

A RESEARCH AGENDA FOR SPATIAL INFORMATION

Introduction

With the imminent establishment of CRCSI-2, which will come into being on 1 January 2010, there is now a significant opportunity for the spatial information community, including Government and the Victorian Spatial Council, to leverage the \$170 million research capability that will be available for the next seven years.

However, achieving these benefits requires careful planning and commitment of resources.

A necessary first step to developing specific proposals is the creation of a research agenda aligned to the needs of the Government and the VSC.

This document therefore is based on the strategic needs of Government and the VSC and will be used to engage with CRCSI-2, researchers (universities) and other collaborators in the private and public sectors to develop specific R&D projects.

The environment for spatial information

The development of spatial information is occurring in an environment of significant policy and technical change. For example, information sharing, opening access to public sector information, and the call to be more innovative are all requiring the spatial information community to think about how spatial information is being managed, delivered and enhanced.

Three specific initiatives that are responding to these and other drivers and setting out a way forward for spatial information in Victoria, and that will have a direct bearing on its development in the short term, are the Victorian Spatial Information Strategy, the ANZLIC Spatial Marketplace and the National Positioning Infrastructure.

Victorian Spatial Information Strategy

The Victorian Spatial Information Strategy sets the overall strategic direction for the spatial information community.

The 2008-2010 Strategy sets out a series of challenges and responses (or strategic directions) that will need to be met to create a 'spatially enabled Victoria'.

Three of those challenges are:

- *The foundations – awareness*: 'Raising awareness about and understanding of the role of spatial information as an enabler'.
- *Accessible data – information management framework*: 'Having a robust information management framework, ensuring data is fit for purpose (including quality and accuracy), discoverable, accessible, and available; that people are aware of it; and that it can be integrated from various sources (whether within and between organisations, states and nations)'.

- *Institutions – operational rules*: ‘Establishing the right ‘frameworks’ for a flourishing spatial community – with members who have an incentive to participate, supported by enabling principles and operational rules that underpin the spatial information, facilitate sharing it, and support innovative developments based on that information’.

Two of the strategic directions are addressing the structures needed to meet these challenges: the framework and information management.

- *Creating a framework in which the use of spatial information can flourish* – supporting access to spatial information through the rules, principles and structures that deliver appropriate standards and establish mechanisms for delivering and sharing spatial data.
- *Maintaining the foundations for Spatial Information Management* – so that spatial data is available, accessible, and clearly understood by users. This will be achieved in a number of ways, including ensuring data is fit for purpose, development of technical solutions that encourage accessibility, raising awareness, and discoverability of the data – through catalogues and other means.

ANZLIC Spatial Marketplace

Another major initiative that has the potential to impact on activities in Victoria is the ANZLIC Spatial Marketplace.

The Marketplace is focusing on developing an infrastructure that is at once accessible to non-specialist users, is capable of supporting transactions between suppliers of data and users, and allows easy publishing, distribution and discovery of and access to spatial information.

The ‘marketplace’ must be able to support:

- finding and accessing spatial resources (data, products, services, processes)
- publishing and marketing these resources, and
- gathering of intelligence from the spatial market place to facilitate bringing together suppliers and users for the development of new spatial resources

The impact on the Victorian Framework will be that its capabilities must be available for the market place to function.

National Positioning Infrastructure

ANZLIC is also engaged in promoting the development of a national positioning infrastructure. To date its activities have focused on developing a national positioning policy to provide a framework for the infrastructure and, in conjunction with PSMA Australia, the development of a national position dataset at the 20cm level with data drawn from existing CORS stations predominantly held or managed by jurisdictions.

Victoria’s Vicmap Position-GPSnet network will play a central role in the development of the national infrastructure.

Strategic Impetus

SII is responsible for delivering an information management model to ensure that spatial information is accessible and available. It has three components – policy, management of core (framework) spatial information, and providing the underpinning infrastructure that can deliver spatial information.

Within this context, its Strategic Goals for 2009-2012 are:

- Improved discovery of spatial resources
- Encourage a cultural shift toward spatial resource sharing
- Improved access to spatial resources
- Improved awareness of the value of spatial resources

The benefits of achieving these goals will be:

- Productivity gains across industry and government
- Enhanced management of the natural and built environment
- Victoria is recognised as a leader in the use of spatial resources
- Improved confidence in government's ability to deliver services

The Victorian Spatial Council is currently focused on delivering the Victorian Spatial Information Strategy 2008-10 (VSIS).

The Strategy recognises the close links between frameworks and technologies for achieving its aim of developing of a 'spatially enabled Victoria', and that

'until appropriate integrating frameworks and technologies are put in place, the promises of [the new and emerging] technologies will not be realised'.

