Land administration systems (LAS) are now challenged by new technologies and radically different demands for land information for modern governments. Spatial information is good enough to support spatial identification and location enablement applications available in every significant type of software (word processing, spread sheets, professional applications, Web systems, GIS and databases). A place on earth can be defined with precision on the ground and in computers. Digital data can be attached to a location as never before. With appropriate computer facilities and the underpinning interpretative information layers which translate computer language into understandable descriptions of places, governments can potentially identify ‘where’ their policies are happening. A nation’s ability to reap the benefits of the spatial enablement of information requires the highest level input from its government and private sectors.

These challenges are discussed in the context of developing a vision of iLand, a concept of spatially enabled information for modern government. This article sets this vision in the history of land administration, and the growing reliance on a new kind of information about land and its attributes that is relative and aspatial in regulation of activities and taxation.

INTRODUCTION
New technologies available in land administration systems offer significant opportunities to modern industrialised democracies. These opportunities are explored in a vision for land information called iLand which focuses on spatial enablement of government. The vision is primarily to assist design and implementation of governments’ information policies, particularly in relation to land information, anticipating public and private needs. It is part of a large project that explores the issues generated by delivery of sustainable development, rapidly changing
technology, new property markets, mutating government systems and Australian inventiveness in use of spatial information. The question addressed is –

How can Australia’s land administration systems (LAS) be adapted to capture the efficiencies available from new technologies and to provide essential information needed by modern government?

The vision builds on theoretical approaches familiar in law, public administration and economics, but principally relies on the discipline of engineering, where hard questions receive designed, constructed and managed solutions. Impediments to implementation of the vision are not considered at this stage. iLand is offered as a vision in which computerised information generated by LAS is spatially identified and much more useful, ignoring traditional boundaries between national and state administrations. Building a vision, then comparing its components against reality to identify betterment paths, are well tested and successful methods of achieving international congruity and understanding about LAS. The processes involved are especially useful in a nation of federated states long used to doing things to suit local administrative, not national, needs. The FIG Statement on Cadastre (FIG, 1995) and Cadastre 2014 (Kaufman and Steudler, 1999) were highly influential because these models were far-sighted and cleverly articulated. The spectacular growth in interest in spatial data or information infrastructures (SDIs) also illustrates the utility of designing a robust vision to harmonise innovative solutions to national problems (Williamson et al., 2003).

The article briefly explains land administration history and the key tools of spatial information and the cadastre. The dramatic changes in the information needs of modern governments, particularly in taxation, are explored and placed within land administration functions. Engagement of the Australian government is identified as an inevitability. Finally, a vision for spatially enabling governments is articulated. The key idea is to build on eLand where government puts information in digital form, makes it accessible on the Web, and incorporates small scale reengineering of services, to create iLand, where all major government information systems are spatially enabled, and where location and spatial information are regarded as common goods made available to citizens and businesses to encourage creativity and product development. In short, the vision relies on educating policy makers about the power of spatial information.

AUSTRALIAN LAND ADMINISTRATION

Land administration systems started in Europe because governments needed coherent and fair tax collection systems, then they developed to service land markets. Their basic functions are to organise land tenures, values, uses and development. Their primary tools are surveying, registration systems and databases run by government organisations. The importance of land administration increased after 1990, when systems in modern democracies emerged from their technical focus to engage professionals from the disciplines of engineering, economics, political and social sciences, law and computer technology, to address sustainable development issues. Simultaneously, international organisations and national governments in less developed countries struggled to adapt LAS to deliver land and food security and to build land markets.

The land management paradigm for land administration (Figure 1), grew out of these efforts. This integrated model was developed (Enemark et al., 2005) to assist governments to understand modern land administration and to facilitate sharing among nations at various stages of development. The organisation of land tenure, land value, land development and land use within the local institutional context is shown within the overriding policy of sustainable development.

The Australian context

iLand is far from implementation by any modern government. Moreover, no land administration system is yet able to provide competent support for the new complex property market that has developed especially since the 1970’s (Wallace and Williamson, 2005). Australia’s federal system is, from the viewpoint of land administration efficiency, characterised by an
additional problem: an outmoded constitution with distribution of powers ill designed for modern circumstances. Ideally, a national government should organise the basic standards for capture of detailed spatial information about land, buildings, environment, and so on, so that the information base is nationally cohesive and sufficient for devising and implementing national monetary policy and sustainability. Constitutionally, Australia’s national government cannot do this directly. Most of the information about topography and land parcels is held by states, some by local governments, and some (indeed very important) not by any governments, or even in any organised system, at all (risk and emergency information). While the Australian government undertook the front running in national mapping, marine information, and some topographic information, it is hardly conscious of cadastral information. Meanwhile, federal departments and specialist agencies are engaged in collecting land information relevant to their administrative functions, with the key agency being GeoScience Australia, the national agency for geoscience research and geospatial information within the Department of Industry, Tourism and Resources (http://www.ga.gov.au). Other significant players are the Australian Bureau of Statistics (ABS), Department of Transportation and Regional Affairs (DoTAR), Department of Agriculture, Forestry and Fisheries (DAFF), National Oceans Office (NOO), and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The Department of Defence is a primary user of spatial information, and for reasons of security, their information resources are not available to the public or business or indeed any other government agencies.

