Global Challenges for Land Administration and Sustainable Development

Ian Williamson

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Working Paper

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Abstract

An important government activity of all nation states is building and maintaining a land administration system (LAS) with the primary objectives of delivering sustainable development, particularly by supporting an efficient and effective land market. This includes cadastral surveys to identify and subdivide land, land registry systems to support simple land trading (buying, selling, mortgaging and leasing land) and land information systems to facilitate access to the relevant information, increasingly through an Internet enabled *e-government* environment. For most countries a cadastre is at the core of the LAS providing spatial integrity and unique land parcel identification in support of security of tenure and effective land trading. For many cadastral and land administration officials and for much of society, these are the primary, and in many cases the only roles of the cadastre and LAS. However the role, and particularly the potential of LAS and their core cadastres, rapidly expanded over the last couple of decades and will continue to expand in the future.

But what is a land market in a modern economy? Since LAS were developed, land commodities and trading patterns have undergone substantial changes: they are now complex, corporatized and international. Are our current LAS designed to support a modern land market that trades in complex commodities, such as mortgage backed certificates, water rights, land information, time shares, unit and property trusts, resource rights, financial instruments, insurance products, options, carbon credits, salinity credits, corporate development instruments, and vertical villages? Modern land markets involve a complex and dynamic range of activities, processes and opportunities, and are impacted upon by a wide range of restrictions and responsibilities imposed on land especially since WW II. These restrictions are continually evolving, primarily in response to economic, energy and sustainable development objectives. These developments are made more complicated by changes in information and communications technologies.

One commodity in particular - land information - has the ability to transform the way both governments and the private sector in modern economies do business. The *e-land* administration concept as part of *e-government* initiatives is now being replaced by *iLand* – a new vision for spatially enabled land information. Land information, together with a jurisdiction's spatial data infrastructure (SDI), now has the potential to transform the way a modern society functions: how tax is collected, how heath services are delivered, how the environment and our cities are managed, how we respond to emergencies and terrorism, and how elections are run. Linked to these transformational technologies, such as Google Earth and Microsoft's Virtual Earth, or to location enabled platforms, land information has the potential for spatially enabling governments and societies in ways never imagined.

At the same time, the global challenge of sustainable development is causing its own problems and placing new demands on LAS, SDI and the resulting land information.

The challenge now rests with land administration administrators around the world to capitalize on the opportunities provided by LAS, new technologies, modern land markets, *iLand* and SDIs to better deliver sustainable development.

About the Author

PROFESSOR IAN PHILIP WILLIAMSON, AM, FTSE
Professor Williamson's research is concerned with spatially enabling government and society to support sustainable development. With his team at the Centre for Spatial Data Infrastructures and Land Administration, University of Melbourne, he researches the design, construction and management of land administration systems, spatial data infrastructures, land markets, and spatial information systems. His worldwide consultancies include work for the United Nations and the World Bank. He is a Member of the Order of Australia (AM); a Fellow of the Academy of Technological Sciences and Engineering Australia (FTSE), the Institution of Surveyors Australia Inc., the Institution of Engineers Australia, and the Royal Institution of Chartered Surveyors; an Honorary Member of the International Federation of Surveyors (FIG); and Chair, Working Group 3 (Spatially Enabled Government), the UN sponsored Permanent Committee on GIS Infrastructures for Asia and the Pacific. He was awarded the Centenary Medal in 2003 by the Prime Minister for service to Australian society in geomatics engineering and surveying.

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Table of Contents

Global Challenges for Land Administration and Sustainable Development

Introduction

Land surveyors, lawyers and land administrators are experts in designing, building and managing our land administration systems (LAS). They are experienced in creating, describing and defining land parcels and associated rights. Historically, society required these skills to support an efficient and effective land market in which these rights in land are traded to promote economic development. By the mid nineteenth century, trading involved buying, selling, mortgaging and leasing of rights in land. By the mid twentieth century, land administration and cadastral officials, and associated legal and surveying professionals, assumed that they understood land markets, and that they had developed appropriate professional skills to serve the needs of those markets.

Surveyors who worked from 'whole to part' designed the tools to support land markets - the LAS, cadastres, and supporting technical and administrative skills. Unfortunately these tools were involved in supporting the land trading activities. Designing a land market, of itself, is another question. From the point of view of land administrators, there is little documentation in the literature on how to design and build a land market or even on the development and growth of land markets (however, see Wallace and Williamson 2006a).

Historically, existing land administration (LA) skills are appropriate for simple land markets which focus on traditional land development and simple land trading. Meanwhile, land markets have evolved dramatically in the last 50 years and are now very complex, with the major wealth creation mechanisms focused on the trading of complex commodities. While the potential expansion of our LAS to support the trading of complex commodities offers many opportunities for LA administrators, one particular commodity - land information - has the potential to significantly change the way societies operate, and how governments and the private sector do business.

The growth of markets in complex commodities is a logical evolution of our people to land relationships, and our evolving cadastral and LAS. The changing people to land relationships, the need to pursue sustainable development and the increasing need to administer complex commodities within an ICT (information and communications technologies) enabled virtual world, offer new opportunities for our land administration systems. However many challenges need to be overcome before these opportunities can be achieved.

Research aimed at understanding and meeting these challenges is undertaken within the Centre for Spatial Data Infrastructures and Land Administration, Department of Geomatics, University of Melbourne (http://www.geom.unimelb.edu.au/research/SDI_research/). The over arching focus of the Centre's research projects is spatially enabling government in support of sustainable development. The Centre identified a potential for land information that goes far beyond the land administration endeavour. This potential is called spatially enabling government. One key to achieving this capacity involves using land information in entirely new ways, gathering momentum of technological changes and returning that momentum back to invigorate land administration functions.

