BEYOND SDI: THE CASE OF VICTORIA

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ABSTRACT:

This paper describes a current definition of spatial data infrastructure (SDI) from Global Spatial Data Infrastructure. Based on this definition the contextual development of the Australian spatial data infrastructure is described, followed by a description of historical development of Victoria's SDI in the past decade and a half. It started from a situation analysis in 1991 to assess needs for a coordinated approach to managing GIS through development of framework datasets to the current web-based spatial information delivery infrastructure. Using the framework of a "business model" the approach to developing SDI in Victoria is described. In the process the organisation involved, Spatial Information Infrastructure of Department of Sustainability and Environment in Victoria is positioned as an infrastructure provider in the market. Partnership is its primary pathway to development. However based on recent development locally and globally it is highlighted that there may be a need to start to think beyond the current concept of SDI.

1. INTRODUCTION

According to The SDI Cookbook Version 2.0 (Nebert, 2004), 'the term "Spatial Data Infrastructure" (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data … using a minimum set of standard practices, protocols, and specifications' to provide 'a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general'. This concept has broadly guided the development of SDI in Victoria for over a decade.

This paper describes the achievements of SDI development in Australia and Victoria, and documents Victoria's approach in the framework of a business model that links the technical inputs of the organisation-in-charge to the desired economic and policy outputs. The paper concludes by suggesting that the concept of SDI may change significantly in future and that there may be a need to starting to think beyond SDI. At that time the business model described could serve as a baseline to chart the course of future development.

2. CONTEXT OF SDI DEVELOPMENT IN AUSTRALIA

Over the last decade or more in Australia SDI development in its various guises has been coordinated by Australia New Zealand Land Information Council (ANZLIC), the peak inter-government and multi-jurisdictional body at national, state and territorial level. The mapping and spatial data standards are determined by the Inter-government Committee of Surveying and Mapping (ICSM). In 1995, the Federal, State and Territorial mapping agencies in Australia joined forces to form Public Sector Mapping Agency (PSMA) to create the first national cadastral and topographical dataset that underpinned the 1996 Census. Since then it became the national body that develop and market national framework datasets such as light version of the national cadastral dataset (CadLite) and Geographic National Address File. More recently, in response to the need of the spatial information industry the Federal

Government initiated the Action Agenda to help develop the industry. As a result, the private sector organised itself into Australian Spatial Information Business Association; the professional bodies in the industry into Spatial Sciences Institute and the academia/research sector into The Australasian Spatial Information Education and Research Association. In 2003, the Federal Government jointly funded the spatial information research proposal put forward by a consortium of state governments, universities and a group of 43 private companies resulting in the creation of the Cooperative Research Centre for Spatial Information.

Development of the Australian SDI (ASDI) has always been a key objective of ANZLIC, which has recently provided a self evaluation of the five modules of ASDI (Blake 2005):

- Module 1: ASDI Governance
- Module 2: Access to Data
- Module 3: Data Quality
- Module 4: Interoperability
- Module 5: Intergratability

In general, the achievement is satisfactory and Victoria has been a key participant in the process through the involvement of Spatial Information Infrastructure (SII), which is part of the Department of Sustainability and Environment (DSE), the organisation charged with developing Victoria's SDI. On the one hand SII provides the channel into Victoria for implementing standards and policies agreed at the national level. On the other hand it feeds local and state data from Victoria up for consolidation into national data products, and represents Victoria's interests when developing national policies and standards.

3. SDI ACHIEVEMENTS OF VICTORIA

The predecessors of SII started building Victoria's SDI in the early 1990s through commissioning the GIS Situation Report 1991 by Tomlinson Associates Ltd. Ever since a number of policy/strategy documents were produced. The State's GIS policy function was merged with the surveying and mapping

function in 1995 to better integrate Victoria's capability to develop its SDI. By the release of the third document, Victorian Geospatial Information Strategy 2000-2003 (VGIS) (DSE, 2000), in 2000, it was possible to see the different components of the SDI already being put in:

- The identification of the fundamental datasets.
- Improvements in the quality of that data .
- Introduction of a new pricing policy which resulted in a considerable reduction in data licence fees.
- Research agreements with tertiary institutions.
- Agreements for commercial contractors to manage the state's fundamental datasets.
- Partnership with local governments to update the cadastral database.
- Increased options for accessing data, particularly through the growth of the internet.

