INTRODUCTION

The popular use of spatial technologies involves showing images and tracking assets and inventory in an increasing array of instruments, the most common being the ubiquitous mobile phone. These technologies penetrate into even low income poor countries, but their take-up and development concentrates in highly developed countries. This high-end use of these technologies will determine their future.

Remarkable as these popular applications are, spatial technologies can also be used in even more dynamic, transformational ways. Transformational use of spatial technologies occurs when they are used to improve business processes of government, and assist delivery of policies for equitable taxation, conservation of natural resources and planning for rational growth. Use of this transformational capacity of spatial technologies in government creates a spatially enabled government (SEG).

Spatially enabled government is achieved when location and spatial information are available to citizens and businesses to encourage creativity, and governments use place as a means of organising their activities in addition to information. (Wallace and others 2006).

The major impediment to take-up of spatial information is counter-intuitive. We all use the new technology in our daily lives, but our capacity to understand the power of spatial information is remarkably small. In fact only about 1% of people in any society really understand spatial information with about 5% of people knowing something about the special technology. For 95% of people, spatial information and its supporting technologies is a mystery. Teaching people about spatial information and its technologies is therefore the first task in painting a vision of what is possible.

The 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 The adage of a “picture tells a thousand words” is now out of
date. New digital pictures tell many stories, and, if the enabling platform is built, the pictures will become management tools of government. Spatial technologies are moving quickly.

In Australia, since October 2006, Google Maps and Google Earth, combined with a geocoded national address file (GNAF), created an internationally unique opportunity. In an instant, a user can present any known postal address on screen, with combinations of satellite images of the on-ground reality, cadastral boundaries and address information. Seamless streaming of the images, and attachment of vital text information, are but two new technical facilities. These achievements were delivered by the visionary efforts of national agencies of ANZLIC - Australia’s Spatial Information Council, the Intergovernmental Committee on Surveying and Mapping (ICSM), the Public Sector Mapping Agency (PSMA), and Geoscience Australia, and state and territory agencies, through their technical know-how, and research skills. Remarkable though GNAF is, this ability to “find, see and describe” is only the beginning of spatial enablement. Transforming governments to capitalise on spatial enablement is the future.

Research background to spatially enabling government

Professor Ian Williamson and his team at the Centre for Spatial Data Infrastructures and Land Administration (the Centre) have researched these areas for over a decade, attracting many research grants from government and private sources. The continuing research theme is delivery of sustainable development through reengineering the processes of administering land and resources. Particularly in the last five years, these research activities populated international land administration theory and practice with new concepts that found support in the community of scholars and practitioners in the discipline. The significant concepts include

- the land management paradigm (Enemark and others 2005)
- spatial data infrastructures (SDI) (Williamson and others 2003)
- sustainability accounting (Wallace and others 2006); iLand (Wallace and Williamson 2005)
- stages of development of land markets (Wallace and Williamson 2006b)
- complex commodities (Wallace and Williamson 2006a; 2006b)
- marine administration (Rajabifard and others 2005)
- integration of natural and build environment datasets (Mohammadi and others. 2006)
- management of all signification restrictions and responsibilities affecting land (Bennett and others 2007)
- a flexible cadastral model (Kalanitri 2007).

These new concepts developed along side the rise in spatial technologies which are now used throughout the world to visualize information and facilitate eGovernment (Goodchild 2003) and spatially enabled accounting systems (Sarkar 2005). By combining these new concepts with the energy and potential of spatial technologies, the research team refined the concept of SEG (Wallace and others 2006), a new way of seeing how the technologies can be used to reengineer the way government works, not merely the way it sees information.

SEG demands innovation in research. Modern, coordinated, and citizen driven approaches to information initiatives can no longer be developed by departmental, silo-based, enterprises. However, despite best government efforts, application of information and use of
communications technology (ICT), including eGovernment, have been ad hoc and uncoordinated.