These agencies, and the state and territory agencies in LAS shown in Figure 2, are independent. The Office of Spatial Data Management (OSDM) coordinates spatial data access and pricing in the Australian government and fosters private sector activities. Successful related cross boundary initiatives include the Australian Spatial Council (ANZLIC), Public Sector Mapping Agency (PSMA), Intergovernment Committee on Survey and Mapping (ICSM) and National Land and Water Audit (NLWA); these depend on cooperation, not power.

Under the Constitution, usually states or local governments hold land information. Without a world war, transfer and cooperation are slow (Warnes et al., 2002), but have achieved notable successes. PSMA provides national seamless datasets on coastlines, roads, railways, water, national parks, Cadlite (including the

Despite Australia’s embedded silo systems of information about land, and people to land relationships, dramatic improvements in organisation of spatial information occurred after 1990, the most well known product being the national geo-coded address file (GNAF), compiled by PSMA using data from the Australian Electoral Commission, Australia Post, and states and territories. The ABS initiative of mesh blocks created the first opportunity for geographically referenced statistics, and allows information about a farm, factory, house or business to be assigned to its correct mesh block through its street address (ABS, 2005). Australia’s 350,000 mesh blocks will become the basis for spatially organising all political, statistical and administrative geographical information, though few understand the implications of the new design. Though spatial awareness had increased rapidly, more needed to be done. ANZLIC, in early 2005, therefore proposed a new socio-economic and emerging issues strategic committee to support wider adoption and use of spatial information in non-traditional communities of practice.

**State, territory and local governments.** The federated states and territories manage the land and land information within their boundaries. They follow the historical models of separate treatment of each of the core land administration functions. Land valuation, land tenures, land uses and land development are dealt with in silos, each with their particular database and administrative organisation. Day-to-day assignment and management of planning zones and buildings, including much of the heritage work, are handled by over 700 local governments. These agencies collect land information in ways to suit their internal management, not immediate users, let alone emerging users.

**Spatial enablement**

Spatial enablement of information offers solutions to otherwise intractable problems about organising information and permits more equitable and effective administration of land and resources. Spatial

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**Figure 2.** Australian land information management agencies *(Warnest et al., 2002)*
information is diverse. It includes position, time, distance, measurements and relationships of a person, place or thing, typically held in a geographic information system (GIS) but also in any system that understands the world in geospatial terms. Spatial information is based on coordinates (longitude and latitude, or X and Y, and height, Z,) and allows positional functions of digital systems to track a place on earth’s surface, measurements, and relations (notably times and distances). Popularity of GIS jumped by orders of magnitude as capacity to handle map and geographic information production, shrinking and enlargement, overlaying and access, improved. Land information held in computers now stands to be revolutionised by location or spatial enablement: the capacity of software (usually a database or a GIS) to identify the position of an item in relation to other items and in relation to its position on the earth. Thus location enablement allows databases and other computer applications to graphically identify places and positions of items and processes and, increasingly, to provide useful details about characteristics. Imagine tracking international parcel deliveries, or managing international airports.

Integration is the current theme of spatial enablement which, at its best, could combine cadastral information about individual properties (or parcels, technically) and information about attributes of land. Once this combination is conceived, the land administrator can deliver policy and planning utility by merging, say, land parcels and properties information, and land use types in council planning schemes. Or by automatically and graphically combining survey defined property polygons with general attributes such as land use, owners, interests, land cover, boundaries, calculated area, tenure, lot/plan, reserve, suburb, postcode, rate registration number, account number, building permit number, and so on. The information can be presented as images or pictures, without losing the analytical capacity of relational databases.

The high take-up of spatial information technology by organisations seeking better land management opportunities is well known. The growth was so spectacular that an entire new concept was designed to manage and coordinate the explosion. The spatial data infrastructure, SDI, was born and became a world-wide phenomenon. (Groot and McLaughlin, 2000, Van Orshoven et al., 2003; Williamson et al., 2003, Masser, 2005). While spatial information is visible in many Web applications, equivalent improvements in LAS have proved to be much more illusive.

**Central role of the cadastre**

Digital information about land is central to the policy framework of modern land administration. In iLand, digital position information is going to be even more central to government. The cadastre, or the land use and parcel map, is the vital information layer of an integrated land management system and, in future, it will underpin information systems of modern governments. The role of a digital cadastral data base (DCDB) reflects careful collection of information through survey methodologies. The parcel orientation of the DCDB allows ordinary users to confidently identify land. Thus the DCDB is the core layer for both historical and practical reasons, particularly because it is built by surveyors who use rigorous methods to measure and mark the earth.

