Indicators for Assessing Spatially Enabled Government Services

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Abstract

In order to deliver a greater range of services and information to users across jurisdictions, the concept of Spatial Data Infrastructures (SDI) is beginning to progress towards the development of an enabling platform, helping to link services across jurisdictions, organisations and disciplines. Spatially enabling government is now part of the objectives of countries in the Asia Pacific, Europe and North America. Australian governments have moved in a similar direction to 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. However, there are still no accepted methods for assessing progress towards spatial enablement.

This paper aims to introduce and discuss various challenges and issues associated in the new vision of spatially enabled government and society. It also discusses the importance, role and value of benchmarking government services and the level of their spatial enablement and proposes methods for selecting indicators for measuring and comparing different aspects.

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Introduction

A government or society 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 e-government and broader government ICT strategies. It is also defined as an innovator and enabler across society and a promoter of e-democracy. 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. In the knowledge economy, we are increasingly operating in a virtual world through the medium of the Internet.

One of the features of the Internet was an apparent irrelevance of location, as users can access information without regard to where exactly they or the information resource is located. This led to an early concept of the "death of distance" (Cairncross 1997). However, as the knowledge economy got more established and entrenched in society, the need for location-specific information increased. While the exact location of information providers and users is still irrelevant, the need to find "where" something is, or how to navigate from "here" to "there" has increased as users became more aware of the existence of the information to answer such questions. In the field of commerce, e-commerce was complemented by "l-commerce," supplementing commerce offerings on the Internet with appropriate location information that will assist the potential customer to decide on which of the alternatives is most convenient for them. Where is the nearest restaurant, mall, or

outlet of a particular retailer to one's current location? Such questions led to the development of location-based services as a specialized sector of the geospatial industry.

Analogous to the development of e-commerce is e-government, whereby government agencies use the Internet and other information and communication technologies to deliver services to citizens, businesses and other government agencies. Service delivery is improved because service takers actually "take" services from available options, allowing service providers to offer more flexible and numerous options than if they had to push them to the users.

One of the key features of government services, and the associated choices in e-government is the location of the services centres, vis-à-vis the service takers, be they citizens, businesses or government agencies. This has led to the concept of spatially enabled government (SEG), which is now part of the objectives of countries in the Asia Pacific region, Europe and North America. Australian governments have moved in a similar direction to 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 emerging trends in Australia and many other parts of the world.

Spatially Enabled Government Services – A Working Definition

A government service is regarded as spatially enabled if the service delivery process incorporates seamless access to all the information that a user of the service might need to make spatial or location-specific decisions associated with the service. This is a specific application or instantiation of the definition of spatially enabled society (above). For example, in a land administration application, a proprietor who is interested in a particular parcel of land would require information relating to, among others, the nature of existing interests in the parcel and adjoining parcels, and the location and size of the parcel of interest. Depending on the intended use of the land, they might also need information relating to topography, soil type, rainfall, demographics, utilities and infrastructure. Information relating to such issues would usually be provided in geographic information systems.

In a spatially enabled society, such information could already be available ubiquitously as common goods. They could be available through computer networks, possibly as a "one-stop" arrangement. However, the user would be expected to know which datasets are required and to specifically request for, and combine them. With emphasis on the spatial enablement of services, the onus is on the service provider and system designers to ensure that relevant spatial information is integrated into any enquiry or request application. The service provider would have included spatial considerations in all decision analyses undertaken during the planning phase. Issues relating to the locations of service points; of target beneficiaries or service takers; resources and other input factors required to deliver the service; would all have been analysed together with social, economic and financial issues. Subsequently when a user enquires about the service, the query result would include spatial aspects.

From Spatial Data Infrastructures to Spatially Enabled Societies

In this context, in order to deliver a greater range of services and information to users across jurisdictions, the various datasets, and information products and services would be part of the Spatial Data Infrastructures (SDI). The SDI was initially conceived as a mechanism to facilitate access and sharing of spatial data for use within a GIS environment. This was achieved through the

use of a distributed network of data custodians and stakeholders in the spatial information community. The SDI so conceived requires that the complete process be delivered through a coordinated set of technical standards, institutional policies, enabling legislation, human resource dimensions, access networks, and other technologies in an infrastructure framework; of course the data to be shared and distributed have to be created and maintained. It can be regarded as a dynamic, multi-stakeholder, collaborative approach to creating, managing and disseminating the geospatial data and information content needed for socio-economic development.