This new vision for managing land information to spatially enable governments is called *iLand*. The components of the *iLand* vision include:

- a collaborative whole of government approach to managing spatial information using spatial data infrastructure (SDI) principles,
- better understanding of the role that the LAS plays in integrated land management (land markets, land use planning, land taxation etc),
- seamless integration of built and environmental spatial data in order to deliver sustainable development objectives,
- improved interoperability between our land information silos through *e-land* administration,
- more flexible technology and models to support cadastres, especially to introduce a third dimension of height, and a forth dimension of time,
- a national geo-coded street address file linked to the cadastre,
- better management of the complex issues in our expanding multi-unit developments and vertical villages,
- better management of the ever increasing restrictions and responsibilities relating to land,
- incorporation of a marine dimension into both our cadastres and (land) administration systems.

The fundamental idea is to rebuild LAS to support emerging needs of government, business and society to deliver more integrated and effective information, and to use this information throughout government and non-government processes by organizing technical systems in the virtual environment around place or location.

To understand these descriptions of a possible invigorated LAS future, it is useful to trace how land administration met the challenges of economic development and social change in the past.

Land Administration Systems

An understanding of the components of LAS and their evolution can help predict how they will develop.

The Importance of the Cadastre

Digital information about land is central to the policy framework of modern land administration and sustainability accounting (Williamson et al. 2006a). The cadastre, or the large scale, land parcel map related to parcel indices, is the vital information layer of an integrated land management system, and, in future, will underpin information systems of modern governments.

While some developed countries do without a formal "cadastre", most generate digital parcel maps (or digital cadastral data base or DCDB) reflecting land allocation patterns, uses and subdivision patterns, and even addresses and photographs. A country's DCDB is its core information layer. It 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 of taxation, and, more recently, titling of land. 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 significant value out of land.

The greatest potential of the DCDB lies with the information industry at large, as the principal means of translating geographic coordinates and spatial descriptors of land parcels into meaningful descriptions of places that everybody can understand. Land parcels describe the way people physically use and think about their land. The familiar configuration of parcel based descriptions in the DCDB ensures people-friendly identification of precise locations of impact of private ownership and, more vitally, of government, business and community policies, regulations and actions. In cadastres supported by professional surveyors, the descriptions have the added advantage of being legally authoritative.

While having a cadastre is not mandatory for a LAS, all modern economies recognize its importance, and either incorporate a cadastre or its key components in their LAS. For example, Australian LAS did not evolve from a traditional cadastral focus as did their European counterparts, but their cadastres are equal to, and sometimes improve upon, the classic European approach.

The cadastral concept shown in Figure 1 (FIG 1995) is simple and clearly shows the textual and spatial components, which are the focus of land surveyors, land registry and cadastral officials. The cadastre provides a spatial integrity and unique identification for land parcels within a LAS. However, while the cadastral concept is simple, implementation is difficult and complex, especially when linked to a national geo-coded street address database. After ten years, the model remains a useful depiction of a cadastre. However, it needs to be extended to incorporate the evolving and complex rights, restrictions and responsibilities operating in a modern society concerned to deliver sustainable development. It also does not show the important roles for the cadastre in supporting integrated land management, or in providing critically important land information to enable the creation of a virtual environment, the more practical level, e-government, and eventually a spatially enabled government. However, other initiatives of the International Federation of Surveyors (FIG) do highlight the changing roles of the cadastre, such as CADASTRE 2014 (FIG 1998) and the Bathurst Declaration on Land Administration for Sustainable Development (FIG 1999).

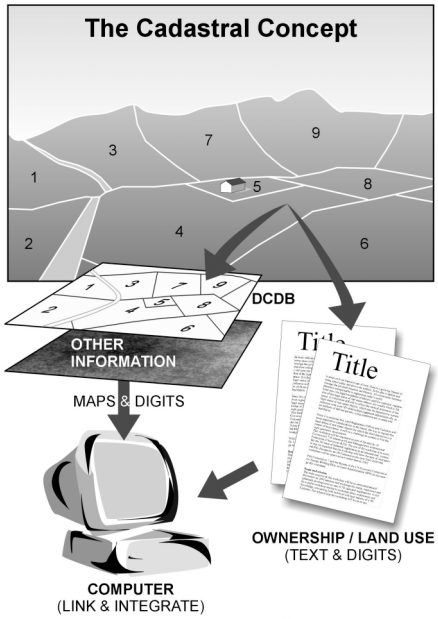

Figure 1
The Cadastral Concept
(FIG 1995)

The Evolution of Land Administration Systems

The evolution of LAS is influenced by the changing people to land relationship over the centuries. Even though Figure 2 depicts a Western example of this evolving relationship, a similar evolution can be plotted for most societies. This diagram highlights the evolution of feudal tenures to individual ownership, the growth of land markets driven by the Industrial Revolution, the impact of a greater consciousness about managing land by formal land use planning, and, in recent times, the environmental and social dimensions of land (Ting et al.

1999). Historically, an economic paradigm drove land markets; however this has now been significantly tempered by environmental, and more recently, by social paradigms. Simply, the people to land relationships in any society are not stable, but are continually evolving.

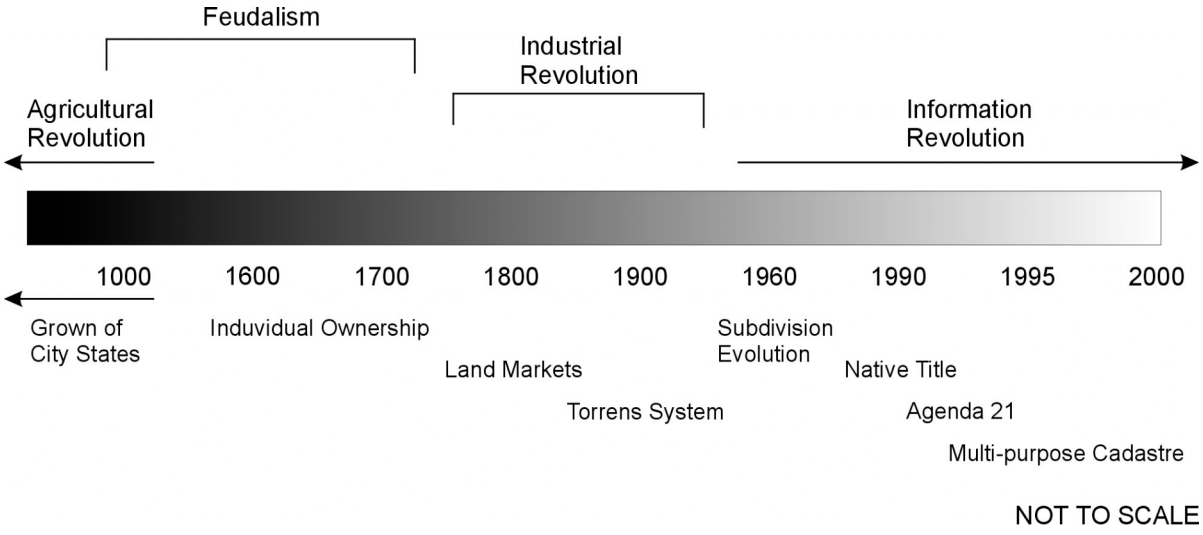

Figure 2 Evolution of people to land relationships
(Ting et al. 1999)