While some developed countries do without a formal cadastre, all generate digital maps of land allocation patterns, uses and lay-outs, and they keep sophisticated parcel maps showing roads, land lay-out, and even addresses and photographs. Without these digital facilities, modern governments cannot understand the built environment of cities, manage land competently, utilise computer capacity to assist policy making, or retrieve value out of land. The characteristics of the cadastre are the large scales of its data (typically 1:500 - 1:1000 in urban areas with 1:2000 - 1:10000 in rural areas) covering very small areas of land, such as street blocks or local government areas, and the seamless horizontal or two dimensional merger of the areas by the computer to reflect urban and rural land uses of a country. Since most of the information is derived from survey practice, the software used to support cadastral functions is particular to digital surveying systems. Different software is used by GIS to manage geographic information. While this distinction is technically significant, iLand presupposes that the variability of survey based and GIS systems will diminish, allowing much more interoperability of systems and information (Elfick, 2005).
Despite the importance of the cadastre (or its equivalent), many of the pressures of modern government threaten its future. DCDBs (or, indeed, reasonable standard hard copy cadastres) are expensive to create and to maintain if their use is limited to mapping and subdivision. The opportunity to cover the cost of DCDB maintenance by attaching overheads to new parcellations or subdivisions is limited because the charge per parcel is excessive and there is no reason why new parcels should subsidise the security of digital information pertinent to all others. Given their construction costs, marketing DCDBs at prices set for cost recovery limits their use in and out of government, even though the georeferenced databases are still used extensively. Access opportunities and charges are questions that an information vision must eventually address. In iLand, the DCDB is destined for a much broader role as fundamental government infrastructure equivalent to a major highway or railway, though it was originally created on behalf of taxpayers merely for better internal administration. Ideally, taxpayers and businesses (especially the utility providers) should access the DCDB free, or at least available for very affordable charges and through convenient information exchange arrangements (Onsrud et al., 2004; Committee on Licensing Geographic Data and Services, 2004). The greatest potential for the DCDB is within the land information industry at large, as the principal means of translating the scientific X, Y and Z coordinates into meaningful descriptions of places, facilitating understanding of precise locations of government, business and community policies, regulations and actions.

INFORMATION NEEDS OF MODERN GOVERNMENTS

Multi use, interoperability and the land information interchange

In old technologies, land information was tabular: data sets of numerical identifiers for parcels, and names of owners in alpha numeric files. Australia had multiple systems. For instance, multiple sets of owner/parcel files existed in Victoria alone in the 1980’s. The land registry held the authoritative owner parcel information, but no other agency could use title data. To be fair, the information was not digitised in a form suitable for uses beyond the registry. Other jurisdictions had similar issues of duplication, incompleteness and incompatibility of data sets. Even without the privacy rules, land registry data would languish in registry computers unless a significant policy shift was made. The beginnings of such a shift are evident in the take up of Web opportunities.

Computerisation significantly improved and extended opportunities for land registries particularly as focus shifted from collection of information within government agencies for their internal purposes to making information work for the combined purposes of the primary agency, other jurisdictional agencies, across and among governments and even in the private sector. Much of the effort in organising land information, especially in spatial form, now concentrates on multi-use and mechanisms of interoperability. The transition from the browser (look and see) to a true information interchange is described in Figure 3.

Analysis of Australian web facilities in the eLand environment of 2005 (Kalantiri et al., 2005) shows that the systems were used to retail certificates and information previously obtained in paper form. Reengineering typically required a decade or more of consistent input capable of surviving successive administrative and policy changes and was not the eLand focus (Bennett et al., 2005). Moreover, the cost of Internet systems to support eLand initiatives was typically underestimated. A simple Internet banking system for the Commonwealth Bank of Australia operative in 2005 cost $100m. Governments were not prepared to spend anything like that on Web enablement of land administration. Initiatives in eConveyancing depended on convincing business models showing reengineered data entry and processing would save administrative overheads in addition to private sector savings.

These commendable initiatives suited their times. However more is needed to satisfy the needs of modern
governments. Land is now more taxed, more regulated and more in need of sustainable management than ever before. The *iLand* vision of spatially enabling governments aims at releasing the power of land information to service these emerging policy needs.

**Management of land information**

Spatially enabling government requires designers to appreciate the difference between data and information. Given their ever expanding capacity, computer systems now hold masses of data. Good government is not about having data, but about having information. Appreciation of this difference is most apparent in Western Australia where the Department of Land Administration became the Department of Land Information, and where its Shared Land Information Platform (SLIP) focused on business activities (Searle and Britton, 2005). Meanwhile, traditional LAS activities of state and local governments - land registration, valuation, planning, rates collection, stamping of transactions, land taxing – continue to generate land information that languishes in the source agencies and is not spatially enabled. Governments now collect data about land for a multitude of purposes some of which are indicated in the Table 1. The point of Table 1 is to show how management of land information might change when relieved from the technical restrictions of source (either national or state), scale (large scale cadastral or small scale spatial) and technology (GIS or survey based). The idea is to demonstrate the power of integration of datasets inherent in design for a national SDI, and eventually a seamless merger of data collected by spatial and survey applications. Table 1 ignores the distinction, so well embedded by history, professional practice, technology and administrative structures, in favour of a more flexible approach to land information. A distinction between the relative stability of the data about natural and built features and the changeability of information about buildings, owners, values and controls might indicate better business model for data management for future needs. Another emerging need is driven by water trading policy: should this innovation succeed, a column for the water environment would be appropriate, and hydrography and associated data would take on significantly different functions supporting market distribution of water.

