consistent standards and policy are required to enable this sharing, integration and distribution of spatial data hence standards for Data Models, Metadata, Transfer and interoperability of storage and analysis software. Policy particularly needs to be consistent for the pricing and access to spatial data within and between jurisdictions.

These components and attributes of SDI are strongly related and often overlap. The authors do not make the assertion that these are the only factors influencing SDI nor that this is a fully structured model. Rather, the authors wish to identify and segment the complex integrated components as a basis to facilitate further discussion and as a means to isolate the institutional related issues that affect SDI partnerships. The fundamental interaction between people and data is governed by the technological components of SDI: Access Network, Policy, Standards. Rajabifard’s diagram (Figure 1) demonstrates the dynamic inter-relationships between the people and spatial data within an SDI. The dynamic nature of the SDI environment is attributed to the rate of technological advancement and changing user needs. This suggests an integrated SDI cannot consist of the spatial data, value-added services and end-users alone, clearly other important factors regarding interoperability, policies and networks influence the system (Rajabifard and Williamson, 2001).

![Dynamic](image.png)

*Figure 1. Nature of relationships between components of SDI (Rajabifard and Williamson, 2001)*
SDI DEVELOPMENT WITHIN AUSTRALIA

Administration of Spatial Information

SDI development in Australia is being advanced by three key bodies: ANZLIC – the Spatial Information Council (ANZLIC), the Intergovernmental Committee on Surveying and Mapping (ICSM) and the Public Sector Mapping Agencies Australia Inc. (PSMA). Together with Australia’s eight States and Territories and the Commonwealth Government, these bodies are providing leadership for spatial information and various elements of SDI development nationally (Warnest et al., 2002).

ANZLIC is the peak intergovernmental council for spatial information in Australia and New Zealand (ANZLIC, 2002a). ANZLIC is a national committee representing an extensive community of coordination arrangements that facilitate the unity of views and interests of spatial data users and producers across government and the public sector (Bell and O’Keeffe, 2001). ANZLIC was originally established in January 1986 as the Australian Land Information Council (ALIC) by agreement between the Australian Prime Minister, State Premiers and Chief Ministers and later formally included New Zealand (ANZLIC, 2002a). Membership of ANZLIC comprises representatives from all jurisdictions, a representative from the Commonwealth Government and a New Zealand representative. In addition to providing a jurisdictional coordinating structure, ANZLIC provides the overarching framework for other relevant coordinating bodies, such as ICSM and PSMA (Bell and O’Keeffe, 2001). Until recently, ANZLIC administrative support was provided from within the Commonwealth Government. In 2002, ANZLIC now operates a national office with three full-time Commonwealth staff, a chief executive and two project officers to provide central administrative services to the Council (Fairall, 2002).

ANZLIC maintains two dedicated standing committees working towards the ASDI and development of the spatial information industry. The first committee, which is of particular interest to this paper, is the ASDI Standing Committee that coordinates ASDI technical implementation projects and ASDI related activities of ICSM and ANZLIC sub-committees and working groups (ANZLIC, 2002a). The ASDI Standing Committee identifies and promotes the development of the standards and protocols required for implementation of the ASDI. The second is the Industry Development Standing Committee, which has a mission to work with industry to remove regulatory, statutory and policy impediments to the development of a robust and commercially viable national private sector spatial industry (ANZLIC, 2002a). Each committee is chaired by a Council member and comprises broad government and industry membership from within Australia and New Zealand (Clarke, 2001).

ICSM undertakes the development of national geodetic, topographic and cadastral standards and reports to ANZLIC. PSMA is an intergovernmental consortium formed in 1993 comprising all public sector mapping agencies of the federal, state and territory level to integrate the best available map data for a national digital map base of Australia (Bell and O’Keeffe, 2001). PSMA, formally incorporated in 2001, develops national spatial datasets such as road networks and cadastre by integrating jurisdictional datasets (Clarke, 2001). Both PSMA and ICSM are represented on the ANZLIC ASDI Standing Committee (Clarke, 2001).

