

Spatially Enabled Society

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SUMMARY

“Spatially enabled society” is an evolving concept where location, place and other spatial information are available to governments, citizens and businesses as a means of organising their activities and information. In particular spatial enablement is usually used in a ubiquitous and transparent manner by a wide cross section of society. By its very nature spatial enablement demands a “whole-of-government” approach. Popular uses of spatial technology involve displaying imagery, then tracking assets and inventory through an increasing array of devices, the most common being the ubiquitous mobile phone. Remarkable as these applications are, spatial technology can be used in even more dynamic ways. Transformational use of spatial technology occurs when it is used to improve business processes of government and the private sector, including equitable taxation, allocation of services, conservation of natural resources, and planning for rational growth.

This paper explores the evolving concept of spatial enablement by drawing on international trends as well as focussing on developments in Australia. The paper highlights the importance that the cadastre and land administration plays in spatial enablement and particularly the role that the street address plays. A model is proposed that shows the role of the cadastre and spatial data infrastructure in supporting spatially enablement in society.

Spatial enablement has the potential to revolutionise the way governments do business and the way they interact with society. The only limitations are creativity and development of a shared vision of what is possible.

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1. INTRODUCTION

“Spatially enabled society” is an evolving concept where location, place and other spatial information are available to governments, citizens and businesses as a means of organising their activities and information. Publications on the topic started appearing about five years ago and have rapidly increased. Conferences have appeared such as the Australian Government’s “Spatially enabled government” conference 2007 and the Global Spatial Data Infrastructure (GSDI) Association GSDI-12 world conference in Singapore in October 2010 having the theme “*Realizing Spatially Enabled Societies*” as well as adopting this theme for the Association in its next work period; workshops have been organised such as the Spatially Enabled Government workshop, Korea, 2007 organised by the UN supported Permanent Committee for GIS Infrastructure for Asia and the Pacific); and working groups (Working Group 3 - Spatially enabled government, PCGIAP) have appeared to expand and capitalise upon the concept. Publications include the book by Rajabifard (2007), Wallace and Williamson (2005), Wallace and others (2006) and Williamson and others (2006). The theme of the recently successful Australian Cooperative Research Centre for Spatial Information (AUD 80 million for research) had the overall theme of spatially enabling Australia. This session in FIG 2010 is another step in discussing and expanding on the concept.

Spatial enablement, as promoted in this paper, is usually used in a ubiquitous and transparent manner by a wide cross section of society. By its very nature spatial enablement demands a “whole-of-government” approach. Popular uses of spatial technology involve displaying imagery, then tracking assets and inventory through an increasing array of devices, the most common being the ubiquitous mobile phone. Remarkable as these applications are, spatial technology can be used in even more dynamic ways. Transformational use of spatial technology occurs when it is used to improve business processes of government and the private sector, including equitable taxation, allocation of services, conservation of natural resources, and planning for rational growth.

2. SPATIAL ENABLEMENT

Spatial enablement is not just about developing and using geographic information systems (GIS) technologies. It is a concept that permeates the whole of government and society and draws heavily on the land administration system and the spatial data infrastructure available in the jurisdiction. The concept is central to a new book titled “Land administration for sustainable development” (Williamson, Enemark, Wallace and Rajabifard, 2010) also presented in this congress. The following section is based on section 14.3 “LAS to support spatially enabled society” in this book.

Spatial technologies are evolving quickly, particularly with regard to land related data. Google and other companies, are partnering with national agencies of countries to deliver their cadastres linked to a geocoded national address data base, and high resolution imagery freely over the Internet. In some countries such as Australia, in an instant, a user can present any known postal address on screen, with combinations of satellite images of the on-ground reality, authoritative land boundaries and address information. Seamless streaming of the images, and attachment of vital text information, are but two new technical facilities. Even though these developments are an exciting technological achievement, this ability to “find, see and describe” is only the beginning of spatial enablement.

This spatial enablement comes when countries capitalise on the power that is generated from land information within their land administration and related systems. For complex, developed economies, the land parcel is one of many possible property objects. Other objects include planning zones, heritage areas, car parks and the hundreds of other organisational and valuable arrangements made for better land management. The design of the land information system needs to be sufficiently comprehensive to take these into account and manage them through a spatial data infrastructure (SDI). The most effective management, given technological trends, is likely to lie in spatial enablement of the various sets of information. Spatial enablement is ultimately a transformational technology to assist efficient organisation of government and its administrative systems. This transformational capacity is used little or not at all in the majority of countries, thereby limiting their ability to capitalise on this new technology and constraining the future of its spatial information professionals and businesses.