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**Figure 3. Evolution of land information processes**

Based on John McLaughlin, 2004
<table>
<thead>
<tr>
<th>Natural dataset</th>
<th>Land environment</th>
<th>Marine environment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Datasets of natural and built features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geodetic control network (national triangulation)</td>
<td>The question of whether this is maintained is now challenged by GPS technology. The balance of opinion is that it remains essential for survey integrity</td>
<td>Extensions of survey standards into shallow and even deeper water is standard. In deep water environments, GPS is used.</td>
</tr>
<tr>
<td>Digital terrain models (height)</td>
<td>Generated by predecessor of Geoscience Australia on Australian Height Datum since 1970’s.</td>
<td>Bathymetry – ocean floor models</td>
</tr>
<tr>
<td>Topographical maps</td>
<td>Typically information and images generated by environment and agricultural managers.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Geographic names</td>
<td>Generated by Gazetteer, GeoScience Australia</td>
<td>As for land</td>
</tr>
<tr>
<td>Hydrography</td>
<td>Water authorities</td>
<td>Wind, tidal and current information</td>
</tr>
<tr>
<td>Land use and cover</td>
<td>Generated by agricultural and environmental managers</td>
<td>Poorly collected but improving quickly</td>
</tr>
<tr>
<td>Cadastral data</td>
<td>Generated by land registration and parcelisation processes and vary among the various jurisdictions</td>
<td>Parcels are the basis for most marine farming and mining activities, however information is not available because of lack of coordination among various marine administrations</td>
</tr>
</tbody>
</table>

**Datasets of land information constructed by modern democracies**

| Buildings | Building fabric, installations, risks | Marine infrastructure, channel markings, pipelines, shoreline facilities are poorly coordinated |
| Land ownership | Land registry records and in case of non-private land, records of land managers. | Equivalent registries deal with marine resource allocation |
| Land uses controls | Information about parcels, properties, business activity areas | Regulatory systems are isolated and patchy |
| Land values | Market and government values | NA |

**EMERGING DATA NEEDS**

| Public restrictions on private land | An emerging issue of organising increasing regulation of land uses and activities. As yet, no single solution to organisation of this information exists. | Not yet applicable. |
| Responsibilities for land | A related emerging issue for organising land management across all sectors. | Not yet applicable. |
| “New” interests and property | Complex commodities and market based instruments | Not yet applicable. |

Table 1. Spatial and land datasets in modern government
Table 1 is not definitive, though it has a pedigree. The first section of natural and built features borrows from Groot and McLaughlin (2000), with the addition of marine data (Strain et al., 2005). The data sets, even together, are far from sufficient and many other data sets are necessary for management of land and land based activities for sustainable development. Administrative boundaries, aerial photography and images over time, roads by centre lines and names, and many others exist as well as the selected illustrative spatial datasets shown in Table 1. Omission of some sets regarded in particular jurisdictions and agencies as core activities is in the interests of brevity only. Meanwhile, Table 1 captures the forward momentum in land administration by including datasets on restrictions and responsibilities that do not yet exist. Any data management systems of the future will need to adapt to meet data availability, access and management decisions. A next challenge for Australian LAS lies in the development of a framework capable of servicing complex commodities (Wallace and Williamson, 2005) and market based instruments that facilitate divergent ownership and management of various components of land (water, carbon credits, biota, vegetation and others under construction). The greater challenge is to use **iLand** to adapt LAS to incorporate the new ways governments generate and use information about land, citizens and activities.

### Changes to nature and content of land information

**Complexity of spatial information.** Even if corrected to an ideal accuracy, tabular information from core LAS functions is no longer sufficient to support sustainability policy. Nor is it easy to spatially enable tabular data and make it visualisable in a computer. Spatial data are not the same as integer, alphanumeric or symbolic data for a number of reasons: spatial data are scale dependent; spatial queries are inherently complex; all spatial queries, analysis and modeling are dependent on data models which have many and varied dimensions; and integrating spatial data with other data types is particularly difficult due to their different data structures. So, while spatial data can now be included and manipulated in large databases, the collection, management, manipulation, integration, use, presentation and querying of spatial data is complex. Another complication is, however, much more significant.

**Relativity of land information.** Information in survey plans and geographic systems reflects reality and is capable of being tested against what is seen on the ground. It is constantly subjected to efforts to make computer information verifiable by scientific methods. By contrast, for modern governments modern land information increasingly involves relativities inherent in complex socio/legal constructs dependent on the cognitive capacity of citizens (Wallace and Williamson, 2005) and the competence of government land administration. The relationship between the information inherent in these socio/legal abstractions on the one hand and the physical parcels depends on both government land administration and democratic functioning. The land registry provides the framework information about people and what they do that underpins the legal construction of property rights, the social meaning of ownership of land and economic opportunities delivered to a vibrant, multi-tiered land market. The economic significance of the relationship between a recording and the abstract socio/legal arrangements it protects is remarkable (Wallace and Williamson, 2005). Accuracy of this kind of land information comes from sources other than scientifically verifiable reality. In a Torrens system, the administrative act of recording an owner is combined with the announcement of its legal meaning and the cognitive response of the public. The land might be visible, but the socio/legal realities are not. Paradoxically, the need for these constructs to be supported by accurate, complete and high integrity registers is overpowering. No country can run a successful economy if its land register contains **dirty** data.

