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Re-engineering SDI design to support Spatially Enabled Society and Government,

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Introduction

Meeting sustainable development objectives is a complex and temporal process involving multiple stakeholders. The creation of economic wealth, social stability and environmental protection can be achieved through the development of products and services based on spatial information collected by all levels of government. These objectives can be facilitated through the development of a spatially enabled government and society, where location and spatial information are regarded as common goods made available to citizens and businesses to encourage creativity and product development. This requires data and services to be accessible and accurate, well-maintained and sufficiently reliable for use by the majority of society which is not spatially aware.

As a result of this, these days we are hearing more and more terms link 'spatially enabled government', 'spatially enabled society', 'spatially enabled', etc. In particular, we now see more dedicated events on these topics in different part of the world. But what is spatial enablement? A society or a government can be regarded as spatially enabled when location and spatial information are regarded as common goods made available to citizens and businesses to encourage creativity and product development. Spatial enablement uses the concept of place and location to organise information and processes and is now a ubiquitous part of eGovernment and broader government ICT strategies. It is also defined as an innovator and enabler across society and a promoter of eDemocracy. As a result of this, we are potentially on the verge of the most dramatic change in the use of spatial information (SI) in our lifetime.

According to the results of a survey on Spatial Enablement of Australian Government (SEG) conducted by Geoscience Australia in 2007, the vision for spatial enablement leads to improved decision making; reduction of administrative costs; whole of government outcomes; and enhanced industry development opportunities. However, this requires data and services to be accessible and accurate, well-maintained and sufficiently reliable for use by the majority of a society which is not spatially aware.

The aim to develop spatially enabled governments was a key outcome of the 17th United Nations Cartographic Conference for Asia and the Pacific (UNRCC-AP) and the 12th meeting of the UN supported Permanent Committee for GIS Infrastructure for Asia and the Pacific (PCGIAP) in September 2006 in Bangkok, Thailand. These movements prompted Working Group 3 (formerly

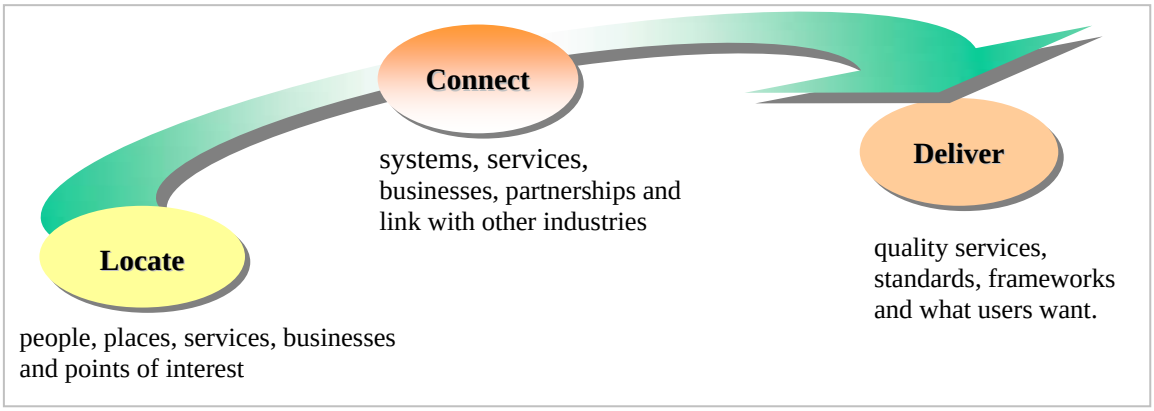
Cadastre) of the PCGIAP to refocus its activities on Spatially Enabled Government as part of developing national Spatial Data Infrastructures (SDI). In conjunction with the GSDI Association, WG3 (Spatially Enabled Government) of the PCGIAP held a dedicated workshop on "Spatial enablement of government and NSDI – policy implications" during the 13th PCGIAP meeting in Seoul, Korea on 12th June 2007.
According to the outcomes and report of this workshop, Spatially Enabled Government (SEG) is where "…data, information and related business services with spatial content become ubiquitous in the daily conduct of government agency business and in the efficient and effective delivery of government services...". A spatially enabled government is one that has ready access to the spatial or geographic or location based information and associated technologies that it requires and is applying these productively to government decision making, including developing policy and supporting its own business processes.

SEG increasingly operates in a virtual world. However, we still have a long way to go. Key initiatives include building authoritative registers within the European Union and using a legislative framework for SEG (for example, as in the EU, Japan and Korea). These trends are coupled with institutional and structural reforms in the use of SI and SDI as an enabling platform. Most uses of SI still focus on coloured maps, and do not use the full potential of SI to re-engineer the activities of government, though SEG is starting to be used to improve business processes in some non-traditional areas. In the next few years the world will have to re-position spatial information to unlock knowledge.