Representatives from each of the eight State and Territory jurisdictions, the Commonwealth and New Zealand that make up ANZLIC, PSMA and ICSM are usually drawn from the respective Government land administration or mapping agency of each jurisdiction. The Commonwealth’s National Mapping Division, formerly known as AUSLIG and now structured within Geoscience Australia, together with the newly formed Office of Spatial Data Management (OSDM) works closely with ANZLIC supporting the pursuit of the ASDI and industry development goals. OSDM, supported by Geoscience Australia, has the lead responsibility for ASDI implementation in the Commonwealth Government. ANZLIC is affiliated with other regional SDI coordination bodies that support the development of the ASDI and its contribution as a component of regional and global SDI initiatives. Figure 2 depicts the organisational structure and relationships between the key political/administrative bodies in Australia, providing a simplified view of the communication channels and hierarchy of reporting.
Commonwealth coordination of land related information commenced as early as 1983 (OSDM, 2002). Despite subsequent changes to coordination arrangements over the next decade, an inherent weakness of a focus on land and technical matters still remained, which restricted the ability of the Commonwealth to address broader spatial data management issues. The Commonwealth Spatial Data Committee (CSDC), formed in 1992, set out to maximise the benefits from spatial information by enabling efficient use of spatial data through common standards and avoiding duplication of effort in the collection and management of that data. The CSDC promoted the development of a NSDI through working with State and Territory agencies and interaction with the spatial information industry (OSDM, 2002). In 2002, the Commonwealth introduced the OSDM with new strengthened coordinating and reporting arrangements to facilitate the implementation of whole-of-government spatial data policy, particularly the Spatial Data Access and Pricing policy which would involve mutually benefiting arrangements with the States and Territories. The coordinating structure comprises a Policy Executive that provides strategic direction and a Management Group to act as a reference group for the OSDM. The respective roles of each entity is as follows (OSDM, 2002):

**Commonwealth Spatial Data Policy Executive (CSDPE)** The chair of the CSDPE represents the Commonwealth on ANZLIC with the support of the CSDMG providing high-level input to establish the position of the Commonwealth in that forum. Membership of the CSDPE largely comprises CEO level personnel from key Commonwealth departments including Department of Industry, Science and Resources (chair), Environment Australia, Agriculture Fisheries and Forestry Australia, Department of Transport and Regional Services and the chair CSDMG (ex-officio). The role of the CSDPE is to report to the responsible Federal minister on data policy implementation such as pricing and access arrangements intra-Commonwealth, and inter-jurisdictionally.

**Commonwealth Spatial Data Management Group (CSDMG)** The CSDMG consists of Senior Executive level managers and reports to the Policy Executive on the implementation of spatial data policy. The CSDMG is required to submit an annual work plan to the Policy Executive. In undertaking the work plan, the Management Group act as a reference group for the OSDM. Additional responsibilities include the provision of representatives for ANZLIC sub-committee and work groups, maintenance of linkages with major Commonwealth initiatives for which spatial information is a key resource, and advise the Policy Executive on the needs and expectations of the spatial data user community.

**Commonwealth Office of Spatial Data Management (OSDM)** The OSDM provides administrative support to both the Policy Executive and the Management Group and undertakes daily management of the work plan and associated workgroups established by the Management Group. The role of the OSDM is to establish and maintain links with all Commonwealth agencies that collect, manage or use spatial data in order to share skills and experiences and promote efficient use of Commonwealth data. The OSDM further represents the Commonwealth in the negotiation of whole-of-Government spatial data access arrangements with the States and Territories.

The role of the OSDM is consistent with that of the National Mapping Division within Geoscience Australia. National Mapping is assigned with the task of coordinating Commonwealth land information programs, advising Government on land information issues and policy, coordination and standards for the ASDI. Although the OSDM is supported by Geoscience Australia with respect to operational and human resources, OSDM will operate independently with primary goals to (OSDM, 2002):

- Maximise the Commonwealth’s benefits from spatial data.
- Support the growth of the spatial information industry.
- Facilitate community access to spatial data held by the public sector.
The need for strengthened coordination of spatial information management as recognised by the Commonwealth has also been reflected in the States and Territories. Spatial information coordinating mechanisms have been established in most of the jurisdictions with each providing representatives on ANZLIC committees and sub-committees. While an in depth review of the coordinating mechanisms of each State and Territory is beyond the scope of this paper, research being conducted at the Centre for Spatial Data Infrastructure and Land Administration at the University of Melbourne is looking at modelling SDI development nationally with particular focus on the SDI partnerships driving development in jurisdictions and their contribution towards the ASDI (Warnest et al., 2002).

