

A Spatial Data Infrastructure for a Spatially Enabled Government and Society

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

With this in mind Spatial Data Infrastructures (SDIs) are being developed by many countries as an enabling platform to improve access, sharing and to integrate spatial data and services. However there are still many challenges to overcome in order to have a fully functioning SDI and to guarantee the investment in its development. Furthermore, in order to deliver this SDI, there needs to be a mechanism of assessment that uses a set of agreed indicators to measure the progress of its development and delivery of its services. In this regard, the assessment of SDIs is an important component in any SDI design and development and needs to be part of an SDI

support strategy. This assessment can help to better understand the issues, to find best practice for certain tasks and to also improve the system as a whole.

This chapter aims to introduce and discuss various challenges and issues associated in re-engineering current SDI design to support the new vision of a spatially enabled government and society. It also discusses the central role that an SDI plays as the enabling platform. In order to support this, the chapter also discusses the importance of having an SDI assessment mechanism or strategy as part of the SDI to measure the success and delivery of SDI services aligned with the objectives of SDI development. The chapter then highlights a range of activities and processes to be created across all jurisdictional levels to facilitate SDI design and assessment, including aspects of its design, creation and the processes involved in its development, particularly governance of an SDI platform and the overall relations between different challenges and the SDI assessment process.

1.1 INTRODUCTION

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 the sharing of spatial data to 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, to support more effective cross-jurisdictional and inter-agency decision making in priority areas including 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 that has a federated state system, and as a result, developing 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 the immediate work group. As a result, jurisdictional governance and inter-agency collaborative arrangements

are necessary in order to bring together both information and users to facilitate the realisation of spatially enabled society.

This chapter discusses various challenges and issues associated in reengineering the current SDI design to facilitate SDI development, monitoring and their assessments. The chapter outlines the role of the SDI to create more effective decision-making processes to deal with cross-jurisdictional issues by creating an enabling platform that links services and information across jurisdictions and organisations. In support of this process, SDI assessment will be discussed as an important mechanism to facilitate this role. SDI assessment is also important for the new vision on spatially enabled government and society and would support a knowledge base for accessing information that is derived from a model of integrated datasets with different perspectives.

1.2 SDI-VISION

Many countries around the world are developing SDIs as a way to better manage and utilise their spatial data assets as such information is one of the most critical elements that underpin decision making across many disciplines. An SDI is about facilitating and coordinating 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 (Figure 1.1). The success of these systems depends on collaboration between all parties and that their design supports the efficient access, retrieval and delivery of spatial information.

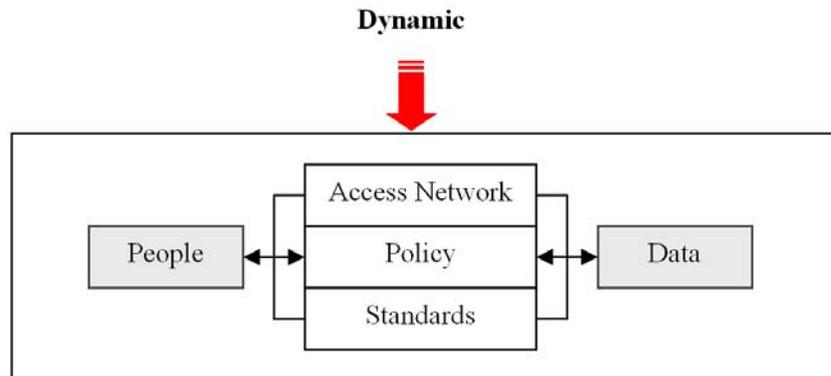


Figure 1.1: SDI nature and Components

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

1.3 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. The SDI enables users to save resources, time and effort when trying to acquire new datasets by avoiding duplication and the expense associated with the generation and maintenance of data and its integration with other datasets. However SDIs are an evolving concept and can be viewed as an enabling platform that link 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 to 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 (GSIDI, 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 the duplication of expenditure 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 the design of the spatial information system, its applications and subsequent business uses. Finding optimal SDI models, reflecting current social, cultural and business systems, requires ongoing research 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 where the SDI promotes partnerships of spatial information organisations (public/private) to allow access to a wider scope of data and services, of greater size and complexity than they could provide individually. The SDI as an enabling platform can be viewed as an infrastructure linking people to data (Rajabifard et al., 2006b) by linking data users and providers on the basis of the common goal of data sharing (Figure 1.2).