Another relativity is also obvious: land information concerns people and their relations with spaces, areas and activities related to land. It changes rapidly and its meaning and significance are variable according to the perspective of viewers. While spatial enablement of this information to deliver the **iLand** vision is necessary, the conversion must reflect inherent
variability and dependence on relationships; its systematic administration requires great care. Information about the natural and physical environment is not so complicated.

**Content of land information.** Australia’s land information is not yet sufficiently well organised for management of a modern state. There are some notable gaps. Unlike Germany, The Netherlands and Denmark, much of the information about building capacity, type, structure, age, and the permits for building construction and renovation, is not kept in a nationally coherent fashion. Administration of building information is spread through government, semi-government agencies and the private sector, and predominantly managed by the 700 or so Australian local governments and private businesses through planning and building approval powers. Information management capacities vary greatly, as people who deal regularly with owners’ corporations associated with multi-occupancy buildings already know.

While information gaps provide a challenge, changes in the content of land information are much more significant. Content change occurred principally in two processes: land regulation, including regulation of land markets, and land taxation, using land to generate public revenues. The iLand vision assumes that both of these processes could benefit from spatial enablement of relative information data sets. Both involve a shift towards land information that is relative and socio/ legal in nature. Given advancement in capacity, state and national legacy database systems might be able to service these combinations, but the utility of using multiple databases is challenged by the new spatial technologies.

**Land and resource regulation, restrictions and responsibilities.** In mid 2005, business compliance was estimated to absorb 8 percent of Australia’s GDP. Like all modern democracies, despite efforts at deregulation and co-regulation, Australia produced extensive layers of laws, requirements and conditions affecting especially business activities which demanded high level management skills of the nation’s bureaucratic institutions. In brief, regulatory designs since World War II passed through three broad stages:

- An initial stage of legislative and regulatory descriptive laws compromising detailed prescriptions and non-negotiable standards. Up to the 1970’s the statute books of the various jurisdictions fitted comfortably on library shelves.
- A second stage, apparent in the 1980’s and 1990’s following the growth in consumer regulation and redesigned professional regulation, produced performance based, co-regulation models, deregulation for competitive markets, sunsetting of regulations and fashionable codes and practice standards. Content negotiation and self regulation were evident. Access and implementation issues replaced enforcement issues (Ayers and Braithwaite, 1995; Godden, 2005).
- The next stage of complex regulation involved responses to the expansion of the regulatory environment with costs of compliance being measured. The problem might be identified, but solutions are far from forthcoming.

Within these general trends, increasing regulation and restrictions affecting land gave rise to large scale political and institutional concerns. The first signs were apparent in the 1980’s with the South Australian review of legislation affecting land, followed by the Filed Land INterests (FLINT) project of the Victorian Law Reform Commission. Recent diagnoses include an Australian Parliament (2001) report, a Western Australian Legislative Council report (2004), articles by a group of three authors: Davies *et al* (2001), Lyons *et al* (2002a; 2002b) and a survey on restrictions by ANZLIC (2005). In response to these concerns, the land registries (not DCDBs) were seen as offering opportunities for recording a vast array of government and public administration restrictions on land.

This is not a surprising conclusion, given the orderly and effective Torrens system administration. However, the great success of the Torrens system is its clean and unadorned management of the Australia’s land markets by recording private interests in land. To encumber the parcel registry with the task of ordering, recording, and administering decisions of government agencies is
a diversion from the core registry functions. There is no persuasive reason to accord government administrative restrictions indefeasibility, state guarantee and survey precision of parcel based records. On the other hand a remarkable opportunity potentially exists for using parcel style information and systems capacity in the DCDB along with spatial information capacity of other government agencies to deliver more transparent and open management of some land restrictions. The first step is development of a coherent typology of restrictions, perhaps along the lines of Figure 4.

A second step involved extending Torrens registration theory to incorporate the concept of ‘below the line’ registration for administrative and other interests. Existing computer operations supporting land registries can assist management of some information about restrictions. At the minimum, below the line services relying on the registry parcel based information held in tabular database systems could incorporate additional lines of text or attributes representing some administrative decisions. This minimum however is not capable of managing restrictions for which information is not in text form, not parcel related, and not related to equivalent boundaries. Registry information is not spatially enabled, even though it relates to surveyed parcels. Much of the information people want is business activity and property (not parcel) information. Information on quality of buildings, fire compliance, pollution and contamination, last sale prices and so on, is also in high demand. Land restriction information is often relative to land uses, more likely to change, huge in potential to affect land values, and significant for the public. Spatial enablement of restriction information by the agency of source or through GIS overlay in which properties are identified, are also options. Meanwhile, the overall management of restrictions and responsibilities is one of the acknowledged challenges for LAS both internationally and in Australia.