Development of the ASDI

In November 1996, ANZLIC released a discussion paper defining SDI for Australia and New Zealand. The paper sets out the vision for the ASDI and is regarded as a significant catalyst for SDI dialogue and development both locally and in international forums (Holland et al., 2001). The discussion paper documents four key components that form the cohesive structure of the ASDI model (ANZLIC, 1996: p.5):

- **Institutional Framework** - The policy and administrative arrangements for building, maintaining, accessing and applying the standards and datasets;
- **Technical Standards** - The technical characteristics of the fundamental datasets;
- **Fundamental Datasets** - Spatial datasets deemed essential to the national interest and that require national coverage, produced within the institutional framework with compliance to the technical standards;
- **Clearinghouse Network** - Platform for community access to the fundamental datasets.

ANZLIC’s model for ASDI model proposes a Distributed Network of fundamental spatial datasets maintained by individual custodians, integrated through the adoption of consistent standards, policies and administrative principles (ANZLIC 1996; Holland et al., 2001). Since the release of ANZLIC’s vision for an ASDI, ANZLIC and its working groups have enjoyed notable successes such as the Australian Spatial Data Directory released in 1998. The Directory links government and commercial nodes in each State and Territory and spatial data agencies within the Commonwealth Government (ANZLIC, 2002b). The nodes are database servers that allow query and retrieval of spatial dataset information across the Internet in accordance to the ISO information search and retrieve protocol Z30.50 (ANZLIC 2002b). The directory now comprises over 30,000 metadata records (information about the individual datasets) on 24 distributed nodes (ANZLIC 2002c; Clarke 2001). ANZLIC’s other notable achievements and efforts have included: developing national pricing, copyright and data access policies and guidelines and formulating national agreements for access and management of spatial data across jurisdictions (ANZLIC, 2002d).

The ASDD represents a principal step in the development of SDI for Australia, allowing the many disparate agencies to list the spatial datasets they keep and by providing a gateway for users to query the availability of datasets Australia wide by theme or geographic extent without having to contact individual agencies. Geoscience Australia maintains the gateway to the ASDD on behalf of ANZLIC as part of its broader Commonwealth responsibility for the ASDI. The ASDD nodes are implemented and maintained by the individual agencies within each jurisdiction and it is the responsibility of hosts to maintain their own metadata in accordance with the ANZLIC Metadata Guidelines (ANZLIC, 2002b). Clarke (2001), a past chair of the ASDI Standing Committee, recognises that although to date much work has been undertaken, considerable effort is still required before all of the components of the ASDI are operating as a fully functioning infrastructure.

ANZLIC with the support of the national office is addressing the need for a fully functioning ASDI. ANZLIC recently released a draft architectural plan for public comment that details a proposed technical design for the Distributed Network. The draft proposal, developed by the Technical Working Group of the ASDI Standing Committee, acknowledges the ASDD as an important first component of the Distributed Network for the ASDI (ANZLIC 2002d). The Distributed Network concept extends beyond the existing metadata registry role of the ASDD, allowing users to view, query, search for features by geographic name, print and download spatial data in both vector and raster formats. The design provides for existing international software and information exchange protocols and standards developed by the Open GIS Consortium (OGC) (refer to OGC’s “Vision” for Web Services Figure 3), Worldwide Web Consortium (W3C) and the ISO 19100 series for geographic information (ANZLIC, 2002d). These protocols and standards allow communication between sources of spatial data and are consistent with the ANZLIC’s objective for the ASDI as a mechanism to provide better access to the wide range spatial information held by the many public and private agencies throughout Australia (ANZLIC 2002d).
Role of the Spatial Information Industry in SDI Development

In Australia, we are now observing a strengthening and unification of the spatial information industry (Jacoby, et al., 2001a). Developments nationally saw Senator Nick Minchin release the Spatial Information Action Agenda "Positioning for Growth" in Parliament in September 2001. The Action Agenda (ISR, 2001a) sets out 45 recommendations for Government, Industry and Academia to work together in advancing Australia's spatial information industry by identifying opportunities for and barriers to growth, and development of framework policy to foster an internationally competitive industry. The roles of the public and private sectors are changing as governments move away from being service providers to providing the policy, framework, coordination and facilitation. Governments are increasingly out-sourcing non-core business activities to the private sector and community (ANZLIC, 1996). This changing role is in-line with the federal government National Competition Policy (NCP) of Australia and New Zealand that set to remove government barriers to competition (Southbridge, 1997). The spatial information industry needs to reposition itself to take advantage of the new opportunities presented by ASDI development.