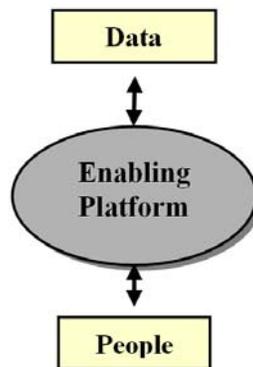


Figure 1.2: SDI connecting people to data

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 to engage 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 in order to build a view, respond to queries and allow decisions to be based on both the built and natural environments. There is however a need to move beyond a simple understanding of the 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 to discovering, accessing and communicating 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 academia) can gain access to a wider share of the information market. Greater access is achieved by organisations providing access to their own spatial data and services, thereby 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 to access and deliver data and/or information. This integration would be based on common standards and business understanding which combines distributed functions that are provided by participating organisations to deliver services which are structured and managed a way they are 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. The benefits would also include the administration and institutional aspects of such features, where both technical and institutional aspects are incorporated into decision-making (Rajabifard et al., 2006b).

The creation of an enabling platform would lower barriers to access and the use of spatial data for government and the wider community within any jurisdiction, particularly for 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 investments in capacity to generate and deliver a wider range of spatial information products and services to a wider market. However, 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 the interworking of functional entities within a heterogeneous environment. Further, these concepts and principles can be used as indicators to assess the performance of SDIs.

1.4 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.

The first 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 organisations. In some cases this may require new forms of an organisation to carry out these tasks. The third challenge relates to the establishment of enabling platforms for accessing spatial data and to deliver data related services. The fourth challenge arises from the changes that are taking place in the nature of spatial information users in recent years. In place of the spatial professionals who have pioneered these developments is an increasing number of end users who will require some training in spatial thinking to become more literate users. As a consequence, there are a number of new capacity building tasks to be undertaken in order to create a fully spatially enabled government. In addition to these four challenges there should also be an ensuring mechanism that measures and monitors the progress and response to each challenge in designing and developing an SDI and also for the ongoing support of its services. The mechanism would be an SDI assessment process as illustrated in Figure 1.3. As part of the process for this assessment, all the challenges need to be identified, analysed, monitored and fed back to the overall system in such a way that improves the development and management of the implementation plan and ongoing support work. Further, a spatially enabled government is one that plans to achieve three broad goals:

1. 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;
2. The creation of economic wealth through the development of products and services based on spatial information collected by all levels of government; and
3. The maintenance of environmental sustainability, through the regular and repeated monitoring of a wide range of spatial indicators distributed throughout the country.

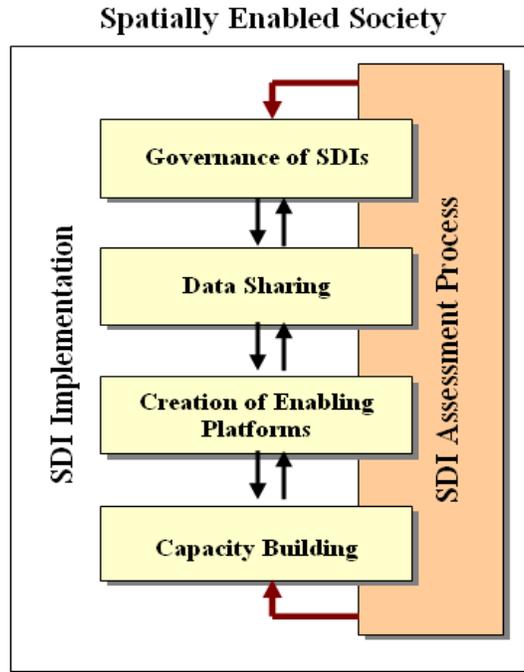


Figure 1.3: Strategic Challenges and SDI Assessment Process
(Modified from Masser et al., 2006)