Through VGIS in 2000 - 2003, the State was able to consolidate and appoint designated custodians for Victoria's eight fundamental ('framework') spatial datasets, collectively known as Vicmap, which comprises:

- **Geodesy** – 100,000+ survey marks and a network of GPS base stations, collectively known as GPSnet.
- **Property** – 2.5 million parcels and properties.
- **Transport** – every road in Victoria, including forest trails, fire tracks and property access roads.
- **Address** – 2.1 million addresses .
- **Administrative boundaries** – including locality, electoral, local government, and postcode boundaries.
- **Elevation** – slopes, aspects and contours.
- **Hydrography** – all water courses and features.
- **Imagery** – aerial photography, as well as Landsat and SPOT satellite imagery.

By the time the Victorian Spatial Information Strategy (VSIS) 2004-07 (DSE, 2005) was endorsed by Victorian Government in April 2005, additional achievements have been made the include:

- a coordinated spatial information management environment (the Strategy) to facilitate data sharing and exchange, and integration through interoperability standards .
- multi-level governance through a whole of spatial industry coordinating body, the Victorian Spatial Council, whole of government body, the Victorian Government Spatial Committee; and a departmental body, the DSE/DPI Spatial Committee, with the latter two created in partnership with the respective Chief Information Officers.
- An expanded retail network of data service providers .
- Quality standards and auditing tools for framework datasets.
- Web-based delivery of spatial information to public.
- Custodianship agreements in place to support the development of flexible topographic map products.
- Outsourcing of development of innovative paper-based topographic maps.
- Partnerships with private sector companies to develop innovative products/services such as address validation and address-based products delivery.

Formal participation in the Cooperative Research Centre for Spatial Information (see section 2 above).

4. BUSINESS MODEL

4.1 General Concepts

SDI development is complex. It is a joint effort involving stakeholders from different levels of government, the private sector, academia and the professions. Individuals or groups may each play a single but different role or take on multiple roles. This is very much determined by one's positioning and business model in the spatial information industry.

Chesbrough and Rosenbloom (2002) see a business model as providing "a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic outputs". Applying Chesbrough and Rosenbloom's concept to SII in relation to the spatial information market/industry there are six functions of a business model:

- Articulate a *value proposition*, ie., value created to the users by SII's products and services .
- Identify a *market segment*, ie., who the users are and how revenues can be generated.
- Estimate the *cost structure* and *profit potential* .
- Define the structure of the *value chain* in SII to create and distribute the products and services.
- Describe the position of SII in the *value network*, linking suppliers and customers.
- Formulate the *competitive strategy* for SII to help Victoria's spatial information industry to prosper and be competitive so as to realise the benefits of the state's spatial information assets.

4.2 Pre-2000 Business Model

The year 2000 can be seen as a watershed in the development of Victoria's SDI. It is the time when the different components of the SDI were coming together, albeit in their early stages. It is also the time when there was a significant change in the means of accessing spatial information—the growth of the Internet. In a way 2000 marks an end of a business model and the beginning of a new one for SII. This section briefly describes the pre-2000 business model of SII in accordance with its six functions.

Value Proposition

The ultimate value proposition of SII has always been to develop the spatial data infrastructure for Victoria to make it more efficient and effective to use the state's spatial information assets to support decision making and policy development. In the 1990s with the spatial information industry in Victoria as we know it now still in its infancy the focus was on defining the SDI, raising the awareness of value of the infrastructure and to develop the underpinning framework datasets.

Market Segment

In the 1990s the industry was growing and changing. Generally there was limited knowledge of the industry and the market, which were both evolving.