By combining the new concepts in sustainable development of land and resources with the energy and potential of spatial technologies, these technologies can be used to reengineer the work processes of governments, agencies and businesses, not merely the way they manage information. This is now a clear priority of governments for many governments in the most developed countries.

The central role of spatial technologies is now moving beyond traditional land administration to non-spatial government functions. These technologies are now used throughout the world to visualize information and facilitate e-Government and spatially enabled accounting systems. The transformational use of spatial technologies expands the popular view of spatial enablement that identifies it with GPS “finders” in ubiquitous digital instruments (vehicle tracking systems, mobile phone systems, assets and management of common electrical appliances) and visualisation tools, with a more comprehensive view of what can be done with spatially enabled systems. This expansion is probably as significant as the evolution from paper to digital systems.

The spatial tools are no longer sequestered in mapping agencies where they were originally created. The broader attractions of spatial technologies lie in how they present information, whether users rely on computers and the Internet, or on communications technologies. The adage of a “picture tells a thousand words” is now out of date. Spatial systems convert queries into much more people friendly results. The power of the visual over the verbal both reduces the amount of information and organises it into “brain-ready” information. When people are spatially informed, the “map condenses thousands of spreadsheets”. Combined with the web environment, opportunities for communication of information among levels in the managing agency and between the agency and its stakeholders are vastly improved. The conversion

chain moves data into information and then into knowledge, so that managers and policy makers can make more informed decisions. Potential improvement in manageability of business processes is inducing government agencies to take up spatial enablement, even if maps and visualisation systems are not part of their normal IT repertoire.

Most agencies and businesses start spatial enablement processes by taking up the geocoded address file as a means of introducing spatial tools in their suite of technical supports and information technology. A spatially enabled business organises its activities and processes around “place” based technologies, as distinct from using maps, visuals, and web-enablement. The initial innovation involves using geocodes and other spatial information related to places and locations to organise business management and processing systems. This adds to or substitutes for the unique business file numbers, identification numbers, dates and so on, that now populate standard relational databases, object oriented architectures and service oriented architectures. The next innovation, and one that involves novel uses of spatial technologies, will bring this tool into agencies that do not traditionally use spatial information, including tax offices, human services, health services, census, immigration and other service agencies.

These transformational uses involve organization of social, employment, economic and environmental data in relation to reliable and authoritative coordinate identification of significant places. Authoritative coordinate identification systems facilitate the integration, not merely the presentation, of information throughout an agency or board. At first new spatial systems became popular because they delivered the benefits to business processes of traditional users of land information, including emergency management, resource and water management, land management, and marine management. Now, spatial enablement supports identification of where non-spatial data sets apply, and potentially allows the seamless interrogation even by agencies that do not traditionally use spatial information.

The spatial enablement of society is only possible with forward planning and a shared vision of what is possible. This vision is at the heart of the next generation of land administration systems.

3. SPATIAL ENABLEMENT AND SDI

As discussed by Rajabifard (2009) ready and timely access to spatial information is at the heart of spatial enablement - knowing where people and assets are - is essential and is a critical tool for making any informed decisions on key economic, environmental and social issues. Spatial information is an enabling technology/infrastructure for modern society. Our relationships with our physical world and the way we use our social networks are changing as we deploy technology in new ways to create new ways of interacting with each other.

In facilitating this and to improve access, sharing and integration of spatial data and services, SDIs have emerged as an enabling platform. 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 and in meeting sustainable development objectives which are complex and involved temporal processes with multiple stakeholders. Having said that, the ability to gain access to information and services has moved well beyond the domain of single organizations, and SDIs now require an enabling platform to support multi-sourced data integration and the chaining of services across participating organizations and countries.

The ability to generate solutions to cross-jurisdictional issues has become a national priority for many countries for the development of effective decision-making tools which 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 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 realization of spatially enabled society.

In order to better manage and utilise spatial data assets in support of spatial enablement, many countries around the world are developing SDIs as a way to facilitate data management and data sharing and utilise their spatial data assets as this 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 if spatial enablement is to be a reality.

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, organizational 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. 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.