Take-up of spatial technologies faces even more significant impediments. Given they are “cutting edge”, their potential lies beyond existing government ICT strategies. Thus, throughout the hierarchy of state, territory and national governments, opportunities to reengineer business processes through spatial technologies are being underutilized.

The research problem for spatially enabling government

Governments, and indeed, most people, do not yet understand how to use spatial technologies except for internal purposes, particularly satellite positioning web-based information access and inventory management (such as parcel, aircraft, shipping container tracking).

Research problem: Governments are not using transformational spatial technologies to improve business processes, thereby limiting their effectiveness, efficiency and international competitiveness.

Research aim: To develop an internationally applicable, whole of government path to use or transformational spatial technologies, particularly land information, to manage national activities, provide services and deliver local, national and regional information.

The focus is on use of spatial technologies to facilitate whole of government analysis, management and evaluation of both spatial and non-spatial relationships between people, business transactions and government.

INTERNATIONAL SIGNIFICANCE

SEG is now an international research priority. SEG builds on the technical nature of spatial information, understanding of the international role of the cadastre (that represents the way people actually use their land), the SDI, and world-wide administrative arrangements for land and resources. SEG relies on the transition of international land administration from a technical to a multi-discipline environment combining public policy, law, and public administration, with technical competencies.

Those engaged in building this future include academic researchers in land administration, Geomatics and SDIs, international organisations, state and national committees, and the United Nations, particularly the World Bank, Food and Agriculture Organisation and UN-HABITAT. The United Nations is involved through its Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) especially this workshop, which engages 56 countries. Other research and professional organisations, including the Global Spatial Data Infrastructure Association (GSDI), are also engaged in SEG. This broad collaborative networking builds in the specific achievements listed below.

International trends

a) A robust regional organizational framework for SEG is already provided through the PCGIAP. In September, 2006, the Committee resolved to support spatially enabled government through a three year program to assist take up of spatially enabled systems by regional governments. This program was mandated through Resolution 3 of the 17th United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP) (UN 2006).

b) In Europe, initiatives include those of the European Union, in particular the Infrastructure for Spatial Information in Europe (INSPIRE), and Wageningen University in The Netherlands.
particularly its Centre for Geo-information. SEG also aligns with the Belgium Institute, the world’s only research organisation specialising in SDI development.

c) A major international direction in SEG comes from the United States, the world leader in encouraging the creation and adoption of transformational spatial technologies. The Federal Geographic Data Committee (FGDC) continues to engage in conceptual and technical research, and the National Research Council (NRC) in the National Academy of Science is investigating a national cadastral model for land parcel databases to rationalize the records of over 3000 county agencies.

d) The Singapore Government, principally through the Singapore Land Authority (SLA), has a working group on spatially enabling government. The SLA is charged with holistic management of land and resources in Asia’s smallest country, and is its most dynamic ICT user. Singapore is pioneering the adoption of communications technologies using hand-held mobile digital equipment (such as mobile phones) for transfer and management of spatial information.

The capacity of spatial enablement to improve government and business services was demonstrated by Prof Williamson to international audiences in late 2006 at -

- the International Federation of Surveyors (FIG) congress in Munich, (Williamson and Wallace 2006)
- 17th United Nations Regional Cartographic Conference in Asia and the Pacific (UNRCC-AP) in Bangkok, (Williamson and others 2006b)
- the GSDI-9 Conference in Chile (Williamson and others 2006a), and at
- invited presentations in Spain and the Taiwan Institute for Land Policy (Williamson 2006).

The universal response was positive and acknowledged a new direction for institutional reform, specialist information knowledge and technical capacity. The global audience for this research is already engaged and ready to take up its findings. This meeting of PCGIAP will frame the opportunity for regional countries to participate in these new directions. The Australian government is meanwhile organising a national conference on spatially enabled government in August, 2007, in Canberra.

THE PATH TO SPATIALLY ENABLING GOVERNMENTS

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 appliances management) 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.