**Figure 4.** Typology of restrictions and responsibilities affecting land
Adequacy of core information to support government land policy. Australian land produces multiple and lucrative public revenue streams and still supports housing, businesses and public infrastructure for sustainable cities and farms. For example, recent state land tax increases are well beyond growth trends of the general economy. In New South Wales land tax receipts of $15.246 billion were estimated to grow 17.5 percent in 2005-6 to $17.91 billion. Victoria’s tax was estimated to grow 11 percent in the same year. Stamp duties, council rates, goods and services taxes and capital gains taxes levied in land transactions also increased beyond the consumer price index. Australia is certainly making its land work, despite the relatively dysfunctional, silo based, administration systems. This apparent success is, however, not the entire story. Completeness, accuracy and timeliness of land information is acknowledged to be inadequate for modern businesses and governments (Reserve Bank, 2003; 2004a; 2004b; 2004c).

The most telling examples of policy making in a land information vacuum are found in analysis of land markets for land taxation systems. The most recent notable divergence occurred when New South Wales introduced a 2.25 percent vendor of investment property stamp duty (vendor’s tax) on 1 July 2004. A year later, the New South Wales government denied that this tax affected its receipts of global buyer stamp duty which fell below expectations following a downturn in the overall land market more severe in that state than elsewhere in Australia.

Vendors, of course, hold the key to the time they put a property on the market. If they want to avoid a vendor tax, they withhold. Without some qualitative survey of vendor behaviour, an observer would surmise that natural proclivities of people to act in their best interest contributed to the downturn in the NSW property market. This market was characterised as overheated in 2004, and subject to the cooling factor of raised interest rates by the Reserve Bank of Australia (RBA) Board in late 2003 and early 2004. Information that existed at the time suggested that the vendor tax was a contributing factor. Ninety three percent of respondents to the Australian Property Directions Survey in April 2005 thought the vendor’s tax was having a detrimental effect on the market. Government denials of impact, including the NSW Treasurer’s budget speech of 25 May 2005, stood in contrast. However, budget figures publicised in mid 2005 showed that stamp duty estimates were not met, and receipts had fallen well below expected returns. Shortly after, the New South Wales government announced the tax was removed as from August 2005. From the perspective of good land administration, the question is not whether the vendor’s tax was right or wrong, it is the adequacy of knowledge about land markets before and after the RBA interest rate rises available to the New South Wales Government. The apparently robust market was, in fact, so volatile that any negative change had much deeper influence than policy makers anticipated. What had happened, especially since 1980, was a fundamental change in the nature of land information needed by modern governments.

The Revolution in Land Information

Land regulation and taxation run counter to the trend to build on land information that is certain and testable because it relates to the physical world. They require voluminous and relative information sets about land, its owners, managers and users, and their activities. The information is relative because it is related to ever-changing relationships between land (parcels, properties and sites of business activities), users, managers, owners (as individuals, aggregated owners, earners of particular incomes etc), times, refined legal concepts and relationships among them. This information generates case by case outcomes to very important questions.

New information relativities are illustrated by a simplified version of capital gains tax (CGT) (Figure 5). While most of the information in the decision chain is variable or relative, the constant and unchanging part of the story is, of course, the land.

Other examples of the relative nature of information used in the calculation of liabilities and taxpayer responsibilities are available. Effective tax collection depends on basic land information about the land parcel and/or the property, including ownership, land use type, use by owner and occupier, official value, and its actual and potential sale prices. Combinations of the
information are required both for fair calculation of income tax liabilities and setting sound tax policy. Land tax calculations are complicated and vary among particular tax schemes. Similar considerations apply in the case of goods and services taxes and asset tests involved in calculating entitlements to social security. The Australian government is keenly aware of its need to manage these variables. Large scale databases and collections of information and data matching procedures indicated in Table 2, are proposed for national agencies. These initiatives replicate the datasets held in state and territorial agencies, which in their turn, involve substantial replication of core land information.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Database</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Taxation Office</td>
<td>Land transactions since 1999</td>
<td>To facilitate the collection of CGT and goods and services tax (GST)</td>
</tr>
<tr>
<td>ABARE</td>
<td>Non-arable land</td>
<td>To facilitate land management</td>
</tr>
<tr>
<td>Australian Prudential Regulation Authority</td>
<td>Risks and claims</td>
<td>To better manage insurance business sector</td>
</tr>
<tr>
<td>Centrelink</td>
<td>Land ownership</td>
<td>To administer pension entitlements</td>
</tr>
<tr>
<td>Australian Reserve Bank</td>
<td>Australian property markets</td>
<td>Australian Property Monitors was commissioned to provide timely and complete information about the property markets in major capital cities.</td>
</tr>
</tbody>
</table>

Table 2. Australian land data needs
To assist data sharing, a great deal of work is being done on harmonising datasets. The most significant is ICSM’s Harmonised Data Framework for transfer and interoperability of information across jurisdictions. This deals with survey information underlying the DCDB. Registering authorities will be moving from a visual representation of an interest [a picture of a plan] to a numerical model of that interest with a view to creating software which can visualise the spatial extent of that interest (Cumerford, 2005, p774). The issue is now to consider whether a program of spatial enablement of government information sets would better satisfy inter and intra government information needs than replicated databases. The relative newness of spatial information technology and modelling systems built around them suggests that alternatives to databases were not considered.