The Action Agenda is supported by the concurrent release of the Spatial Data Access and Pricing policy, which the Commonwealth claims will greatly improve access to fundamental spatial data held by government. The policy aims to maximise benefits to the community from the Commonwealth’s investment in spatial data and promotion of growth of the spatial information industry (ISR, 2001b).

Key businesses from the spatial information sector are uniting arms to form the Australian Spatial Information Business Association (ASIBA) (Jacoby et al., 2001a). ASIBA is an important early outcome of the Action Agenda providing a single point of contact for Government (ISR, 2001b). To complement ASIBA is the recent collaboration of professional bodies that have initiated moves towards formation of a Spatial Sciences Coalition (SSC). It is anticipated both industry and the profession will each have a single voice to tackle issues and lead the spatial information industry (Jacoby et al., 2001a).
NATIONAL SDI RESEARCH PROJECT

In order to understand and describe SDIs it is essential to map the complex spatial data relationships on which they are based. As discussed earlier, SDI development is reliant on the fundamental partnerships, institutional arrangements, communication networks and standards. There has been a global trend for countries to expand or consolidate their efforts in developing SDIs through partnerships. In the 1990s, NSDI development took a broad-based approach to encourage cooperation among stakeholders to integrate disparate data assets (Masser, 1998). Constrained by existing technical and institutional arrangements, agencies developing SDI focused on promoting the adoption of common standards, as well as fast-tracking integration of selected strategic data sets through partnership arrangements (ANZLIC, 1996).

A key principle of SDI is sharing and SDI by definition involves multiple agencies and organisations. Two Australian examples of partnership initiatives are: the Property Information Project conducted by the Victorian Government in which a partnership between Victoria's 78 Local Governments and the State is creating a uniform view of all property information (Jacoby et al., 2001b; Newnham et al., 2001); and the establishment and continued achievements of PSMA in integrating the best available map data from each State and Territory jurisdiction (Grant and Roeberge, 2001; Mooney and Grant, 1997). These two initiatives confirm that partnerships can be successfully formed among custodian agencies at the various political/administrative levels to construct elements of SDI. To date little work has been undertaken on mapping these partnerships particularly at the national level. Although many case studies of NSDIs have been documented globally, the studies often contain little comparative analysis between other NSDIs, nor critique of the case study methodology adopted.

The Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne won an Australian Research Council Partnerships with Industry research grant to study SDI partnerships within Australia. The grant is supported by Land Victoria of the Victorian Government and Land and Property Information of the New South Wales Government through their longstanding commitment to joint research with the University of Melbourne and their common need to better understand the nature of SDIs. The research will form a three-year study investigating the nature and extent of SDI development in Australia with the aim of developing a method to model National SDI within countries that are a federation of states. Their contribution highlights the importance placed on this research with outcomes set to contribute to the development of their future administrative strategies and policies that will facilitate SDI development and lead to the next generation of SDIs (Warnest et al., 2002).

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CONCLUSION

The concept of SDI remains an innovation despite the many definitions and models published by various governments and agencies worldwide. Further research is required to better understand the dynamic nature and complexities of SDI to assist administrators to implement this form of infrastructure into the future.

Based on ASDI development, the challenge faced by government and industry is to develop and implement complete and consistent state and nation wide SDI to support new community demands for spatial information. Government is meeting this challenge through new coordinating structures geared to implement whole-of-government policy for spatial information and to support growth of the spatial information industry. Developments in the spatial information sector show a period of strengthening that will ultimately support future SDI development. The lead government agencies for spatial information are also re-positioning in a concentrated effort to advance implementation and development of the ASDI.

This study contributes to research underway at the Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne that has adopted a national approach to SDI research focussing on the ASDI and the partnerships that underpin SDI development.
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**BIOGRAPHY**

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**Professor Williamson** Professor Williamson is the Professor of Surveying and Land Information, Head, Department of Geomatics, and Director, Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne. His teaching and research is in the areas of cadastral, land and geographic information systems, land administration and spatial data infrastructures and he advises state and federal government, UN agencies and The World Bank in these areas. He was Chairperson of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors 1994-98, and is the current Director for United Nations Liaison for the FIG. He is also Chairperson of Working Group 3 (Cadastre) of the United Nations-sponsored Permanent Committee on Geographic Information Systems Infrastructure for Asia and the Pacific 2001-2004.