In turn, Western nations developed land administration or cadastral responses to evolutionary changes in people to land relationships over the last 300 years, shown in Figure 3. The original focus on land taxation expanded to support land markets, then land use planning, and, over the last decade or so, to provide a multi-purpose role supporting sustainable development objectives (Ting and Williamson 1999).

Even within this evolution, LAS must continue to service the 19th century economic paradigm by defining simple land commodities and supporting simple trading patterns (buying, selling, leasing and mortgaging), particularly by providing a remarkably secure parcel titling system, an easy and relatively cheap land transfer system, and reliable parcel definition through attainable surveying standards (World Bank 2004 and 2005).

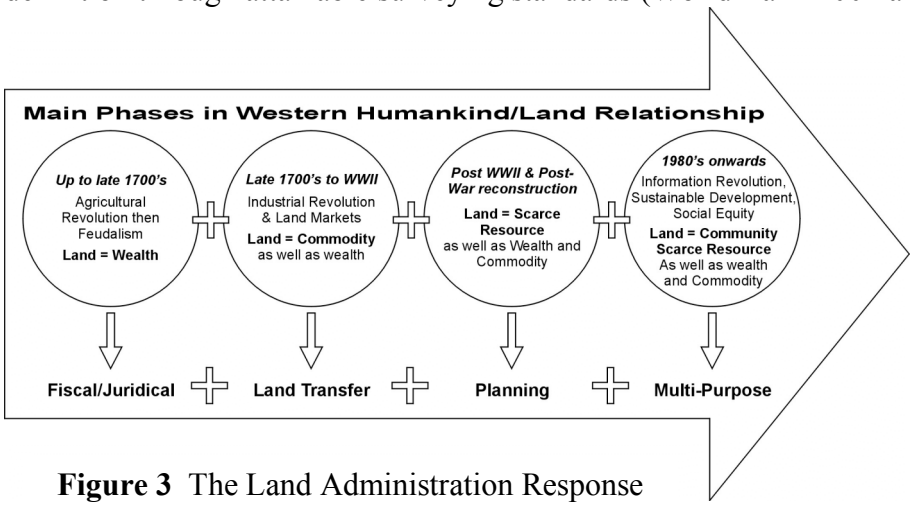

Figure 3 The Land Administration Response
(Ting and Williamson 1999)

Arguably, Australia was a world leader in adapting its LASs to support land parcel marketing. Major innovations of the Torrens system of land registration and strata titles are copied in many other countries. However, because of the pace of change, the capacity of LAS to meet market needs diminished. The land market of, say, 1940, is unrecognizable in today's modern market. After WW II, new trading opportunities and new products were invented. Vertical villages, time shares, mortgage backed certificates used in the secondary mortgage market, insurance based products (including deposit bonds), land information, property and unit trusts, and many more commodities now offer investment and participation opportunities to millions, either directly or through investment or superannuation schemes, trusts and property investment vehicles. Meanwhile, the controls and restrictions over land became multi-purpose, and aimed at ensuring safety standards, durable building structures, adequate service provision, business standards, social and land use planning, and sustainable development. The replication of land related systems in resource and water contexts is demanding new flexibilities in our approaches to land administration (Wallace and Williamson 2006a).

Also in Australia, the combination of new management styles, computerization of activities, creation of data bases containing a wealth of land information, and improved interoperability of valuation, planning, address, spatial and registration information allowed much more flexibility. However, Australian LAS remain creatures of their historical state and territory formation. They do not service national level trading, and are especially inept in servicing the trading of new commodities that Australians continue to invent as they "unbundle" land. Moreover, modern societies, which are responding to the needs of sustainable development, are now required to administer a complex system of overlapping rights, restrictions and responsibilities relating to land – existing land administration and cadastral systems do not service this need. A diagrammatic representation of the development of land administration (and cadastral) systems from a policy focus is shown in Figure 4.