Though the initial target was the spatial information community, the SDI soon evolved to become an enabling platform, helping to link services across jurisdictions, organisations and disciplines. Like other tools of the knowledge economy, the wider audience have resulted in more demands on functionality. 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.

According to Victorian Spatial Information Strategy (Victorian Spatial Council 2008), users' demands have shifted to seeking improved services and delivery tools. This will be achieved by creating an environment where we can locate, connect and deliver spatial information as illustrated in Figure 1.

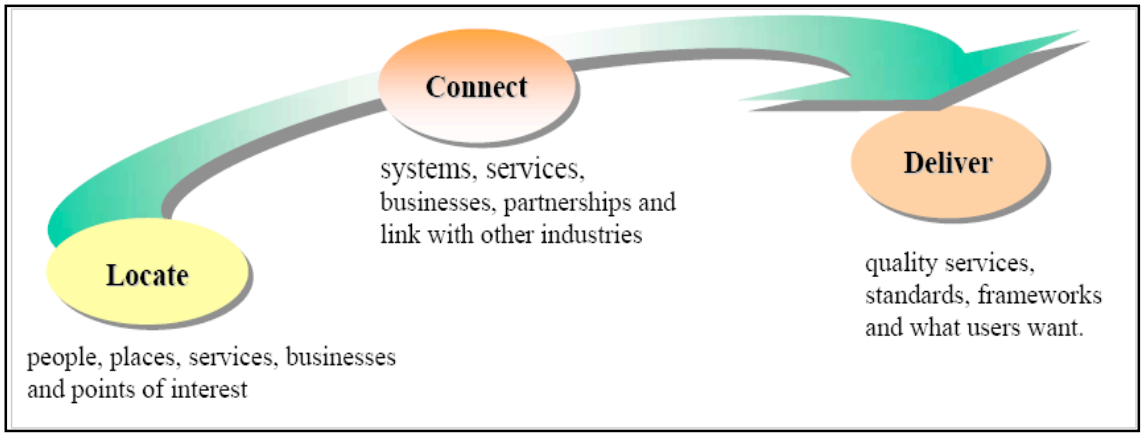

Figure 1: Locate, connect and deliver spatial information (Rajabifard 2008)

To satisfy these new demands, 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 national priorities for many countries 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 data, solutions and services with parties outside of one's immediate work group.

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

- Maintaining complete and optimally continuously updated data sets to support the priority areas of social and economic activity for the particular jurisdictions, organisations and institutions. This should necessarily include national cadastral maps of legal parcels,

properties and legal objects, as an important component of the land administration system. It should however be noted that rural jurisdictions in developing countries may not have functioning cadastral systems, nor the concept of "legal" parcels per se. Yet they have the same needs for appropriately adapted land management information systems to better manage all rights, restrictions and responsibilities relating to land.

Another priority data set is "place" related information, such as national geocoded or georeferenced address files to support navigation and location activities. An important aspect of spatial enablement is deciding where to locate service points to better serve the intended and/or potential users. On the other hand, the users need to determine which of alternative service points to use, and then how best to get there.

- Establishing an enabling platform comprising institutional mandates, collaborative frameworks, governance structures, and legal environments for producing, managing, and sharing spatial data, information and services, as part of national (or appropriate jurisdictional) ICT, e-government and knowledge strategies. Currently, these strategies are developed separately and then "geo-enabled" by appending NSDI policies. Real spatial enablement requires that spatial information be recognised as the integrating common feature between the various social and economic sectors that being improved by the e-strategies, and should therefore be included in all the analyses.
- Developing more holistic data models to integrate separate land administration other public administration systems and location-based services. This would often involve re-engineering the business processes that drive the services, rather than appending geographic information systems.
- Adopting international and/or industry standards to ensure the interoperability and integratability of geoinformation products and services. Using such standards ensures that data and system components can be acquired from the open market when they are available, rather than have to develop them in house; also, programmers, developers and other personnel can be sourced from the open job marked, and some activities may be outsourced, depending on the operational model of the organisation or jurisdiction.
- Maintaining authoritative registers of key spatial information products and services. Providing the ubiquitous spatial information services implied by spatial enablement requires that service providers and users should have seamless access to spatial information. This is facilitated through metadata and clearinghouse systems.
- Building the capacities of service providers to incorporate spatial information in their delivery processes, as well as the user community to make proper use of the spatial information in service taking decisions.
- Providing for continuous innovation through research and development to ensure that the geospatial industries stay abreast of developments in other sectors of the knowledge economy.