SEG builds on existing initiatives but identifies new opportunities for improving efficiency and effectiveness of government administration. It enables 100% of government and society to use spatial technologies in an transparent manner. The key to universal understanding is the use of the cadastre as a fundamental layer of information. This is the information about how people use land in their daily lives: their houses, their places of work, the roads they travel, and so on. Moreover this information has special technical features that mapping information does not have. It is created and verified by scientific activities of surveyors and is tested against how land is actually used. Overall, it is built up by collections of highly reliable information that are continually improved in accuracy and reliability. No other information layer enjoys such a sustained investment in continual improvement and refinement.
A spatially enabled government organises its business and processes around “place” based technologies, as distinct from using maps, visuals, and web-enablement.

The technical core of SEG is the **spatially enabled cadastre**.

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 technical core of SEG is the **spatially enabled cadastre (SEC)**. The next innovation, and one that involves novel uses of spatial technologies, brings these new approaches into agencies that do not traditionally use spatial information, including tax offices, human services, health, census, immigration and other service agencies.

These transformational uses involve organization of social, economic or 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 government. These new uses deliver the benefits of spatial technologies to business processes of traditional users of land information, including emergency management, resource and water management, land management, and marine management. More importantly, the use of SEC supports identification of where non-spatial data sets apply and potentially allows the seamless interrogation illustrated by Example 1, even by agencies that do not traditionally use spatial information. (Williamson and Wallace 2006).

SEG enables the transformational capacity of spatial enablement, particularly use of land information through an SEC, to improve the way governments perform their tasks. Spatial enablement will develop decision making capacity and cross-jurisdictional and inter-agency solutions to national level problems. In turn, SEG will encourage development of spatially enabled businesses and societies.

The significance of SEG for governance in the Asia Pacific Region (APR) lies in rationalization among layers of government and regional cooperation on essential issues. A set of authoritative geocodes for vital land parcels, properties and business activity areas would allow a single place definition to replace the ad hoc array of file numbers, identifiers, dates, reference systems, archive numbers and so on, held in hundreds of incompatible files and databases. By creating the SEC once, updating it systematically and sharing the results, governments effectively streamline data sharing, and allow agencies to focus on their core businesses instead of duplicating owner, parcel and property files.

**The significance of the cadastre**
The need for every nation to manage its land to deliver sustainable development makes a national cadastre the engine of the entire land administration system (LAS). The cadastre underpins each country’s capacity to manage its land (Enemark and others 2005). 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 system, the cadastres or cadastral systems become the core technical engine delivering the capacity to control and manage land through the four LAS functions. The role of the cadastre as the engine of LAS is neutral in terms of the historical development of any national system, though systems based on Torrens systems and German systems, are much more easily focused on land management than systems with French or Spanish heritage.

The cadastre as an engine of LAS is shown diagrammatically in the “butterfly” diagram below. 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 national cadastre is of vital importance, whatever the actual national approach to designing and managing it. All three general approaches used throughout the globe are capable of feeding into a national spatial data infrastructure, and then into sustainable development. They are essential to 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 in the land market, and the economy related to property in land and resources. These cadastres are much more than a layer of information in SDI.

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 implement land management, and 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 cadastre provides an excellent 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 essential cadastral processes for effective land management, and the other the outcome of using the processes to implement land management in environmental, planning and development activities. 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 in SEG. This additional feature of cadastral information is an entirely new purpose, adding to the traditional multipurposes 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. 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.

For SEG, since 2000, and especially since 2005, new spatial technologies like Google Earth, Microsoft Virtual Earth, Oracle Spatial, and many more location based platforms and services, raise entirely new possibilities for cadastral information to service government.
and business (Wallace and Williamson 2006c) Even though cadastral systems around the
world are clearly different in terms of structure, processes, and actors, they are increasingly
merging into a unified global model in which the multipurpose cadastre takes on an increased
importance. Globalisation and technology development support establishment of multifunctional information systems with regard to land rights and land use regulations in combination with comprehensive information about environmental conditions. As a result, the traditional surveying, mapping, and land registration focus of LAS moved away from being primarily provider-driven to now being clearly user-driven. Thus the goal of SEG offers a means of adapting the cadastral engine in ways that were not available a decade earlier to service open-ended functions essential to modern governments. From this perspective, this diagram is a most important theoretical graphic for explaining the future development of land management, land information and government capacity to use spatial information wisely.