A further challenge is to reach those who have not traditionally been associated with spatial information and bring them to a greater understanding of its potential to support the delivery of equitable and sustainable services. This will enable spatial information to reach its potential to 'unify' science, economics, politics, history, and technology by 'linking solutions to location'.

Among the initiatives the VSC is supporting in response to these challenges is setting out and promoting a Spatial Information Management Framework, and sponsoring the Custodianship Program to create a sustainable approach to custodianship of spatial data.

These are putting in place the 'rules, principles and structures' – the outstanding question is how these can be more directly connected to the technical developments that are making information accessible.

An outcome of meeting the objectives of VSIS should be wider knowledge, understanding and use of spatial information – but how can we make this a reality?

Themes

Three key areas for research and development emerge from the current programs for SII and the VSC:

- **Framework** – policy/principles; creating behavioural change; operationalising the principles;
- **Management of data and services**
- **Delivery** – reaching out to non-specialists

Each section below sets out a scenario for the future (3 to 5 years) and proposes priority areas or questions for research and development to achieve the goals set out.

The Framework

(1) Adoption of the Spatial Information Management Framework policy and principles

(2) Behavioural Change

Three to five years from now, it will no longer be necessary to educate people about the SI management principles (custodianship, licensing, pricing and metadata management). These principles will have been built into the technical tools that make it simple and easy for people to publish, search, assess, integrate, visualise, order and generate spatial resources while adhering to them. The use of these tools will be dictated/guided by a consistent set of governance arrangements and business models that are accepted nationally as best practice.

Based on the above scenario, the priority areas for R&D are as follows.

1. **Business and governance models.** Develop a set of business and governance models that provide a reliable and consistent environment that will encourage and give confidence for people to undertake transactions in spatial resources.
2. **Custodianship.** Develop the means to allow people to comply with appropriate established custodianship requirements when publishing spatial resources.
3. **Licensing and pricing.** Develop means to allow people to comply with appropriate established licensing and pricing requirements when publishing and acquiring spatial resources.
4. **Metadata.** Develop means to allow people to comply with appropriate established metadata requirements when publishing, processing and acquiring spatial resources (see also priority 9).
5. **Efficient system of data publication.** Develop a system that incorporates the above requirements to demonstrate how things will be done.
6. **Building recognition and effecting change.** How do we ensure the Spatial Information Management Framework is recognised as integral to making the Australian Spatial Marketplace successful and that it takes its appropriate place in development of the marketplace? How do we ‘sell’ the Framework?

(3) Operationalising the Framework

Three to five years from now, significant intelligence will have been built in the data and associated maintenance systems to automate a number of management tasks.

- *The Victorian framework datasets are vertically aligned automatically. For example, the parcel, road, address and drainage datasets are all aligned seamlessly and automatically when overlaid.*

- *Existing features (points, lines and polygons) in the framework datasets are aggregated automatically to update existing or new framework or business datasets. For example, current parcel data is suitably aggregated to form the approved planning schemes automatically.*
- *Current metadata for framework and business datasets are created automatically when needed by drawing on appropriate attributes in existing corporate databases, such as those for identity/access and data quality management. Metadata will no longer be a database that has to be kept up-to-date separately; it will just be a by-product of current business operations.*
- *Developers and end users of spatial data will be able to generate new spatial services (for example through web services) seamlessly by consuming data originating from different sources, such as vegetation, road and parcel.*

Based on the above scenarios, the priority areas for R&D are as follows.

7. **Vertical topology.** Develop the best means, eg integrated data model or rule-based methodology, to automatically create and maintain vertical topology.
8. **Smart feature aggregation.** Develop an automated means to aggregate up-to-date parcel data to form approved planning schemes.
9. **Metadata generation from source.** Develop an automated means to generate up-to-date metadata for datasets from existing corporate operational databases (see also priority 4).
10. **Seamless data mash-up.** Develop means to allow people to generate seamless data products from existing data sources through web services.

Management of Data and Services

(1) Data

Three to five years from now, SII will continue to coordinate the multi-million dollar investment by the Victorian Government in collecting three main types of imagery on behalf of government. They are satellite imagery, aerial photograph and LIDAR imagery. SII will be able to automate the quality assurance processes for the new data collected. It will apply low cost, easy to use algorithms to identify features such as road, building, vegetation, fence, water point, dam, and features located along the coasts. The algorithms will detect changes in these features in the landscape, extract the data and store them in files or databases and inform the data managers of the data quality and the fitness-for-purpose of these changes. SII will then apply additional low cost, easy to use algorithms to convert the changes into the corresponding vector data and incorporate the changes into the Vicmap suite of framework data according to fitness-for-purpose. The algorithms will inform the data manager of the overall quality of the new Vicmap suite of data.