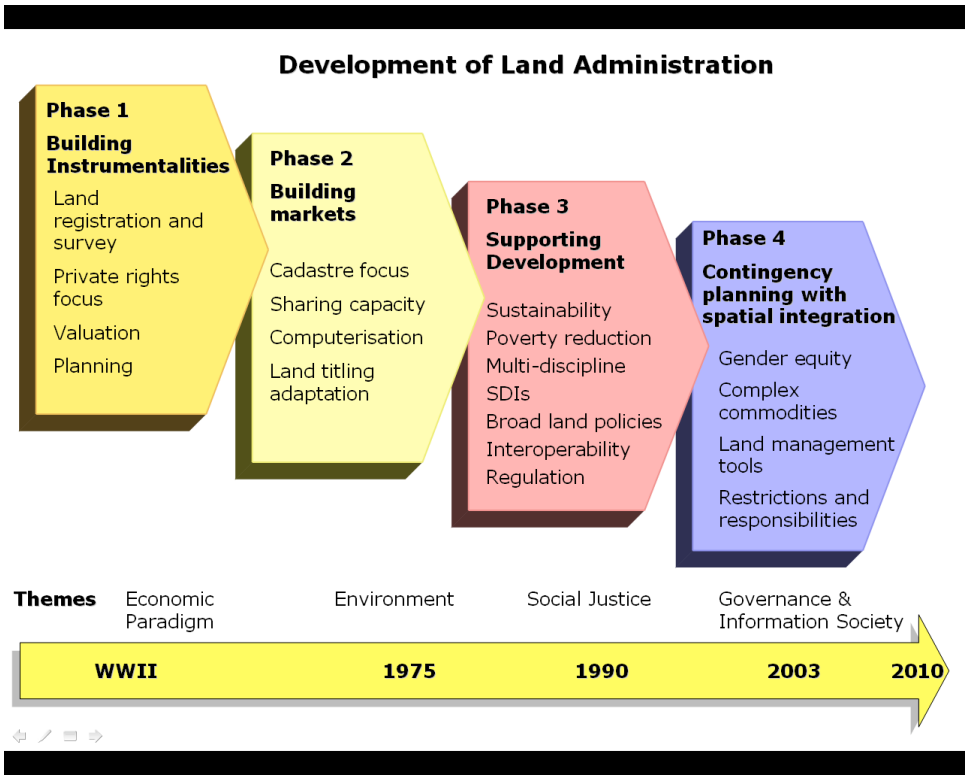

Figure 4 – Development of land administration (after Wallace and Williamson 2005)

The Formalization of Tenures

The situation is just as complex at the other end of the economic spectrum when land use of traditionally organised societies needs to be reflected in a LAS. Modern societies are also now realizing that many rights, restrictions and responsibilities relating to land exist without formalization by governments for various policy or political reasons. This does not mean these rights, restrictions and responsibilities do not exist, but that they have not been formalized in recognizable land administration or equivalent frameworks. A good example is the recognition of indigenous aboriginal rights in land in Australia in the 1980s. Prior to the Mabo and Wik High Court decisions and the resulting legislation in Australia, indigenous rights did not formally exist. Their existence was informal but strongly evidenced by song lines, cultural norms and other indigenous systems, a situation still familiar in the developing world where indigenous titles await more formal construction.

The process of formalizing tenure and rights, restrictions and responsibilities in land is depicted in Figure 5 (Dalrymple et al. 2004). An understanding of both formal and informal rights is important as we move to develop land administration and cadastral systems that are sensitive to sustainable development objectives. Change management processes and adaptation of formal systems always lag behind reality: all mature systems will simultaneously sustain both informal and highly formalized rights while they adjust to absorb emerging interests. Frequently, some rights will be deliberately held in informal systems: one of the largest and most significant commercial management tools in Australia, the trust, remains beyond the land administration infrastructure and relies on formalities generated by client-based practices of lawyers and accountants, held in their filing drawers.

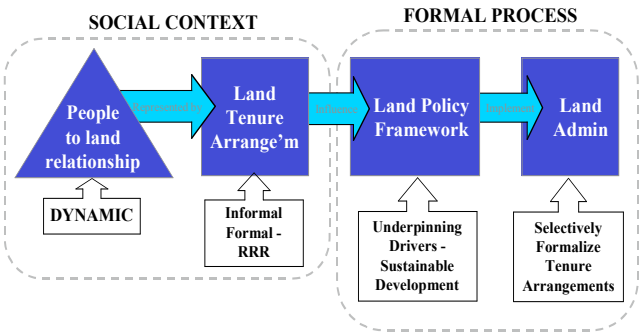

Figure 5 Formalization of tenures (Dalrymple et al. 2004)

Other rights involve minimal formalization for different reasons. Residential leases, too common and too short term to warrant much administrative action, are traditionally organized outside LAS. These rent-based distribution systems nevertheless remain potentially within the purview of modern LAS, policy makers and administrators, as illustrated by Australia's development of a geo-referenced national address file (GNAF). Indeed the development of spatial, as distinct from survey, information provides the timeliest reminder that information about land is potentially one of the most remarkable commodities in the modern land market. Certainly this commodity of information is of core interest to LA administrators. An example of this power is that by inserting any Australian street address into Google Maps displays the up to date cadastral parcel layer.

Implementing and Understanding Regulations and Restrictions

While many rights, restrictions and responsibilities in land are not formalized, many are established by statute or regulation but are not recorded in land registries, or any other form of register. Land uses over time must be managed to mitigate long term deleterious impacts and support sustainable development. As an example, Australian problems of erosion,

salinity and acidity are well documented. Over time, attempts to manage these shared impacts by regulating tree clearance, water access, soil removal, chemical use, building standards, and more, led to great increases in the number of laws, regulations and standards applying to land based activities. The lack of coherent management of restrictions and the information they generate is now apparent. The problem of increasing complexity of social and environmental restrictions over land is now straining our systems, and in some cases failing. For example, the State of Victoria, Australia now implements over 600 pieces of legislation that relate to land, and the national Australian Government implements a similar number. Most of these are administered outside our land administration systems. Similar experiences occur world wide. Calls for inclusion of restrictions on land in traditionally organised LAS are therefore common and international. The idea of including "all restrictions in the land register" was a first-grab solution that is now recognized as impractical. Society needs more transparent and consistent approaches to dealing with these restrictions and the information they generate. While modern registries are adapting to manage those restrictions compatible with their traditional functions, spatial enablement of governments and businesses offer different solutions in the context of *iLand.* (Bennett et al. 2005 and 2006)

The Changing Nature of Ownership

The rapid growth of restrictions on land in modern societies is paralleled by a change in the nature of land ownership. Nations are building genuine partnerships between communities and land owners, so that environmental and business controls are more mutual endeavors. Rather than approach controls as restrictions, the nature of ownership is redesigned to define opportunities of owners within a framework of responsible land uses for delivery of environmental and other gains. This stewardship concept is familiar to Europeans long used to the historical, social and environmental importance of land. For the Europeans, the social responsibilities of land owners have a much longer heritage, with the exemplar provision in the German Constitution insisting on the land owner's social role. The nature of land use in The Netherlands, given much of the land mass is below sea level, presupposes high levels of community cooperation, and integrates land ownership responsibilities into the broader common good. The long history of rural villages in Denmark and public support for the Danes who live in rural areas also encourages collaboration (Williamson et al. 2006b).