The creation of an SDI as 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-

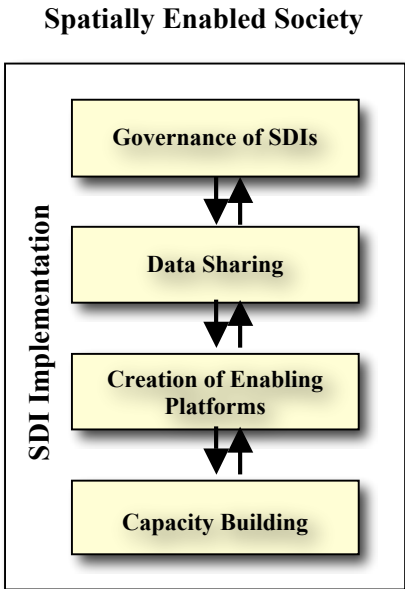


Figure 1: Strategic Challenges

working of functional entities within a heterogeneous environment. Further, these concepts and principles can be used as indicators to assess the performance of SDIs.

In reality, the vast majority of society are users, either knowingly or unknowingly, of spatial information. With these considerations in mind, the challenges that must be overcome to make existing SDIs more appropriate for spatially enabling government and society (Masser *et al.* 2007). Based on this view, there are four strategic challenges as shown in Figure 1.

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 organization. In some cases this may require new forms of organization 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 and wider society.

4. THE ROLE OF THE CADASTRE IN SPATIAL ENABLEMENT

A complete and well maintained cadastre as part of a national systems of land administration is central to the concept of spatial enablement. In particular the cadastre provides the spatial integrity for all property objects and in particular geocoded street addresses. In their book “Land administration for sustainable development”, Williamson, Enemark, Wallace and Rajabifard describe the key role the cadastre plays as the engine of a land administration system and in turn the facilitating role for spatial enablement. This underpins a nation’s capacity to deliver sustainable development. This relationship is shown diagrammatically in Figure 2 (Williamson and others, 2010).

The diagram highlights the usefulness of the large scale cadastral map as a tool by exposing its power as the representation of the human scale of land use and how people are connected to their land. The digital cadastral representation of the human scale of the built environment, and the cognitive understanding of land use patterns in peoples’ farms, businesses, homes, and other developments, then form the core information sets that facilitate a country building an overall administrative framework to deliver sustainable development in a country.

The neutrality of the concept in terms of any actual national cadastral approach is emphasized by showing how all the three formal approaches used throughout the globe are capable of feeding into a national spatial data infrastructure, and then into sustainable development. Wherever the cadastre sits in a national LAS, ideally it should assist the functions of tenure, value, use, and development. In this way, within the LAS, the cadastre or cadastral system become the core technical engine delivering the capacity to control and manage land through

the four LAS functions. They support business processes of tenure and value, depending on how the cadastre is locally built. They identify legal rights, where they are, the units that form the commodities, and the economy related to property. These cadastres are much more than a layer of information in national SDI.