SEG is now part of the objectives of countries in the Asia Pacific, Europe and North America. Australian governments have moved in a similar direction. The Australian Government released its e-Government strategy, "Responsive Government: A New Service Agenda", in March 2006. In announcing its release, the Special Minister of State, the Hon. Gary Nairn MP, stated that a spatially enabled government was likely to be an important contributor to the e-Government strategic outcome. Thus the Australian Government conducted a conference on SEG in August 2007 in Canberra to highlight the importance of spatial information and promote spatial strategies and information as a vital tool for policy development and public sector decision making. The combination of strategies in the spatial enablement of government and mainstream e-Government are now an emerging trend in Australia and many other parts of the world. The SEG Conference in Canberra made it clear that the "where" is precious, and that "place" is a "magic joiner" – a boon in the past, now and in the future. It was declared that SEG promotes innovation. Further, the key message from the Conference was that SEG is here to stay and is rapidly offering new opportunities to government and wider society.

Spatial Information and SDI Vision

In modern society, spatial information (SI) is an enabling technology or an infrastructure to facilitate decision making. Spatial information describes the location of objects in the real world



and the relationships between objects. SI can be a unifying medium in which linking solutions to location. According to Victorian Spatial Information Strategy (VSIS 2008), user demand has shifted to seeking improved services and delivery tools. This will be achieved by creating an environment so that we can locate, connect and deliver as illustrated in Figure 1.

Figure 1: Locate, connect and deliver spatial information

Based on this, ready and timely access to spatial information – knowing where people and assets are – is essential for the creation of wealth in any jurisdiction. It is therefore a critical tool for making informed decisions on key economic, environmental and social issues. With this in mind and in order to better manage and utilise spatial data assets, many countries around the world are developing Spatial Data Infrastructure (SDI) as a way to facilitate data management and data sharing and utilise their spatial data assets as this information is one of the most critical elements underpinning decision making for many disciplines.

SDI is a dynamic, hierarchic and multi-disciplinary concept that includes people, data, access networks, institutional policy, technical standards and human resource dimensions. SDIs were initially developed as a mechanism to facilitate access and sharing of spatial data for use within a GIS environment. However, the role that SDI initiatives are playing within society is now changing. Users now require the ability to gain access to precise spatial information in real time about real world objects, in order to support more effective cross-jurisdictional and inter-agency decision making in priority areas such as emergency management, disaster relief, natural resource management and water rights. The ability to gain access to information and services has moved well beyond the domain of single organisations, and SDIs now require an enabling platform to support the chaining of services across participating organisations.

The ability to generate solutions to cross-jurisdictional issues has become a national priority for countries such as Australia as a federated state system and the development of effective decision-making tools is a major area of business for the spatial information industry. Much of the technology needed to create these solutions already exists; however, it also depends on an institutional and cultural willingness to share outside of ones immediate work group. This creates the need for jurisdictional governance and inter-agency collaborative arrangements to bring together both information and users to facilitate the realisation of spatially enabled society.

An SDI is about facilitation and coordination of the exchange and sharing of spatial data. It is described as the underlying infrastructure, often in the form of policies, standards and access networks that allows data to be shared between and within organisations, states or countries. The success of these systems depends on collaboration between all parties and their design to support efficient access, retrieval and delivery of spatial information.

The steps to develop an SDI model vary, depending on a country's background and needs. However, it is important that countries develop and follow a roadmap for SDI implementation. Aspects identified in the development of an SDI roadmap include the development of a vision, the required improvements in national capacity, the integration of different spatial datasets, the establishment of partnerships, and the financial support for an SDI. A vision within the SDI initiative is essential for sectors involved within an SDI project and for the general public. The SDI vision helps people to understand the government's objectives and work towards them.

Design SDI as an enabling platform

SDI as an enabling platform is an integrated, multi-levelled hierarchy of interconnected SDIs based on partnerships at corporate, local, state/provincial, national, multi-national (regional) and global levels. This enables users to save resources, time and effort when trying to acquire new datasets by avoiding duplication of expenses associated with the generation and maintenance of data and their integration with other datasets. However, SDI is an evolving concept and can be viewed as an enabling platform linking data producers, providers and value adders to data users. With this in mind, many nations and jurisdictions are investing in developing such platforms and infrastructures that enable their stakeholders to work together in a more mutual approach and to create distributed virtual systems that support better decision-making. At the same time, these nations and jurisdictions need a system to assess and monitor the development and performance of the platform.