BUILDING THE SEG ENTERPRISE

SEG includes opportunities for reengineering government business processes and activities, and building national and international leadership in technological and administrative innovation. For Asia and Pacific Region (APR) countries, especially those with well organised spatial information, the opportunities for leadership in international applications are obvious.

Who is involved?
The SEG enterprise however has special characteristics that require much more collaborative and cooperative development among agencies than every before.

Multi discipline involvement
SEG requires national and international researchers from disciplines of Geomatics, Engineering, Management and Law. It involves cooperation between agencies of government that coordinate and manage mapping information, cadastral (or parcel) information and land registration processes.

National collaboration
This national collaboration and cooperation will use processes unique to each nation, but generally they will be based on processes used in, for example, Australia. Here, all major national organisations working with spatial technologies need to be involved. These include Intergovernmental Committee on Survey and Mapping (ICSM), Public Sector Mapping Agency (PSMA), ANZLIC – Australia’s spatial information council, Australian Government Information Management Office (AGIMO) and Geoscience Australia. The “spatial enablement survey” recently distributed to all Australian Government agencies by Geoscience Australia shows how far use of spatial information is already institutionalized in Australian institutions of government. While each of these government committees and national agencies has announced its interest in use of spatial information, none has the capacity to deliver the essential, whole of government, multi-discipline, approach envisaged by this project. This lack of national capacity will generally be present in all APR countries, especially its federated states.

Private sector collaboration
The Australian Spatial Information Business Association (ASIBA) is already working on spatial enablement, focusing on the traditional, rather than transformational, uses of spatial technologies. Likewise, many private enterprise initiatives in the APR countries will
support the broader research design of SEG and continue the engagement of the private sector in developing transformational uses.

**What must they do?**

A five year time frame is probably the shortest within which SEG can be reasonably examined and implemented. The multi-disciplinary nature and breadth of SEG, and the interdependence of its parts, demand a whole of government perspective to investigate the impediments to, and opportunities for, extending use of spatial technologies. Regional agencies need to plan their roles as catalysts for innovation, sharers of information and critical review of efforts. Immediate opportunities include solving issues of duplication, timeliness, relevance, authority and reliability of information; and improving management and service delivery of government agencies and organisations. Interaction between governments and the businesses and communities they serve is also central. These tasks are far too large to be undertaken generically. Another, more targeted approach is needed.

SEG involves reengineering government administration, identifying the tools needed to spatially enable government - the **toolbox approach**.

**Toolbox approach.** Implementation of SEG needs to be organised around describing and developing specific tools or components designed to achieve two stages.

- The first stage aim is to improve organisation of information,
- The second stage is more important and involves encouraging re-organisation of government administration and work patterns.

SEG is more than technical; it frames legal, economic, social and business areas within its integrated approach. The toolbox approach is appropriate for building solutions to large scale problems. The approach was first identified to aid design, construction and management of land administration systems (Williamson 2002). Its advantage lies in ensuring that the individual tools (Table 1) fit together as a coherent whole by constantly testing them against an over-all framework for SEG that evolves as the research progresses. The approach is flexible to embrace new hardware and software that will inevitably appear during the project.