The Australian mining industry provides typical examples of collaborative engagement of local people, aboriginal owners and the broader public. The Australian National Water Initiative and the National Land and Water Resources Audit reinforce the realization that activities of one land owner affect others. The development of market based instruments (MBI), such as EcoTenders and BushTenders, is an Australian attempt to build environmental consequences into land management. Australia's initiatives in "unbundling" of land to create separate, tradable commodities, including water titles, are now built into existing LAS as far as possible. The processes, however, are far from integrated. As yet a comprehensive analysis of the impact of unbundling land interests on property theory and comprehensive land management is not available.

Whatever the mechanism, modern land ownership has taken on social and environmental consequences, at odds with the idea of an absolute property owner. Australia and European approaches to land management are inherently different. While Europe is generally approaching land management as a comprehensive and holistic challenge requiring strong government information and administration systems, Australia is creating layers of separate

commodities out of land and adapting existing LAS as much as possible to accommodate this trading, without an overarching national administrative approach. In these varying national contexts, the one commonality, the need for land information to drive land management in support of sustainable development, will remain the universal land administration driver of the future (Williamson et al. 2006b).

Land Markets

The land market of 1940 is unrecognisable in today's modern market (Figure 6). Modern land markets evolved from systems for simple land trading to trading complex commodities. New trading opportunities and new products were, and continue to be, invented. The controls and restrictions over land became multi-purpose with an increasing focus on achieving sustainable development objectives.

As with simple commodities such as land parcels, all commodities require quantification and precise definition (de Soto 2000). While LAS have not yet incorporated the administration of complex commodities to a significant degree, these modern complex land markets offer many opportunities for LA administrators and associated professionals, if they are prepared to think laterally and capitalize on their traditional measurement, legal, technical and land management skills.

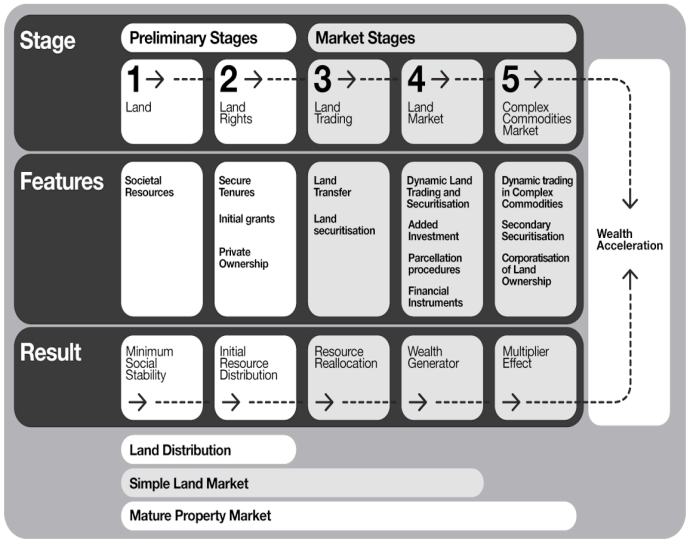

Figure 6 Evolution of land markets (Wallace and Williamson 2006a)

This complexity is compounded by the "unbundling of rights in land" (ie water, carbon credits, salinity credits, biota etc), thereby adding to the range of complex commodities available for trading. For example, the replication of land related systems in resource and water contexts is demanding new flexibilities in our approaches to land administration (Wallace and Williamson 2006a). These emerging demands will stimulate different approaches to using cadastral information.

Our understanding of the evolution of land markets is limited, but it must be developed if LA administrators are going to maximize the potential of trading in complex commodities by developing appropriate land administration systems (Wallace and Williamson 2006a). Figure 6 shows the various stages in the evolution of land markets from simple land trading to markets in complex commodities. The growth of a complex commodities market showing examples of complex commodities is presented diagrammatically in Figure 7.

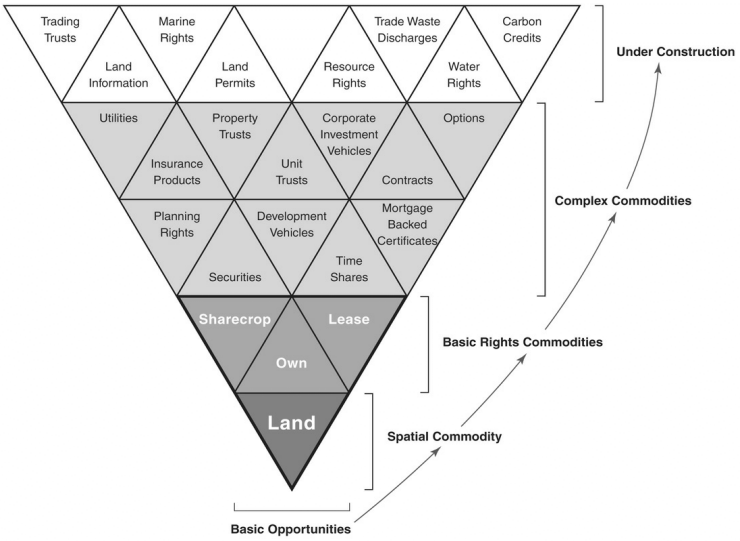

Figure 7 Complex commodities markets
(Wallace and Williamson 2006a)

The Importance of Spatial Data Infrastructures

All LAS require some form of spatial data infrastructure (SDI) to provide the spatial integrity for rights, restrictions and responsibilities relating to land, and the resulting land information. However, the concept of an SDI continues to evolve. In simple terms, it is as an enabling platform linking data producers, providers and value adders to data users. SDIs are crucial tools to facilitate use of spatial data and spatial information systems. They allow data sharing, and enable users to save resources, time and effort when acquiring new datasets. Many nations and jurisdictions are investing in development of these platforms and infrastructures to enable their stakeholders to adopt compatible approaches to creation of distributed virtual systems. Two drivers are evident: the need to organise information to better support decision-making; and elimination of expensive duplication. The success of these systems depends on collaboration between all parties and their design to support efficient access, retrieval and delivery of spatial information.