SDIs aim to facilitate and coordinate the sharing of spatial data between stakeholders, based on a dynamic and multi-hierarchical concept that encompasses the policies, organisational remits, data, technologies, standards, delivery mechanisms and financial and human resources necessary to ensure that those working at the appropriate (global, regional, national, local) scale are not impeded in meeting their objectives (GSDI, 1997). This in turn supports decision making at different scales for multiple purposes, and enables users to save both time and money in accessing and acquiring new datasets by avoiding duplication of expenses and effort associated with the generation and maintenance of spatial data (Rajabifard et al. 2006a).

However, effective use of spatial information requires the optimisation of SDIs to support spatial information system design and applications, and subsequent business uses. The need to find optimal SDI models requires ongoing research that reflects current social, cultural and business systems, as the measured benefits of building SDIs have not been as forthcoming as projected. To achieve this, the concept of an SDI is moving to a new business model, in which the SDI promotes partnerships of spatial information organisations (public/private), allowing access to a wider scope of data and services, of greater size and complexity than they could individually provide. SDI as an enabling platform can be

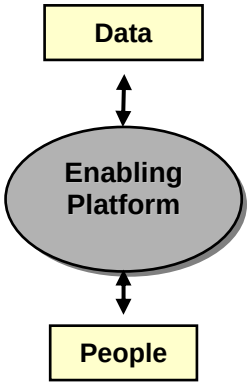


Figure 2: SDI connecting people to data

viewed as an infrastructure linking people to data (Rajabifard et al., 2006b) through linking data users and providers on the basis of the common goal of data sharing (Figure 2).

The development of an SDI as an enabling platform for a country or a jurisdiction will enhance the capability of government, the private sector and the general community in engaging in systems based, integrated and holistic decision making about the future of that jurisdiction. Applications, tools, and different sorts of information would be available through the platform to build a view of, query and allow decisions to be based on, both the built and natural environments. Having said that, however, there is a need to move beyond a simple understanding of SDI, and to create a common rail gauge to support initiatives aimed at solving cross-jurisdictional and national issues.

This SDI will be the main gateway through which to discover, access and communicate spatially enabled data and information about the jurisdiction. Such an entity can be enhanced so that it is possible to share in addition to data, business goals, strategies, processes, operations and value-added products. In this environment all types of organisations participating (including governments, industries, and academic) can gain access to a wider share of the information market. This is done through organisations providing access to their own spatial data and services, and in return, becoming a contributor and hence gaining access to the next generation of different and complex services. The vision is to facilitate the integration of existing government spatial data initiatives for access and delivery of data/information. This integration would be based on common standards and business understanding and combines distributed functions provided by participating organisations to deliver services which structured and managed in such a way that to be seen by third parties as a single enterprise. The benefits of such an environment will be more than just the representation of feature based structures of the world; it will also include the administration and institutional aspects of such features, enabling both technical and institutional aspects to be incorporated into decision-making (Rajabifard et al. 2006b).

The creation of an enabling platform would lower barriers to access and use of spatial data, to both government and the wider community within any jurisdiction, and particularly to the spatial information industry. If barriers are minimised, then entities would be able to pursue their core business objectives with greater efficiency and effectiveness. In particular, industry would be able to reduce their costs, which would encourage investment in capacity for generating and delivering a wider range of spatial information products and services to a wider market. Having said that, in order to develop a successful and functioning platform requires a set of concepts and principles to enable the design of an integration platform that facilitates interoperability and inter-working of functional entities within a heterogeneous environment. Further, these concepts and principles can be used as indicators to assess the performance of SDIs.

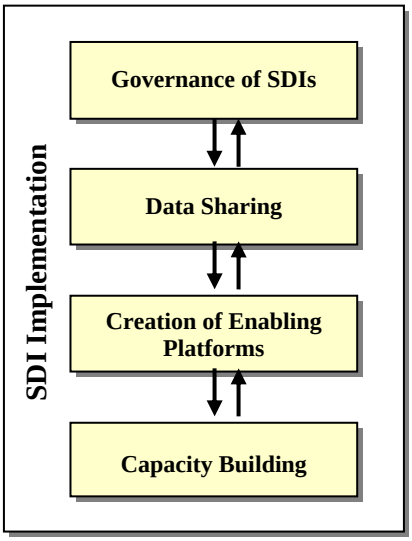


Figure 3: **Strategic Challenges**
(Adopted from Masser *et al* 2006)

Spatially enabled society

Societies can be regarded as spatially enabled ‘where location and spatial information are regarded as common

goods made available to citizens and businesses to encourage creativity and product development' (Wallace *et al.* 2006). In this regard, the vast majority of the public are users, either knowingly or unknowingly, of spatial information. With these considerations in mind Masser *et al.* (2007) highlighted the challenges that must be overcome to make existing SDIs more appropriate for spatially enabling government and society. It addresses four strategic challenges arising out of this new environment (Figure 3).