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**Table 1. Institutional and technical tools for spatially enabling government**

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<tr>
<th>Tool</th>
<th>Description</th>
<th>Stage of development</th>
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<tr>
<td><strong>INSTITUTIONAL AND FRAMEWORK TOOLS</strong></td>
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<tr>
<td>1 Institutional framework</td>
<td>A multi-discipline approach will establish the theory, legal framework, institutional structures suitable for spatially enabling governments and engaging the private sector in innovation.</td>
<td>New tool and major component of the project.</td>
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<tr>
<td>2 Policy on spatial enablement</td>
<td>Policy is outlined in regional policy, research, state and national government policy, and UN-PCGIAP.</td>
<td>Requires significant amplification (Williamson and others. 2006b).</td>
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</table>
### 3 Business models for use of “place” to organise information, services and activities

Spatially enabled governments adapt their business models and organisational frameworks to achieve efficiencies from improved information and technology. Business models create **interoperable government services**. Whole of government land information, especially the cadastre, is spatially enabled, authoritative and created once for multiple uses. Government services, not merely information, are provided through web enabled, portable and interactive instruments and systems.

New tool and major component of project. Requires identification of Australia’s information needs and organisational change capacities. Models will engage private sector.

### 4 Monitoring and evaluation processes

The UN resolution supporting spatially enabled government (2006) requires a monitoring and evaluation program to manage its implementation in the Asia Pacific Region. Business models also require monitoring and evaluation programs for fiscal and non-fiscal measurables.

New tool, building on monitoring and evaluation of LAS (Steudler and others. 2004). International focus will assist regional development.

### TECHNICAL TOOLS

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<th><strong>iLand - a spatial information availability platform</strong></th>
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<td>5</td>
<td><strong>iLand</strong> is about transforming <strong>all information</strong> systems, especially those used in LAS agencies, to take up opportunities offered by spatial enablement, delivering spatial information as a common good on free or low cost basis, and encouraging innovation throughout government, private sector and community users.</td>
</tr>
<tr>
<td></td>
<td>Requires amplification (Wallace and others. 2006). Requires identification of whole of government approach.</td>
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<th><strong>Spatially enabled cadastre (SEC)</strong></th>
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<td>6</td>
<td>The cadastre is the fundamental data layer, and primary source of technical, accurate, large scale, digital information about how land is actually used. Conversion of the cadastre to an <strong>authoritative spatial register</strong> of parcel and property information allows all government agencies to use it many times.</td>
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<td></td>
<td>Enhanced data models now theoretically identified. Suitable implementation paths must be identified.</td>
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<th><strong>SDI - Interoperability and accessibility of spatial information</strong></th>
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<td>7</td>
<td>Spatially enabled information, particularly including information from the cadastre, registries, land planning and valuation, flows through to tax offices, emergency and health services, census offices, service utilities etc, by consistent geo-coding and other means. Use and national take-up of spatial systems are encouraged by: technical solutions; business process options; international compliance; and best practice.</td>
</tr>
<tr>
<td></td>
<td>Identify a national SDI as an international model of best practice. Expand SDI capacity to use spatial systems (Rajabifard and others. 2006)</td>
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The institutional framework to encourage innovative use of spatial technologies will require the tools in Table 1. These tools were identified over the last decade by the Centre for Spatial Data Infrastructures and Land Administration. They all require extensive research and iteration. A national task in building the cadastre into an authoritative register of land parcels and properties (Tool #6) is a vital part of the way forward. The monitoring and evaluation tool will enable the research in each tool to be tested against the overall framework to assist orderly take up of transformational technologies. Government leadership in developing the framework and its implementation paths will be highlighting by the tool-box approach. These leadership roles will stimulate creativity in use of spatially enabled systems in private and community sectors.
CONCLUSIONS

The overall framework and its institutional and technical tools developed to implement SEG will increase efficiency, effectiveness and international competitiveness of governments. SEG will identify opportunities for innovative uses of spatial technologies in public and private sectors. It will showcase achievements of APR countries in SEG internationally, and build on them to reengineer government processes.

Implementation of SEG will achieve cross-jurisdictional and inter-agency solutions essential for effective government and regional management. SEG will support policy priorities in emergency management, taxation, monetary and fiscal agencies and many other essential functions of government, in addition to land and resource management. The use of ‘place’ as a management and accessibility tool will facilitate understanding of the impact of human activities and their interplay with natural systems in all areas of APR.

REFERENCES


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