So far, while the VGIS documents were intended for the whole SI industry, SII needed a foothold. By being within Land Victoria, the land administration authority in Victoria, SII quickly formed a strong partnership with the land administration community in developing the cadastral map base (Vicmap Property). It was also responsible for the provision of

the State's digital road network for emergency ambulance dispatch purposes. At the same time, SII kept the traditional responsibility of supplying Victoria's paper-based topographic maps and related surveying and mapping products

In general the policy and the framework datasets were parts of an infrastructure developed for and on behalf of corporate specialists who were often both users and custodians. In this context the market can be divided into four quadrants depending on whether it is general or specialist spatial capabilities being developed to meet the needs of novice or specialist users.
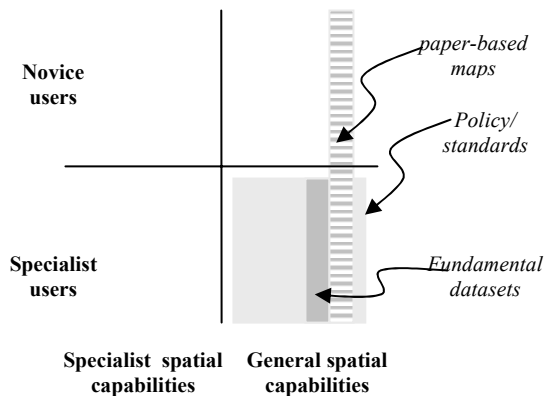

Figure 1. SII's position in the spatial market – pre-2000

Figure 1 depicts SII's position in the market as described above. SII was an infrastructure provider developing the policy/standards and fundamental datasets for primarily specialist users but also supplying paper-based maps to all Victorian users including the novice users.

Cost Structure and Profit Potential

All along, SII is a government organisation funded for Victoria's primary mapping function and helping to deliver Government's policy outcomes by providing necessary spatial information support. It is not in the market for a profit but it is required by Government to generate revenue to maintain certain level of self sufficiency in regard to Government's investment in paper map and framework data businesses. Like other government department, it has to bid for funding to undertake new projects in its effort to develop Victoria's SDI.

Value Chain

In meeting its value proposition and position in the market SII played the following roles as its core business in the 1990s, which form its pre-2000 value chain (Figure 2):

Coordinator of spatial information policies & standards: this is the first role that involves coordinating development and implementation of VGIS based on the needs of users and providers of the industry. It should be noted that in Figure 2 there is no clear distinction between users and providers in the box representing the SI industry as an organisation can be both.

Custodian of Victoria's fundamental spatial datasets: this is the second role that bears full custodial responsibilities for Vicmap data which is Victoria's fundamental spatial information resource. It has two components. One is the

technical component responsible for the continual development, quality assurance and maintenance of the datasets. The other is the stakeholder engagement component that liaises with and form partnerships and/or business agreements other data custodians/providers to pool their data resources together into state wide framework datasets. A good example is Vicmap Property formed in partnership with the water authorities and local councils.

Provider of digital data & paper-based mapping products: this includes production, wholesale and retail responsibilities of the state's digital data and basic paper map products such as the topographic map series, and the associated marketing functions.

The linked grey boxes that lead to "Sustainable Government Policy Outcomes" in Figure 2 represent the value chain in pre-2000 SII giving it the position in the SI market in Figure 1.

Value Network

The value network which is external to SII involves partnerships and business agreements with the providers and users in the Spatial Information Industry. As an illustration the custodian role formed partnership with local councils to obtain up-to-date data on parcels and properties in Victoria. The data was incorporated into Vicmap Property by a data maintenance contractor. After internal quality assurance the updated dataset was passed on to licensed power companies by way of data service providers appointed by SII and managed through the provider role.

University researchers were also engaged to undertake research and development (R&D) in understanding GIS and SDI management in general and managing framework data, especially Vicmap property in particular. In generally the R&D activities addressed tactical problems currently encountered.