These activities create a need for jurisdictional governance and inter-agency collaborative arrangements to bring together both information producers and users to facilitate the realisation of spatially enabled societies where the spatial data and information products are ubiquitously

available to the society at large and utilised seamlessly to underpin the decision making and increase the working efficiency.

Why Benchmark

As many countries make progress in using spatial information to better serve their communities, they develop SDIs to improve access, sharing and integration of spatial data and information products and services. However, there is yet no clear cut method to assess these developments to compare the level of SDIs or the degree of spatial enablement. Despite the different wordings of the definitions of SDIs, their components are more or less understood and accepted. Yet, for example, responses to questionnaires on status of NSDI in African countries produce results that cannot be used to compare the countries (United Nations Economic Commission for Africa 2003; United Nations Economic Commission for Africa 2005). Some respondents would indicate that they have implemented an NSDI because they have established a coordinating committee or drafted a policy document (that may or may not have been approved by cabinet or enacted into law) even without any data to share or metadata to search and discover available data. This situation emphasizes the need for comparable measures of the gap between the objectives of spatial enablement and the current status and track the progress towards achieving them. Such benchmarking and comparison of geoinformation products, services and systems can help to better understand the issues, to find best practice for certain tasks, and to improve the system as a whole. Additionally, benchmarking fosters innovation by focusing attention on key aspects of processes and products, and encouraging healthy competition. It also serves as a tool for accountability by providing higher management and the overall user community with performance measures to assess the services of the providers.

Benchmarking … "is based on the principle of measuring the performance of one organisation against a standard, whether absolute or relative to other organizations" (Cowper and Samuels 1997). In the corporate sector, it is usually applied in the relative sense, and as such it is the process of comparing the products, services and practices of an organisation with those of other organisations, identifying better/higher performing ones, with a view to learning how to improve along the lines of the better performers. However, there is another form of benchmarking used in the public sector:

> It emphasizes the articulation of a vision for a state or community and the establishment of targets to mark progress toward that vision. Typically, the vision transcends government services and addresses other facets of the state or community's quality of life. In many respects, this form of benchmarking is more akin to strategic planning than to corporate-style benchmarking. (Ammons 1999)

This type of benchmarking has been described elsewhere as:

> Standards benchmarking – setting a standard of performance which an effective organization could be expected to achieve. The publication of a challenging standard can motivate staff and demonstrate a commitment to improve the service provided. Information on an organisation's performance against the standard can be used as a monitoring tool by its principals – ministers or councillors. (Cowper and Samuels 1997)

Whether used in the relative or absolute sense, an important requirement for benchmarking is choosing indicators that are relevant to the product or service being assessed.

Outline of Methodology

In proposing indicators for benchmarking spatially enabled government services, it is borne in mind that spatial enablement is multi-disciplinary, drawing from such fields and sectors as SDI, e-government, engineering, political theory, organisational behaviour/organisational theory, knowledge management, information systems and management. This research therefore adopts the organisational innovation process model as a framework for the study on the benchmarking spatially enabling government services and proposes two methods for selecting the benchmarking indicators, namely, data-centric method and service-centric method.

Whichever method is used, (Masser 2007) notes that a working indicator should be:

- Clear and understood by all involved organizations and sectors;
- Involve measurements rather than predictions;
- Measurements of the main goals of the directive (balance between global and detailed indicators);
- Useful for all the involved organizations and sectors;
- Easy to provide (cost of indicators versus usefulness of information).

Data-centric Method

Seamlessly providing for location-specific features implies the existence of spatial data and information products that are accessed transparently as needed by the applications and subsystems in response to user queries. It has been established above that the SDI is the enabling platform for linking spatial data services across jurisdictions, organisations and disciplines. The data-centric indicators are therefore derived from the operation of the SDI, resulting in the following categories of indicators:

I. **Organizational Issues**: level of SDI implementation, degree of operationalisation of governance and coordination arrangements, number and diversity of participants;

II. **Legal Issues and Funding:** nature of partnerships, including public-private partnerships (PPP), policy and legislation on access to public sector information (PSI), legal protection of GI products by intellectual property rights, restricted access to GI further to the legal protection of privacy, data licensing, funding model for the SDI and pricing policy;