The first of these is the need for more inclusive models of governance given that SDI formulation and implementation involves a very large number of stakeholders from all levels of government as well as the private sector and academia. The second concerns the promotion of data sharing between different kinds of organisation. In some cases this may require new forms of organisation to carry out these tasks. The third challenge relates to the establishment of enabling platforms to facilitate access to spatial data and the delivery of data related services. The fourth challenge arises from the changes that are taking place in the nature of the users of spatial information in recent years. In place of the spatial professionals who have pioneered these developments an increasing number of end users will need some training in spatial thinking to make them more literate users. Consequently there are a number of new capacity building tasks to be undertaken in order to create a fully spatially enabled government.

Further, a spatial enabled government is one that plans to achieve three broad goals:

- More effective and more transparent coordination, where voters are able to access the spatial information they require to evaluate the choices made by elected decision makers;
- The creation of economic wealth through the development of products and services based on spatial information collected by all levels of government; and
- The maintenance of environmental sustainability through the regular and repeated monitoring of a wide range of spatial indicators distributed throughout the country as a whole.

Realising this vision of spatially enabled society is dependent on the development of appropriate mechanisms to facilitate the delivery of data and services. These mechanisms should embody the following principles that are the foundation of the INSPIRE initiative (CEC 2004).

Conclusions and Future directions

The ability to implement spatial enablement, requires a range of activities and processes to be created across all jurisdictional levels. In order to facilitate the realisation of spatially enabled society and governments, there is a need for a service-oriented infrastructure on which citizens and organizations can rely for the provision of required services, going beyond what has been described as the first and second generation of SDI development of a data discovery and retrieval nature (Rajabifard *et al.* 2003). This includes a focus for spatial information managers on the delivery of a virtual world which facilitates decision making at a community level within a national context.

There is also the need to develop institutional practices to make existing and future technology more effective. Research has found that very few jurisdictions have developed a framework for establishing a spatial infrastructure that addresses comprehensively operational, organisational and

legal issues. It is these processes that will enable the infrastructure to be readily useable and available to all stakeholders.

This translates into the future focus for spatial information managers on the delivery of a virtual world which facilitates decision making at a community level within a national context. This requires integration of the natural and built environmental data sets and the need for a spatial data infrastructure that facilitates this integration. The technology exists to create this virtual world but this is not enough in itself without the sustained input from both data producers and users.

The benefits of a virtual world will include the representation of feature-based structures of the world as well as the administration and institutional aspects of such features, enabling both technical and institutional (eg. policies) aspects to be incorporated into decision-making. It is this aspect of research that is often identified as more challenging than complex technical issues. The vision of a virtual world however is overly simplistic and presents many challenges, with one of the major challenges being the creation of an SDI to support the vision. Whilst most SDI authorities will agree that SDIs should be user driven, there is little discussion on the spatial information vision for each country or what sort of ICT enabled society we wish to be. However unless an agreement on a spatial information vision for each country (or jurisdiction) is made, it is almost impossible to create an appropriate SDI vision. Therefore the first challenge is to clearly describe and articulate the type of society an SDI should support. Some other challenging questions for future SDI development are posed by the need for a high level of multilevel stakeholder participation in SDI implementation.

Further, the development of SDI initiatives driven more by sub-national governments differ from the top-down approach that is implied by the development of national led SDIs, implicit in much of the current SDI literature. This new bottom-up sub-national view is important as it highlights the importance of diversity and heterogeneity given the different aspirations of various stakeholders. Consequently, the challenge to those involved in SDI development is to find ways of ensuring some measure of standardisation and uniformity while recognising the diversity and heterogeneity of various stakeholders. The use of open standards and an interoperable enabling platform will allow functions and services that meet business needs to be brought together at a sub-national and application level, reducing duplication of effort and furthering the development of a spatially enabled society.

Having said that, the ability to implement spatial enablement, requires a range of activities and processes to be created across all jurisdictional levels (Rajabifard 2007). These include:

- an enabling platform comprising institutional, collaborative framework, governance, legal and technical tools for data sharing as part of ICT, e-government and information sharing strategies;
- building on NSDI and related initiatives;
- using geocodes and “place” related information, such as national geocoded street address files;
- facilitating the use of legal land parcels and legal property objects to better manage all rights, restrictions and responsibilities relating to land;
- developing more holistic data models to integrate separate land administration data silos where they exist;

- maintaining complete and optimally continually updated national cadastral maps of legal parcels, properties and legal objects, as part of the NSDI;
- often re-engineering the institutions of government;
- increasingly legal frameworks to facilitate integration and management;
- activities on spatial data standards, interoperability and integratability;
- development of authoritative registers of key spatial information;
- research and development;
- growth in capacity at societal, institutional and individual levels.

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