This is not to propose that Australian governments need to build a national and spatially enabled land information system. It is to suggest that the huge resources supporting these database activities might in future be better applied to alternative solutions, such as iLand, potentially offering more durable, multi-useable, spatially enabled and interoperable national, state and local government land information. The shift would be from pure land information to a mixture of person, time, activity and quality of information with analysis facilitated by spatial enablement of this information. Figure 6 adapts ANZLIC’s analysis of components of personal and spatial information to illustrate this process. The category of personal spatial information is not necessarily private personal information capable of identifying an individual and constrained by privacy principles, though some (name and address of owner) would be. Much of identifying personal information is nevertheless available given the public nature of land registries and overarching administration powers. While access to some categories of information needs to be negotiated through privacy restrictions, much of the land information iLand seeks to manage is information about the way land is used, when it was bought, price paid and so on.

SPATIALLY ENABLING AUSTRALIAN GOVERNMENTS

Spatial information infrastructure for land management

Technological opportunities significantly improved after 1999 with increased computer capacity, standardisation of Internet services and better GIS. iLand suggests Australia can better organise land and spatial information to enhance policy making for sustainable land management, tax equity or business-to-business ease of operation. An integrated land and spatial information policy concentrating on spatially enabling government is needed.

Useability and utility of land information vital to government and business are significantly improved by spatially enabling information, geo-referencing significant core data, graphical mapping, and overlaying of details and descriptions. Spatial enablement and interoperability of the core information layers enables hierarchical access and use (among other uses). Real-time, pin-point accuracy in land identification and measurement might be thought necessary; indeed demands for land information accuracy, comprehensiveness, completeness and accessibility through the hierarchy of Australian governments are frequently voiced. However, a land information policy cannot wait for national accuracy in information sets, including even the DCDB. Every nation begins transition from current to new systems despite having something less than the ideal to work with. The savings generated are then put into improvement of data. If it were otherwise, we would still be using pass-books for banking.

Public sector innovation in information policy is the key. Technical capacity in spatial information systems is however developing more quickly than governments are able to react. Given the time taken to design and install new systems, they are often out dated when initiated. This international problem is addressed by identification of forward strategies capable of directing take up of technology without constraining opportunities. The European Commission proposal (SEC (2004) 980) for a directive of the European
Figure 6. New information in modern LAS

Parliament and of the council establishing an infrastructure for spatial information in the Community (Infrastructure for Spatial InfoRmation in Europe (INSPIRE), or the European SDI, show how organisation of information can set the path for reform of both services and governance. The cross-jurisdictional European approach is generated by cooperation in establishing a broad framework for development of and access to spatial information, building on the already well established DCDBs. One of the major efforts was articulation of a set of first principles for the INSPIRE framework of spatial information that are worthy of consideration by Australian governments considering iLand as a possible strategy. After adaptation to suit Australian conditions, they are:

- Collect once and use many times
- Maintain at the level most appropriate
- Seamlessly combine spatial data from different sources across a study area and share it between different users and applications
- Collect spatial datasets at one level of government and share them among all other levels
- Ensure that spatial data essential for good governance are widely available and not restricted by excessive conditions, and
- Ensure that spatial data are available, that its fitness for purposes is stated and the conditions of its use are stated.
Without a land information policy aimed at capturing the emerging capacities of spatially enabled information, digitising processes in Australian LAS will continue the trend of converting poor systems into expensive, local, silo, digital systems reliant on technological adaptation to create some degree of utility where a national approach is demanded.

**Implementing the spatially enabled government vision - iLand**

While Australia is a world leader in SDI development, national integration of land administration and of land information is much more restrained. Indeed if it was not for some detectable arguments in favour of more uniform administration, Australian reform efforts would focus almost entirely on electronic conversions inherent in eLand and eConveyancing initiatives.

Emerging spatial information technologies involve a much deeper challenge to familiar patterns and practices of land administration. Convergence of land information and spatial information, and identification of authoritative registers in key administrative areas (land owners, cadastres, persons, businesses, cars, buildings) which all government and non-government sectors should use, are necessary. The spatial enablement of information in these authoritative registers is also essential.

Ideally, *iLand* as described in Figure 7 delivers integrated, spatially enabled land information available on the Web in which the DCDB is the central tool translating technical into accessible information. Implementation involves changes in both LAS and SDI so that the information generated is spatially enabled.

![Figure 7. The iLand vision](image-url)
Improvement in understanding of spatial information and what it can and might do required basic definitions and functionality to be restated constantly. A decade ago, misconceptions arose because GIS, GPS (Global Positioning system), LIS (Land Information System), RS (Remote Sensing) and AM (Automated Mapping) were interrelated and often mistaken for one another (Bishop et al., 2000). The technological framework is now much more sophisticated. However misconceptions are even more likely because understanding lags behind reality and claims for new technology are often unrealistic.

A cautious advance is therefore recommended, building on familiar strategies (Bishop et al., 2000) -

• Improved hierarchical sharing of land information, especially between the state and national levels
• Development of authentic (or authoritative) registers of information and their spatial enablement and methods of creation homogeneity of land information
• Much more emphasis on the arrangement of information to deliver inter-government capacity
• Building land management capacity using land administration processes, and
• Building on Australia’s capacity to create opportunities for government and the private sector in using spatial information in the ICT environment.

Spatial information as essential infrastructure.