By engaging the market to take over certain technical operational, and R&D functions of SII through outsourcing, more players are encouraged to enter the market, develop specialist expertises and grow. In this way SII played an additional role of being the **Champion of the industry** by providing the framework datasets, physically supporting the industry through outsourcing and setting an example on behalf of the Government to grow the industry. In the process it also gained a better understanding of what the market wanted, which in return helped inform the continual development of the other core roles.

These relationships are represented in Figure 2 by the 2-way arrows among the respective roles, and between the roles and the providers and users of the industry.

Competitive Strategy

To ensure that it could come up with the appropriate strategy to develop SDI in general and the framework datasets in particular SII adopted the strategy that includes:

- Amalgamating the policy and surveying and mapping functions, ie., bringing the three core roles of SII (see subsection on value chain above) in the same organisation and were aligned with the spatial data supply chain in the market. This ensured alignment of policy with actual product development and delivery business .

- All core roles with strong stakeholder & customer engagement functions to better understand needs of stakeholders and customers and to partner with key players to leverage their data assets, expertises and business networks to fast track development of framework datasets and their market in a collaborative manner .

Working in collaboration with key players to grow the industry as a whole provided first hand intelligence of market requirements and trend that allowed timely response to market changes
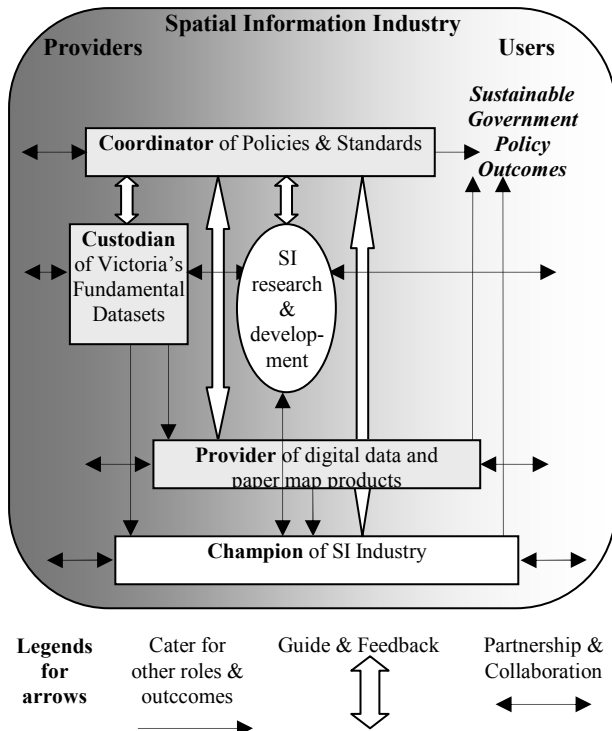

Figure 2. Business Model of SII Pre-2000

4.3 Current Business Model

Since 2000 there were changes to both technology (Rajabifard et al., 2005) and government strategies and organisation (Thomas, 2005) that led to a significant change to SII's business model.

Value Proposition

The basic value proposition of SII holds true as described before. However with the maturation of technology and the SI market the focus has extended beyond provision of data infrastructure to infrastructure for delivery of information and services, underpinned by both business and framework datasets. This change is reflected in the name of SII—Spatial Information Infrastructure.

Market Segment

The advance in technology and associated change in market demand means that previous positioning of SII is no longer appropriate in fulfilling the value proposition. Both the policies and infrastructure, instead of being developed for and on behalf

of the specialists, has to be extended to novices (informed members of public but not GIS specialists) (Figure 3).

At the same time, the previous offering in Victoria's SDI of policies, standards, paper maps for the State and digital framework datasets is no longer enough. It has to be extended to include basic GIS services (query, simple analysis & visualisation) and web-based delivery of data products & services.