III. **Reference Data and Core Thematic Data**: scale and resolution, geodetic reference systems and projections, quality of reference data and core thematic data, interoperability, language and culture;

IV. **Metadata for Reference and Core Thematic Data**: availability of metadata, metadata catalogue availability and standard, metadata implementation;

V. **Access and Other Services for Data and their Metadata**: discovery services, viewing services, download services, transformation services, middleware service;

VI. **Standards and Thematic Environmental Data**; standards, thematic environmental data.

These indicators need to be translated into variables that can be assigned numerical measures for comparison. In that context, the following are proposed as data-centric indicator variables:

1) The Geodetic Component. All spatial data products and services are based on a geodetic framework. Without a uniform geodetic frame, data sets cannot be integrated nor overlaid with each other and therefore interoperability cannot be guaranteed:
    a) Alignment of reference system with ITRS – is the reference system aligned to the International Terrestrial Reference system, and does the entire jurisdiction (or group of jurisdictions) use a uniform geodetic reference frame?
    b) Density of control points (number per km^2) – this affects the ability of practitioners to have access to the resource for ensuring that their measurements are related to the frame.
    c) Density of GNSS reference stations (weighted by country size) – modern satellite-based reference stations facilitate use by practitioners of modern GNSS equipment.
    d) Use of GNSS technology for positioning – what proportion of practitioners have access to GNSS technology and use it in their work?
    e) Accessibility of reference data by practitioners – ease of access and cost (quantitative measure to be determined)
    f) Formal responsibility for maintaining geodetic system – important to have a formally assigned or mandated responsibility for maintaining the geodetic system
    g) Role of professional bodies – do professional bodies exist and have defined role in the maintenance of the geodetic system? Several advantages of having a professional body involved
    h) Role of the private sector (goodness measure)
2) Fundamental data sets (FDS):
    a) Is there a formal agreement on what constitutes the fundamental data sets among stakeholders – each jurisdiction should undertake appropriate studies and/or reviews of data usage and formally define and/or agree on the constituent sets of their fundamental data sets;
    b) For each constituent dataset, is there a formal custodianship/maintenance agreement?
    c) Data quality for agreed data sets, including currency (combined measure based on date of last revision for urban/rural jurisdictions, frequency of updates, etc);
    d) Ease of access and cost.
3) Key thematic layers – each layer evaluated like FDS data sets. Thematic layers are jurisdiction dependent. However, there are some that should be expected to be available in all jurisdictions
    a) Cadastre – or some other layer dedicated to the management and control of transactions in land for economic and social purposes
    b) Geocoded or georeferenced address files/databases for urban jurisdictions – argue that addressing systems are key to the development of location based services and therefore a layer to manage them should be expected in all jurisdictions

c) Other priority themes – based on key development objectives or major economic activities of the jurisdiction, priority data themes should be identified and formal arrangements put in place to provide them for the community of users.

4) Data publication, search and discovery mechanisms.
   a) Metadata – how many data sets are documented in standard metadata systems? How are they distributed – online through the Internet, searchable multimedia devices or in printed form? Are there tools to enable searching the metadata? How long after a data set is created does it get into the system?
   b) Level of automation – after discovering existing data, does user have to download the data separately and process before incorporating in on-going analysis or can they request for transparent access to data or service?
5) Standards
   a) Are international and/or industry standards used?
   b) Are the standards formally adopted for the jurisdiction through approved standardisation processes?
   c) Comprehensive – are there standards for every data set and process?
6) Policy Environment
   a) Existence of policies on custodianship, pricing, accessibility, privacy, etc
   b) Promulgation of enabling legislation – are policies supported by appropriate legal promulgation?

Service-Centric Method

This method proposes to measure the level of spatial enablement of services. It has been established above that a service is spatially enabled if the spatial information needed required by the service is integrated seamless into the delivery or service process. A service would therefore be measured in terms of how integrated the spatial information is to the rest of the process. Does the use need to access the spatial information extraneous from the process, or have to undertake separate processing to use spatial information.

(IBM 2007) presents an asset management scenario in which a customer calls the service centre to report an incident. The agent who took the call would be able to create a service request containing geospatial data, as an integrated part of the service process. The service being spatially enabled, the agent would be able to associate relevant maps showing the location of the potential leak, and boundaries of the service request. It should be noted that the scenario described deals with the complete process or workflow, rather than merely using a software tool. This would score high on a spatial enablement index, compared to a process that would require the agent to separately consult maps – analogue or digital – to include the required spatial components.