The steps to develop an SDI model vary, depending on a country's background and needs. However, it is important that countries develop and follow a roadmap for SDI implementation. Aspects identified in the roadmap include the development of an SDI vision, the required improvements in national capacity, the integration of different spatial datasets, the establishment of partnerships, and the financial support for an SDI. A vision within the SDI initiative is essential for sectors involved within an SDI project and for the general public. The SDI vision helps people to understand the government's objectives and work towards them. Unfortunately many land administrators under-estimate the importance of SDIs in building efficient and effective LAS. They focus on the immediate administrative needs and tasks to provide security of tenure and the support for simple land trading, a narrow focus that restricts the ability of LAS organizations to contribute to the whole of government and wider society through spatial enablement.

SDI as an Enabling Platform

Effective use of spatial information requires the optimization of SDIs to support spatial information system design and applications, and subsequent business uses. Initially SDIs

were implemented as a mechanism to facilitate access and sharing of spatial data hosted in distributed GISs. Users, however, now require precise spatial information in real time about real world objects, and the ability to develop and implement cross-jurisdictional and inter-agency solutions to meet priorities, such as emergency management, natural resource management, water rights trading, and animal, pest and disease controls.

To achieve this, the concept of an SDI is moving to a new business model, in which the SDI promotes partnerships of spatial information organisations (public/private), allowing access to a wider scope of data and services, of greater size and complexity than they could individually provide. SDI as an enabling platform can be viewed as an infrastructure linking people to data (Rajabifard et al. 2006) through linking data users and providers on the basis of the common goal of data sharing (Figure 8). However, there is a need to move beyond a simple understanding of SDI, and to create a common rail gauge to support initiatives aimed at solving cross-jurisdictional and national issues. This SDI will be the main gateway through which to discover, access and communicate spatially enabled data and information about the jurisdiction.

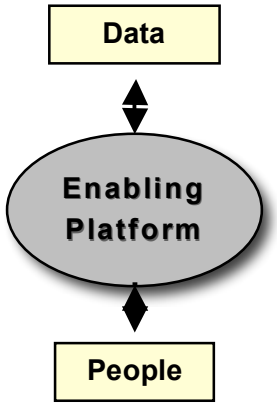

Figure 8: SDI connecting people to data

According to Masser et al. (2006), the development of SDIs over the last 15 years, and the vision of spatially enabled government, have many parallels, but there are also important differences. The challenge is to develop an effective SDI that will support the vast majority of society, who are not spatially aware, in a transparent manner. All types of participating organisations (including governments, industries, and academic) can thus gain access to a wider share of the information market. This is done by organisations providing access to their own spatial data and services, and in return, becoming contributors, and hence gaining access to the next generation of different and more complex services. The vision is to facilitate the integration of existing government spatial data initiatives for access and delivery of data and information. This environment will be more than just the representation of feature based structures of the world. It will also include the administration and institutional aspects of these features, enabling both technical and institutional aspects to be incorporated into decision-making. Following this direction, in Australia, for example, researchers have defined an enabling platform called Virtual Australia (Rajabifard et al. 2006). The concept and delivery of Virtual Australia aims to enable government and other users from all industries and information sectors to access both spatial information (generally held by governments) and applications which utilize spatial information (developed by the private sector and governments).

SDI and Sustainable Development

While SDIs play an essential role in supporting LAS, they also have a wider role in supporting sustainable development objectives. Achievement of sustainable development is not possible without a comprehensive understanding of the changing natural environment, and monitoring the impact of human activities by integrating the virtual representations of the built and natural environments. Despite the significance of data integration however, many jurisdictions fragment institutional arrangements and data custodianship in the built and natural information areas. For example, the land administration, cadastral or land titles

office (which has a key role in providing built environment, people-relevant, data) is often separated from state or national mapping organizations responsible for managing the natural environment data. Fragmentation among data custodians produces diverse approaches to data acquisition, data models, maintenance and sharing. Many countries attempt to address these inconsistencies through development of national SDIs. However, a framework and associated tools to facilitate integration of multi-sourced data are also needed. (Mohammadi et al. 2006) An SDI can provide the institutional, administrative, and technical basis to ensure the national consistency of content to meet user needs in the context of sustainable development.

The Potential of Land Administration Systems

This brief review of the evolution of cadastres, LAS, SDIs, and land markets shows that the traditional concept of cadastral parcels representing the built environmental landscape is being replaced by a complex arrangement of over-lapping tenures reflecting a wide range of rights, restrictions and responsibilities, and that a new range of complex commodities, building on this trend is emerging. To a large extent these developments are driven by the desire of societies to better meet sustainable development objectives. There is no reason to believe that these trends will not continue as all societies better appreciate the needs to manage the environment for future generations and to deliver stable tenure and equity in land distribution.

While the growth of complex commodities offers huge potential for cadastral systems to play a greater role in delivering sustainable development objectives, and supporting the trading of these complex commodities in particular, one complex commodity, land information, is capable of transforming the way government and the private sector do business. The potential offered by land information in a virtual world in spatially enabling government is so large, it is difficult to contemplate. We are starting to glimpse this potential in initiatives such as Google Earth and Microsoft's Virtual Earth as previously mentioned, but this is barely a start. These predictions of the importance of spatial information are also recognized in many influential forums including in the prestigious journal NATURE, and recently in the Australian Prime Minister's statement on frontier technologies for building and transforming Australia's industries (December, 2002). Both these examples place the growth and importance of the geosciences alongside nanotechnology and biotechnology as transformational technologies in the decade ahead.

The significance of land administration and its cadastral core is shown in Figure 9 (Williamson and Wallace 2006c) which shows the transformation of land administration and cadastral systems over the last three decades. The figure shows five stages in the evolution of our cadastral systems from a technology perspective. The first stage recognizes that historically cadastral systems were manually operated with all maps and indexes in hard copy. At this stage, the cadastre focused on security of tenure and simple land trading. The 1980s saw the computerization of these cadastral records with the creation of digital cadastral data bases (DCDBs) and computerized indexes. While this computerization did not change the role of the land registry or cadastre, it was a catalyst felt world wide, initiating institutional change to start bringing the traditionally separate functions of surveying and mapping, cadastre and land registration together.