Figure 3 illustrates the positioning. SII's core business is still to provide infrastructure, albeit including a richer set of products and services. The policy & standards also now cover the whole SI industry. It is expected that corporate GIS specialists and private value-added resellers will develop higher value adding products and services to provide solutions for the Victorian community.
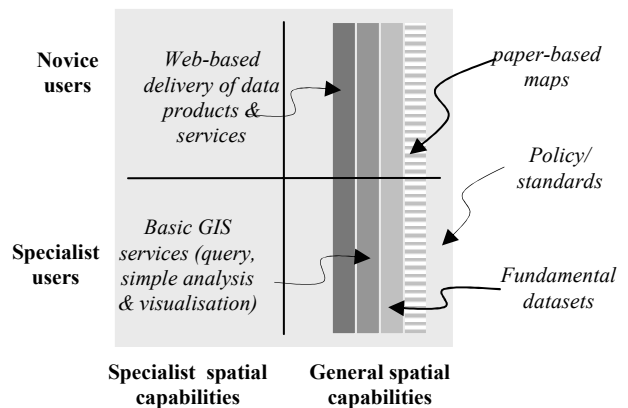

Figure 3. SII's position in the spatial market – current

Cost Structure and Profit Potential

As SII's services are recognised and needed in Government to support various policy outcomes such as those of the Commissioner for Environmental Sustainability, Government will be more prepared to fund its activities. As more citizens and businesses are using and benefiting from the infrastructure managed by SII, there are two likely benefits. One, Government is more likely to continue to support the infrastructure in future, both for Government and the Victorian community. Two, the increase in revenues from the use of framework data will sustain the ongoing maintenance of the data and hopefully further reduce the licence fee in due course.

Value Chain

In meeting its updated value proposition and new position in the market SII plays the following roles as its current core business as the different components of its value chain (Figure 4):

Coordinator of spatial information policies & standards

This role is basically similar to the pre-2000 one except that SII has to support and report to a number of governance bodies such as the Victorian Spatial Council, government's multi-levelled committees that include ICT Policy Committee, Victorian Government Spatial Committee and the DSE/DPI Spatial Committee. As a result, SII is given more policy guidance and stakeholder input but has to be more accountable for its outputs.

Apart from the above policy and governance component, this role is taking on a new component in providing advice and support to stakeholders who want to adopt the standards and best information practices promoted in VSIS.

Custodian of Victoria's fundamental spatial datasets: this role will remain more or less the same. The focus, however, will be shifting to improvement of quality, currency and richness in content to support new demands.
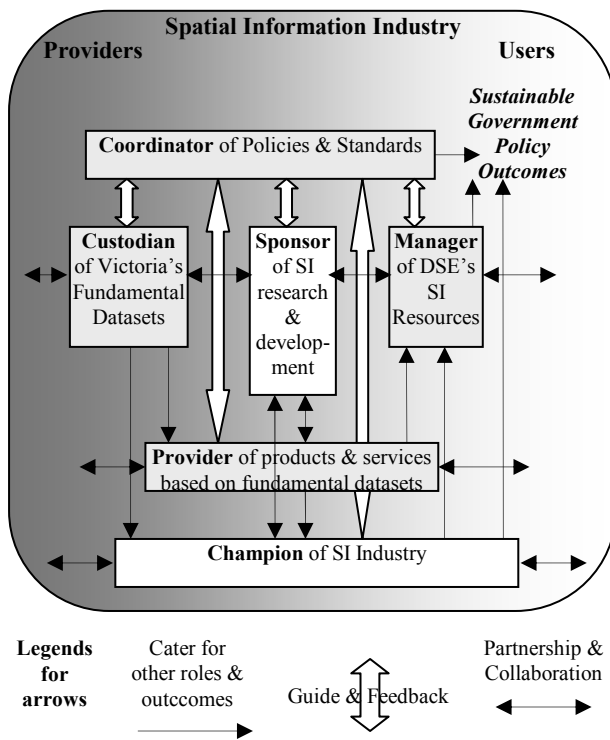

Figure 4. Current Business Model of SII

Provider of products and services based on fundamental datsets: the scope of this role has significantly expanded. On top of the traditional service of providing data/information on physical media such as paper maps, tapes and disks, the delivery is increasingly online via Internet or corporate intranets, providing access to small packets of data in addition to whole datasets.