Cost of and access to information are of particular concern. Microsoft’s virtual earth and Google Earth are demonstrators of the future. They rely on a preponderance of US material, reflecting the energetic use of land and spatial information by a private sector able to access government data for minimum cost (Joffe, 2005). The contrast with Canada, Australia and Europe is stark. Even a small country like New Zealand, where thinking about government support for business is much more open-minded, is able to make information available. In Australia, the lack of funds available for infrastructure maintenance, and policies of cost recovery imposed on agencies are holding back the spatial information industry. Where cadastral and land registry maintenance are separated (as in Victoria) and the land registry cash cow status does not feed the cadastral maintenance program, the cadastre is potentially compromised. The digital cadastre (or its equivalent) is the fundamental data set in a national SDI and a successful land market. In iLand the cadastre is even more significant: modern land administration demands a cadastral infrastructure as the fundamental layer of land information capable of supporting those relative information attributes so vital for land regulation and equitable taxation. Even a simple spatial enablement of land registry information by integrating G-NAF into its system would significantly improve its functionality.

iLand is similar to what in OGC territory is called the Spatial Web. The spatial component of land information is the universal need in all systems of information about land, whether they catalogue sheep dip sites or collect CGT. The advantages of these new computer tools are visualisation of information and interoperability presupposing a workable level of semantic consistency. Indeed, visualisation is the most popular output of spatial systems, though it is far from easy (Bruce and Kahn, 2005). iLand goes further by identifying location as the stable component of most government decisions and means of organisation of complex relative information. Governments can use the location to coordinate other information that, by its nature, changes constantly and rapidly. Information can be organised around the where component of government policies and day-to-day operations. And the where can be made understandable because computers turn X,Y and Z coordinate information into addresses and identifiable places. While technology is not yet at this comprehensive stage, it is clearly going there. Meanwhile, spatial systems are user attractive and improving quickly. Their basic facility allows information to be interrogated through viewable maps, with attribute layers available to highlight aspects of interest to the user, potentially including relative land information generated by modern governments.
CONCLUSIONS

The *iLand* vision is at the initial design phase; the reasons for developing it, its basic components, and its potential are identified. Construction and, possibly implementation, phases require high level government interest (Van der Molen and Welter, 2004), funding, national initiatives, and human and technical resources. Identification of government business requirements and how they can best be satisfied by web based spatially enabled information sharing systems on a national scale is required.

This next generation of interoperable networked architectures and capabilities in spatially enabled governments needs to be built with care. Land information is no longer generated just by land administration. A whole of government approach is needed to ensure that the spatial enablement of networked systems goes beyond the existing core businesses of LAS organisations.

How *iLand* is to be achieved through land administration information layers is of course much more open and is related to re-engineering LAS. The reform directions are sufficiently compelling and complicated as to benefit from a national forum, along the lines of the Australian Digital Cadastral Data Base Workshop of 1996 (Williamson and Fourie, 1998). The background assumptions summarised below are all worth critical evaluation by experts:

• Australia must use cooperation and persuasion among its three tiers of government and the private sector (particularly banks, developers and insurers) to inspire change.
• The location or place affected by government decisions and actions is the stable component of most significant activities. Location is potentially the new organising theme for government administration, not just land administration.
• A LAS is much slower to react to national and technological innovations and pressures. Despite this, changing needs are apparent.
• Land management requires seamless administration of land, land resources and marine environment, and now market based instruments. Water management issues must also be included.
• Land information is more complex than spatial information about visible land; topography, surface use, roads, lot numbers, buildings, aquifers, etc. The new kind of land information needed by modern government involves relatively true and ever-changing socio/legal constructs affecting owners, interests, rights, restrictions, risks and many other aspects. This relative information can be spatially enabled in modern applications, provided the parcel and property layer is well built.
• Management of restrictions on land and modern taxation demands solutions that are interoperable rather than multiple, stand-alone databases.
• The parcel layer, or DCDB, is much more significant than a map; it is the means of interrogation by the universe of users, and already underpins achievements in G-NAF and mesh blocks. In short, it connects the identified spaces with the ways we talk about them, as properties, addresses and places of interest.
• Two fundamental tools are required for the vision; the *cadastre as a DCDB* and *authentic registers*, in particular the land register. Both should be digital and spatially enabled, and permit interrogation through maps, presentation of information in map and spatial formats, and layering of information from other systems.
• Technological change by government requires cautionary and tested options. Standing well back from the cutting edge and waiting till standards and best practices solidify might save IT dollars, but acceleration of change in the technical fields requires deliberative decisions to off-set the tendency to build bad administrative solutions into digital systems.

At this stage the *how* path should therefore facilitate setting information policies, not defining their content or technical architecture. Broader sharing of property data and land information is essential. Property information is needed for tax assessment, social welfare systems, provision of infrastructure (publicly and privately built) and property management, in addition to the popularly recognised sustainable development
and emergency management. Meanwhile, information technology in land administration itself is in need of thorough going exploration as legacy systems set up decades ago confront the IT world of the future. Given modern computer capacities, government needs less computer power than before, but it must be cleverer (Carr, 2003). Vision, leadership, communication and organising ability are nothing without funding, clear minded views of concrete problems and actual solutions.

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