Figure 9 - Technical evolution of land administration

With the growth of the Internet, the 1990s saw governments start to web enable their land administration systems as they became more service oriented. As a result, access over the Internet to cadastral maps and data was possible. This facilitated digital lodgment of cadastral data and opened up the era of e-conveyancing. However, the focus on security of tenure and simple land trading within separate institutional data silos still continued. At the same time, this era also saw the establishment of the SDI concept (Williamson et al. 2003; Rajabifard et al. 2005). The SDI concept, together with web enablement, stimulated the integration of different data sets (and particularly the natural and built environmental data sets) with these integrated data sets now considered critical infrastructure for any nation state.

Now a significant refinement of web enabled LAS aims to achieve interoperability between disparate data sets, facilitated by the partnership business model. This marks the start of an era where basic land, property and cadastral information can form an integrating technology between many different businesses in government, such as planning, taxation, land development and local government. An example is the new Shared Land Information Platform (SLIP) being developed by the state Government of Western Australia (Searle and Britton 2005). A key catalyst for interoperability is also the development of high integrity geocoded national street address files, notably the Australian GNAF (Paull and Marwick 2005). Similarly, "mesh blocks", small aggregations of land parcels, are revolutionizing the way census and demographic data is collected, managed and used (Toole and Blanchfield 2005). These refinements potentially extend to better management of the complex arrangement of rights, restrictions and responsibilities relating to land that are essential to achieving sustainable development objectives (Bennett et al. 2005). They also stimulate re-engineering of cadastral data models to facilitate interoperability between the cadastre, land use planning and land taxation for example (Kalantari et al. 2005).

The Potential of Land Information - *iLand*

The next chapter of the story requires practitioners, big business and government to see the potential from linking "location" or the "where" to most activities, polices and strategies, just over the horizon. Companies like Google are actively negotiating to gain access to the world's large scale built and natural environmental data bases. In Australia, they have negotiated access to the national cadastral and property maps as well as to GNAF. At the same time, new technologies are being built on top of these enabling infrastructures, such as the Spatial Smart Tag which is a joint initiative in Australia between government, the private sector and Microsoft (McKenzie 2005). We are starting to realize that cadastral and land related information will dramatically spatially enable both government and the private sectors, and society in general. In the near future, spatially enabled systems will underpin health delivery, all forms of taxation, counter-terrorism, environmental management, most business processes, elections and emergency response, for example.

All these initiatives come together to support a new vision for managing land information - *iLand* (Williamson et al. 2006). The focus on realizing the potential of land and cadastral information will transform it into an enabling technology or infrastructure capable of delivering value to government that far outweighs its value as a support for simple land trading and security of tenure. Cadastres will not stop at the water's edge; they will include a marine dimension where there is a continuum between the land and marine environments. Without this basic infrastructure the management of the exceptionally sensitive coastal zone is very difficult, if not impossible (Strain et al. 2006; Wallace and Williamson 2006b).

In the future, cadastral data will be seen as information and a new concept called *iLand* will become the paradigm for the next decade. *iLand* is a vision of integrated, spatially enabled, land information available on the Internet. *iLand* enables the "where" in government policies and information. The vision as shown diagrammatically in Figure 10 is based on the engineering paradigm where hard questions receive "design, construct, implement and manage" solutions. The LAS and cadastre is even more significant in *iLand*. Modern land administration demands LA infrastructure as fundamental if land information is to be capable of supporting those "relative" information attributes about people, interests, prices, and transactions, so vital for land registries and taxation.

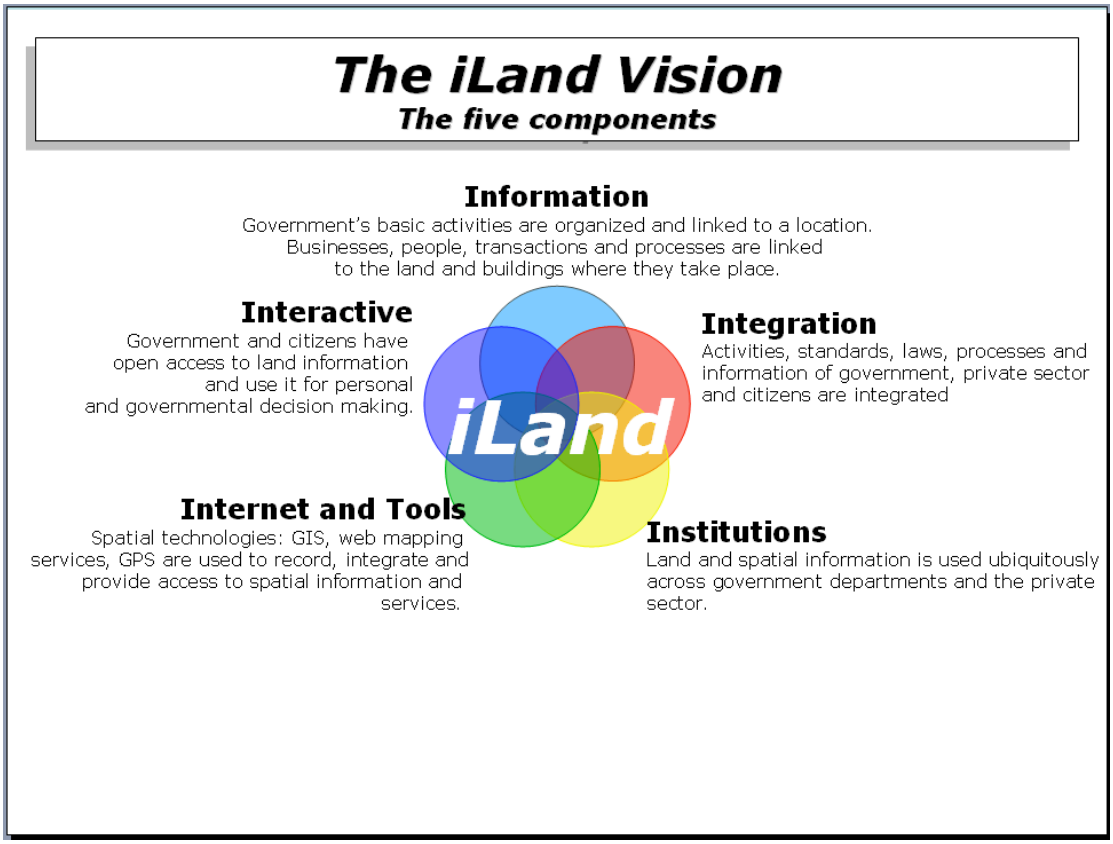

Figure 10 – The *iLand* Vision (Williamson and Wallace 2006)