Attention is also given to working closely with specific communities of practice, such as the land administration community, to provide better user experience and outcome by adding basic GIS services that include search, query, simple GIS analysis and visualisation (via web-based maps). In a recent survey of SDI activities in Australia, this is found to be the trend (Rajabifard et al. 2005).

Another important service is to manage the very large framework datasets, including taking updates from data contractors, incorporating them into the main datasets and packaging them for delivery to or access by customers and corporate clients.

With the incorporation of the GIS and remote sensing functions in 2000 SII also provides specialist mapping, GIS and remote

sensing services. The services are increasingly to support internal use.

Manager of DSE's SI resources: this role is to implement VSIS in DSE to better manage the Department's SI data resources to support its various functions. This role is a condensed role that draws on the experience/expertises of the other roles and applying it to DSE.
In this role SII also provides services to DPI under an existing shared services agreement between DSE and DPI. Any innovative SI products and services created for DSE/DPI is also expected to be made available to Government as a whole.

The linked grey boxes that lead to "Sustainable Government Policy Outcomes" in Figure 4 again represent the current value chain of SII in the SI market.

Value Network

As in the pre-2000 case SII continues to engage with the users and providers of the industry to ensure a smooth data/value chain to deliver its core business outcomes. It continues to be the **Champion of the industry** promoting new opportunities for the growth of the industry. This includes outsourcing of development of new paper-based topographic maps for Victoria. Developing with industry partners new infrastructure for address validation and address-based information/map delivery services based on a web service architecture.

Building on its close working relationship with academia SII successfully collaborated with its industry partners in getting federal funding to establish the Cooperative Research Centre for Spatial Information. By investing $1 million in the consortium behind the bid SII took on an additional role as **Sponsor of SI R&D.** It also provides Victorian Government with access to $78 millions worth of research capacity in Australia in support of the R&D needs of Victoria.

Competitive Strategy

Currently SII is continuing with its tradition of working in partnership with organisations in the industry to fulfil its value proposition. Through taking on new roles and expanding on its existing roles SII is able to extend its presence as an infrastructure provider from policy development through hands-on infrastructure development to providing real services to end users ranging from novices to GIS specialists both individually and as a corporation as in the case of DSE/DPI.

While the expertises developed in the process are valuable right across its many roles, it is the market intelligence that SII is getting through its multiple roles that enables it to:
- think strategically.
- act proactively.
- respond timely to opportunities and trends.
- deliver business and policy outcomes in a holistic and sustainable manner by taking a whole of industry perspective.

In this context it is regarded that the strategy has been effective in fulfilling SII's value proposition.

5. BEYOND SDI

From the 1990s to the new millennium changes in technology and supply and demand of spatial information in the market shifted the focus of SDI development in Victoria from data, especially framework data, to data products and basic GIS services. In respond SII changed its business model, not so much the fundamentals encapsulated in the components of *value proposition* and the *cost structure and profit potential*, but more the focuses in *market segment*, *value chain*, *value network* and *competitive strategy*.

The concept of SDI has served Victoria well in guiding its effort in the last decade. However the rapid change in technology together with any potential impact of the entrance to SI market by global behemoths, such as Google, Microsoft and Yahoo, is gradually casting doubt on the long term relevance of the term SDI. An early sign in support of this perception is provided by the demand by the Governing Board of the Cooperative Research Centre for Spatial Information in Australia for a new approach beyond SDI to conceptualise "Virtual Australia", the foundation concept of the Centre.

It is too early to predict what will happen to the concept of SDI in future and how it will change the strategy or even the business model of SII. In any case this paper could serve as a baseline for SII to chart its future course.

6. CONCLUSIONS

Using the framework of a business model this paper describes two phases of SDI development through the current and pre-2000 (1990s) experience of Spatial Information Infrastructure (SII) of the Government of Victoria in Australia. In the process the paper identifies SII as a spatial information infrastructure provider that caters for individual and corporate needs, covering both novice and specialist users.

This evolution of SDI development in Victoria is by and large guided by the concept of SDI. However there are signs that things may change in the future, particularly in regard to the concept of SDI. It may be time to think beyond SDI.

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