Realising this vision of a spatially enabled society is dependent on the developing appropriate mechanisms that facilitate the delivery of data and services. In addition, developing or adopting an SDI assessment mechanism, or approach as part of the development process and SDI strategic plan, would be an important step in realising a spatially enabled society that uses an SDI as an enabling platform. The SDI assessment will therefore come to play a crucial role in the managing our SDI initiative and that pertaining to the administration of our societies. In this context, identifying critical factors and processes in the acquisition, implementation and utilisation of an SDI assessment approach can facilitate the management of diversity among different components of SDI models. As part of this process, and by identifying key human and technical factors for SDI assessment within classes of potential users, SDI coordinating agencies will then be able to better define and develop their strategies to achieve their objectives. An important decision that has to be taken beforehand relates to how the assessment has to be carried out and this will vary between different assessment approaches as described in the other chapters of this book.

1.5 FUTURE DIRECTIONS

In order to facilitate the realisation of a spatially enabled society and governments, there are many aspects which need to be considered, including the need for a service-oriented infrastructure on which citizens and organisations can rely for the appropriate 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). Further, there needs to be a focus for spatial information managers to deliver a virtual world which facilitates decision making at a community level and 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. In addition to this assessment, framework and selection of an assessment approach for SDI assessment is also another element necessary for the support of a spatially enabled government and society which uses an SDI platform.

This translates into the future focus for spatial information managers to deliver a virtual world which facilitates decision making at a community level and within a national context. The focus requires integrating 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 of both data producers and users.

The benefits of a virtual world will include the representation of feature-based structures, as well as the administration and institutional aspects of such features, for enabling both technical and institutional (eg. policies) aspects to be incorporated into decision-making. It is this structural 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. One of the major challenges is the creation of an SDI to support the vision. While 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 that is aspired. Unless an agreement on a spatial information

vision for each country (or jurisdiction) is made however, 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. Another element would be selecting an SDI assessment approach. Its selection would be an important strategic element as part of designing and managing the SDI initiative.

Further, the development of SDI initiatives, that are 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 which can be done by the proper selection of an SDI assessment approach. 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 the duplication of effort and furthering the development of a spatially enabled society. The ability to implement spatial enablement however, 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 geo-codes and “place” related information, such as national geo-coded 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 integration;
- development of authoritative registers of key spatial information;
- research and development; and
- growth in capacity at societal, institutional and individual levels.

1.6 CONCLUSIONS

Developing a spatially enabled government and society is ongoing and multi-disciplinary. Achieving the vision will draw on a wide range of experiences and disciplines from surveying and mapping, land administration, GIS, information and communications technology, computer science, legal and public administration and many more. In this regard this chapter has addressed four strategic challenges and ensuring an SDI assessment mechanism that needs to be considered when implementing SDIs to spatially enable society. This SDI assessment is an important element to measure and monitor the progress and also to show the potential areas for improvement which is the main objective of this book. The first assessment indicates the need for new and more inclusive models of governance to enable the very large number of stakeholders, from all levels of government as well as the private sector and academia, to participate in the management of the processes of SDI implementation. The second challenge considered the strategic questions associated with data sharing between different kinds of organisation. The third challenge relates to the establishment of enabling platforms to facilitate access to spatial data and delivering data related services. It can be viewed as an infrastructure linking people to data by linking data users and providers on the basis of the common goal of data sharing. Further, this infrastructure would be a vehicle from which both textual and spatial data are utilised to form a range of supportive functions for

those within the industry as well as for non-spatial and non-technical user groups. The fourth challenge related to the capacity building issue of which tasks need to be undertaken in order to create a fully spatially enabled society. In order to facilitate the response to these challenges the needs of an SDI assessment mechanism is also highlighted.

Further, the ability to implement spatial enablement requires a range of activities and processes to be created across all jurisdictional levels.

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