Based on the above scenarios, the priority areas for R&D are as follows.

11. Automated identification and extraction of features from new imagery as follows

- road
- building
- vegetation
- fence
- water point
- dam

- break-lines (change in land form)
 - all these features located along the coasts
12. **Automated change detection** by comparing features identified from the updated datasets with existing ones and reporting on the relevant qualities of the changes compared with the existing datasets for vetting by data managers
 13. **Automated incorporation of approved changes** to existing datasets to produce an updated version, based on appropriate rules for vertical topology, with a report on the change in quality of the resulting datasets
 14. **Automated process of detecting changes** in Vicmap datasets for end users to update locations of assets defined in relation to features in Vicmap datasets
 15. **Automated process to extract information** from existing/available datasets, eg, local government or Google, to update Vicmap datasets (see also priority 23)
 16. **Automated quality assurance** of updated imagery provided by custodians/suppliers

(2) Services

Vicmap Position will be a seamless positioning infrastructure that integrates the existing CORS network with other indoor positioning infrastructures such as LOCATA and RFID to provide positioning information any where, any time. Building on this capability, Vicmap Position will support intelligent transport in various forms at various locations such as dock, road, railway line, shipping lane, flight route, forest and paddock, including the management of revenues generated as a result. At the same time telephone companies and their partners will be able to provide a wide range of mobile services based on the locations of people with GPS/GNSS (or simply Vicmap Position) enabled mobile phones.

Based on the above scenario, the priority areas of R&D are as follows.

17. **CORS network data archiving.** Legal, operational and technical recommendations for CORS network operators to address data archiving challenges.
18. **CORS network performance and node spacing regimes.** Reliability and accuracy of NRTK solutions under varying CORS node spacing regimes during periods of increasing solar activity and availability of growing GNSS satellite constellations.
19. **Optimising height outcomes for CORS network users.** ‘On the fly’ high accuracy geoid correction model input, validation, computation, expansion and access.
20. **Certification standards, governance and processes.** Development of standards, processes and possible governance models for an Australian CORS network certification framework. A working example is TUV certification in Germany.
21. **LGSP.** More efficient communication protocol for satellite data.

Delivery

(1) Reaching non-specialist audiences

Three to five years from now customers not traditionally key users of spatial information will be engaged. Just like the case with existing customers, we will know the spatial information requirements of these new customers in managing investment, risk, resource allocation and the

growth in market share. The spatial information community will have identified and put in place means to satisfy these requirements. The means include capabilities as follows.

- *Using the current and authoritative data in Vicmap, SII will apply low cost and easy systems (algorithms & data models etc.) that allow the data to be incorporated and symbolised in a pre-determined manner to form small, medium to large scale maps to suit various purposes. Appropriate levels of details will be presented in such a way as to allow easy distinction of features in the landscape at the scale in question.*
- *SII will understand the functions and capabilities of innovative electronic media of information delivery that include PDF maps, e-books and e-paper, and have developed means of presenting and updating maps and spatial information innovatively through these media in a low cost and easy to use manner.*

Among other things, suitable business arrangements with key industry players such as Google, Microsoft and Yahoo will have been established to leverage off their information holdings and technologies to extract and deliver fit-for-purpose information ready for use by the customers. The means and business arrangements will incorporate licensing and pricing practices that are in line with government policies and able to promote use of spatial information in Victoria.

Based on the above scenarios, the priority areas of R&D are as follows.

22. **Market research.** Market research will be conducted to identify potential new customers and their requirements.
23. **Leveraging global information infrastructure.** Establish business and technical arrangements with companies such as Google, Microsoft and Yahoo to make use of their information and infrastructure assets to generate innovative spatial resources for the industry (see also priority 6).
24. **Scalable mapping system.** Develop a system of data models and algorithms to simplify production of multi-scale mapping products based on a common set of datasets, for example Vicmap.
25. **PDF maps, e-books and e-paper.** Explore options of utilising emerging e-media such as PDF maps, e-books and e-paper to diversify and improve the delivery of spatial resources and their updates.
26. **Increasing understanding and bringing new users.** How do we increase the level of understanding among non-data managers so that we achieve wider use of spatial information? What is stopping us from getting the message across? What is the story we need to tell the right ‘influencers’– in all three levels of government, the private sector, utilities, academia, regulators, as the VSC has been given the responsibility to do under VSIS? How will the non-traditional spatial information users be brought to the marketplace?