Another example of a service with a high degree of spatial enablement is the multi-agency community emergency support system described in (AusSoft Solutions 2008). Though the various emergency agencies have high end custom spatial solutions, they are not designed to work together to respond to major emergencies that require coordinated corporate approaches. Though the case studies presented in the submission describes the components of a software solution, Latitude

Guardian, the enhancement achieved resulted from the coordination process. The operator that receives calls reporting incidents does not interact with any GIS, but simply enters the incidents in a database, using appropriate codes. From the database, the incidents are retrieved by the GIS modules and plotted on maps, enabling a supervisor assign resources, whose locations have been pre-loaded into the database.

The problem with the service-centric method is that normal services vary according to economic and social objectives of different jurisdictions. This presents the problem of comparability of indicators because some services are more amenable to spatial enablement than others. However a common set of services could still be identified that is expected to be in every jurisdiction. One such common set of services that every jurisdiction has to deal with is land administration. Every society, community or jurisdiction has to administer its land, being the base of all human activity. The services delivered by governments in respect to managing access to rights in land, and transferring such rights, as well as other transactions could be assess for spatial enablement and compared with each other.

With developing countries, a common objective reflected in their development programmes is to reduce, if not eliminate, poverty. A common set of services targeted at the poor could therefore be used as a guideline for the benchmarking.

The World Bank's World Development Report of 2004 was on "Making Services Work for the Poor" (World Bank 2004). We therefore propose to use the services exemplified in that report and review them for spatial content. These are:

- Basic Education Services
- Health and Nutrition Services
- Drinking Water, Sanitation and Energy

In assessing the spatial enablement of these services, it is necessary to consider the objectives of spatially enabling them? These include:

- To improve services by incorporating geographics in their planning, implementation and evaluation;
- To enable planners to take into consideration where the service takers are located and therefore the optimal locations of the service points;
- To enable users to compare various location options and determine optimal method of accessing the service, including proximity, navigation and co-location with other services and activities of interest to them

The actual questions that should be asked in assessing the spatial enablement of the services include:

- Did the planning processes for the services explicitly consider the locations of the resources to be used to provide the services? The location of the service takers, vis-à-vis the services? The co-location of the services with other activities of potential interest to takers?
- Identify "where" questions that are pertinent for each service and at each phase and measure to what degree the processes provide for these questions – even if only implicitly.

Conclusion

This paper has discussed the concept of spatially enabled government as the natural progression from SDIs. The SDI was initially conceived as a mechanism for sharing spatial data among stakeholders using networks that allow users to discover available datasets and download them for use in their GIS and other spatial applications. As the products and services of the SDI become available to a wider user community outside the geospatial professional groups, demands for more diverse services developed. 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. As the system responded to these newer demands, the SDI evolved into an enabling platform for linking spatial data services across jurisdictions, organisations and disciplines. The result is the spatially enabled society.

A spatially enabled society is characterised by a ubiquitous provision of geographic information so that services will incorporate spatial information seamlessly in the delivery process. As governments respond to this trend, they need to articulate the vision of the desired outcome and continuously monitor their progress toward the goal of full spatial enablement. This requires the identification of indicators for benchmarking of their services.

The concept of spatial enablement is still developing and there are not yet enough comparators for relative benchmarking with best practices. However, it is also used in an absolute sense as standards benchmarking, with comparison being against stated end results. However it is used, there is need for indicators to define and quantify the desired outcomes for the measurements.

This paper has proposed two methods for selecting these indicators. The first method, referred to as data-centric, builds on the fact that spatial enablement expects a functioning SDI as the source of the spatial information that will be made available ubiquitously. The method therefore proposes to measure the level of development and operationalisation of the SDI. Items to be assessed include the geodetic frame and data sets, at the technical end, and standards and coordinating arrangements at the governance end of the continuum.

With the working definition of a spatially enabled service as one in which the delivery process integrates the spatial information for the user to make any location or "where" decisions, the service-centric method proposes to measure the degree to which users would have access to spatial information without any extraneous process. The problem however is that government services depend on the economic and social priorities of the jurisdiction. In comparative benchmarking, this can be overcome by first deciding on a common set of services, such as land administration. For developing countries, the common set of services could be those directed toward eradicating poverty, such as basic education services, etc.

The next step in this study is to develop a toolkit to apply the methods to pilot countries to calibrate the indicators for general application.

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