Significance of the Cadastre

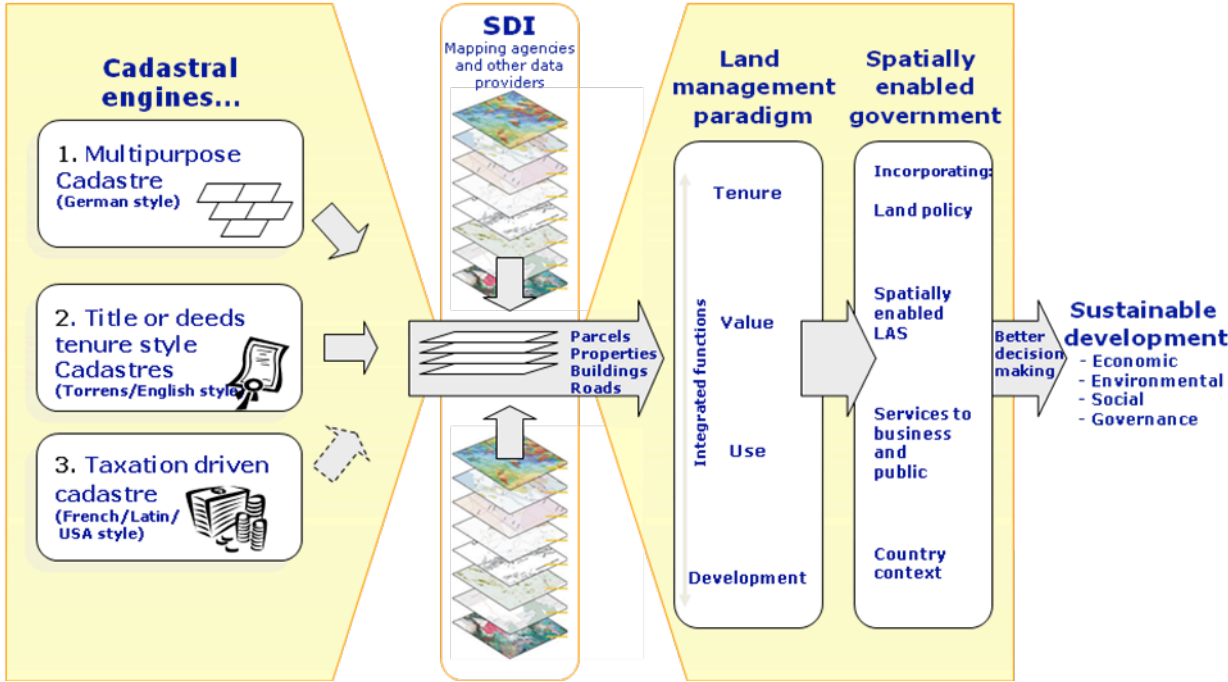


Figure 2. The cadastre as an engine of LAS - the “butterfly” diagram (Williamson and others, 2010)

As stated by Williamson and others (2010) while these connections are usually thought of as computer generated, even in manual systems, cadastral information about parcel attributes and their unique identifiers is able to be used throughout the four land administration functions to deliver efficiencies for government service and businesses. The requirement that this vital information should be created once and used many times underpins the identification of the cadastre as the authoritative register of parcel information, an idea appropriate for any formal system, whether digitized or not. In this way, the paradigm provides a foundation for eventual digital conversion of emerging LAS processes for countries about to embark on upgrading their system.

The diagram demonstrates that the cadastral information layer cannot be replaced by a different spatial information layer derived from geographic information systems (GIS). The unique cadastral capacity is to identify a parcel of land both on the ground and in the system in terms that all stakeholders can relate to, typically an address plus a systematically generated identifier (given addresses are often duplicated or are otherwise imprecise). The core cadastral

information of parcels, properties and buildings, and in many cases legal roads, thus becomes the core of SDI information, feeding into utility infrastructure, hydrological, vegetation, topographical, images, and dozens of other datasets.

The diagram is a virtual butterfly: one wing represents the cadastral processes, and the other the outcome of using the processes to implement the land management paradigm. Once the cadastral data (cadastral or legal parcels, properties, parcel identifiers, buildings, legal roads, etc) are integrated within the SDI, the full multipurpose benefit of the LAS, so essential for sustainability, can be achieved.

The body of the butterfly is the SDI, with the core cadastral information sets acting as the connecting mechanism. This additional feature of cadastral information is an additional role, adding to the traditional multipurpose of servicing the four functions. This new purpose takes the importance of cadastral information beyond the land administration framework by enlarging its capacity to service other essential functions of government, including emergency management, economic management, effective administration, community services, and many more functions. In advanced systems, integrated cadastral layers within a jurisdiction's SDI ideally deliver spatially enabled LAS to support the multipurpose of tenure, use, value and development. However building this kind of interaction between these four functions is not easy. The historic institutional silos, separate data bases, separate identifiers, and separate legal frameworks need to be reorganized. For most countries this presents another major land administration challenge.

5. CONCLUSION

The use of spatial information is undergoing a revolution. Historically spatial information was the exclusive technology of surveyors, cartographers and later GIS professionals. Today spatial information is increasingly being used in a ubiquitous and transparent manner by government and wider society across most activities and business processes. The use and impact of spatial information could arguably have the impact of moving from the hard copy to digital world. The lead is coming from the most developed countries where government, business and wider society are becoming spatially enabled.

But the vision of spatial enablement requires an enabling platform or infrastructure using the SDI concept linked to modern land administration systems incorporating complete and up-to-date cadastres as their engine. Importantly these systems provide geocoded street addresses for all property objects, the key facilitator of spatial enablement. These are not trivial achievements and are challenges being faced by countries worldwide. New governance arrangements, new government institutions, new standards, new technologies and a strong commitment to capacity building are all part of the journey. Even so there is general agreement that the returns from an investment in spatial enablement are more than justified.

NOTE

This paper draws heavily on other publications by the authors and others on the evolving concept of spatially enabled government and spatially enabled society, and particularly Rajabifard (2009), Williamson, Wallace and Rajabifard (2006), and Williamson, Enemark, Wallace and Rajabifard (2010).

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BIOGRAPHICAL NOTES

Ian Williamson is both a professional land surveyor and chartered engineer who is Professor of Surveying and Land Information at the Centre for Spatial Data Infrastructures and Land Administration, Department of Geomatics, University of Melbourne, Australia. His expertise is the cadastre, land administration, and spatial data infrastructures. From 2006-9 he chaired the Working Group on Spatially Enabled Government for the UN supported Permanent Committee for GIS Infrastructure for Asia and the Pacific (PCGIAP).

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