The Role of Land Administration in Spatially Enabling Government

Most governments already have considerable infrastructure and administrative systems for better management of land and resources. Basic information creating processes are cadastral surveying that identifies land; its supporting digital cadastral database (DCDB) that provides the spatial integrity and unique land parcel identification; registering land that supports

simple land trading (buying, selling, mortgaging and leasing land); running land information systems (LIS) for land development, valuation and land use planning; and geographic information systems (GIS) that provide mapping and resource information. For modern governments at all stages of development, one question is how best to integrate these processes, especially to offer them in an Internet enabled *eGovernment* environment.

Twenty years ago, each process and collection of information was distinct and separate. Two changes in the world at large challenged this silo approach. First, thanks to improvements in technology, the infrastructure available to support modern land and resource management now spans three distinct environments: the natural, the built and the virtual environments. Second, the pressures on managers created by increased populations, environmental degradation, water scarcity and climate change, require governments to have more accurate and comprehensive information than ever before.

How governments treat their land information will define their transformation of internal and external processes. The *e-Land* administration concept as part of *eGovernment* initiatives is now moving to a wider use of spatially enabled land information, expressed in the concept of *iLand* - integrated, interactive spatial information available on the Internet. The conversion of processes to spatially enabled systems will increase useability, access and visualisation of information.

Governments can be regarded as spatially enabled when they treat location and spatial information as common goods made available to citizens and businesses to encourage creativity and product development, and use ”place” or location as a means of organizing their information, and even their activities. The vision of a spatially enabled government involves establishing an enabling infrastructure to facilitate this use of place or location to organise information about activities of people and businesses, and about government actions, decisions and polices. Central to spatial enablement as a process is spatial enablement of information in LAS. Given the potential of new technologies, once the infrastructure is built, use of place or location will facilitate the evaluation and analysis of both spatial and non-spatial relationships between people, business transactions and government. (Williamson and Wallace 2006)

An infrastructure capable of supporting spatial enablement of governments and societies includes technical, institutional, legal, social, and knowledge transfer issues. All of these need to be identified. In Australia and other countries at similar levels of development, given current technologies, the path to spatial enablement could involve the steps identified in Table 1 below.

For other countries with different institutions, laws, and information technologies, the appropriate steps will be different. Whatever the steps in a nation’s path, the need to improve availability of information to inform policy decisions remains universal.

10 Tools to spatially enable Australian governments for sustainable development		
No.	**Tool**	**Description**
1	***Use of spatial information***	Major departments and agencies use maps and visualisations to present information and permit interactive interrogation. Australia already has significant expertise.
2	***Spatial information availability policy***	Spatial information is available as a common good on free or low cost basis, encouraging innovation throughout government, private sector and community users.
3	***Cadastre as the fundamental layer of information***	The cadastre is the primary source of technical, accurate, large scale, digital information about how land is used. It must be converted into an **authoritative register** of spatial land information (Wallace, EGM paper).
4	***Easily understood mechanism for using spatial enablement throughout agencies***	Spatially enabled land information from the cadastre, land and resource registries, land planning and valuation, flows through to tax offices, emergency services, health services, census offices, service utilities and so on, by consistent geo-coding or other means, for example, Australia's geo-coded national address file (GNAF), Netherlands Kadaster compliance with XML-compatible data for a multi-national system, in International Spatial Infrastructure project (INSPIRE) of EU.
5	***A national and widely implemented land information policy: iLand***	Whole of government land information policy aims to ensure that basic land information, especially the cadastre, is both spatially enabled and authoritative.
6	***Interoperability of spatial information - Australian SDI***	A National SDI provides the web-enabling platform, and solutions to interoperability of information about natural and built environments, and coordination of terrestrial, coastal and marine information.
7	***Interoperability of all government information and services***	All government information becomes interoperable, initially via geo-coding and related IT systems, (not just geo-coded land information as at 2006), in sufficiently flexible arrays to take advantage of technical and institutional innovations.
8	***Service delivery through eGovernment***	Government services, not merely information, are provided through spatially enabled, web enabled or portable instrument enabled, and interactive, systems.
9	***Use of "place" to organise information, services and activities***	Government organizes information and activities around unique geocodes, and other spatial information relating to places and locations, in addition to, or in place of, unique business file numbers, identification numbers, dates and so on, that now populate standard relational databases and object recognition systems in object oriented architectures, merging into service oriented architectures. This involves reorganisation of government activities, from local, state and national levels and introduction of new legal, technical and organisational frameworks. New business models are invented.
10	***Monitoring and evaluation***	Continuous reappraisal of processes against policies.

Table 1 – Ten tools to spatially enable governments for sustainable development

These developments and drivers will introduce complexity into the design of LAS as they adapt to assist delivery of a broader range of public policy and economic goals, the most important of which is sustainable development. Re-engineering LAS to support sustainable development objects is a major change in direction for traditional LAS and is a significant challenge (Enemark et al. 2005).

These global trends to move LAS down this path, and the national and historical methods used to incorporate sustainable development objectives into national LAS were examined in an Expert Group Meeting (EGM) in Melbourne in December, 2005 with leading stakeholders and land policy experts from Australia and Europe (Williamson et al. 2006a). Distinctions between approaches used in modern European democracies and in Australia were identified. The European approach showed more integration between the standard LAS activities and measures of sustainability. Australian policy was more fractured, partly due to federation and the constitutional distribution of powers. In contrast, Australian LAS pioneering lay in incorporating market based instruments (MBI) and complex commodities into LAS, and revitalization of land information through inventive Web based initiatives.

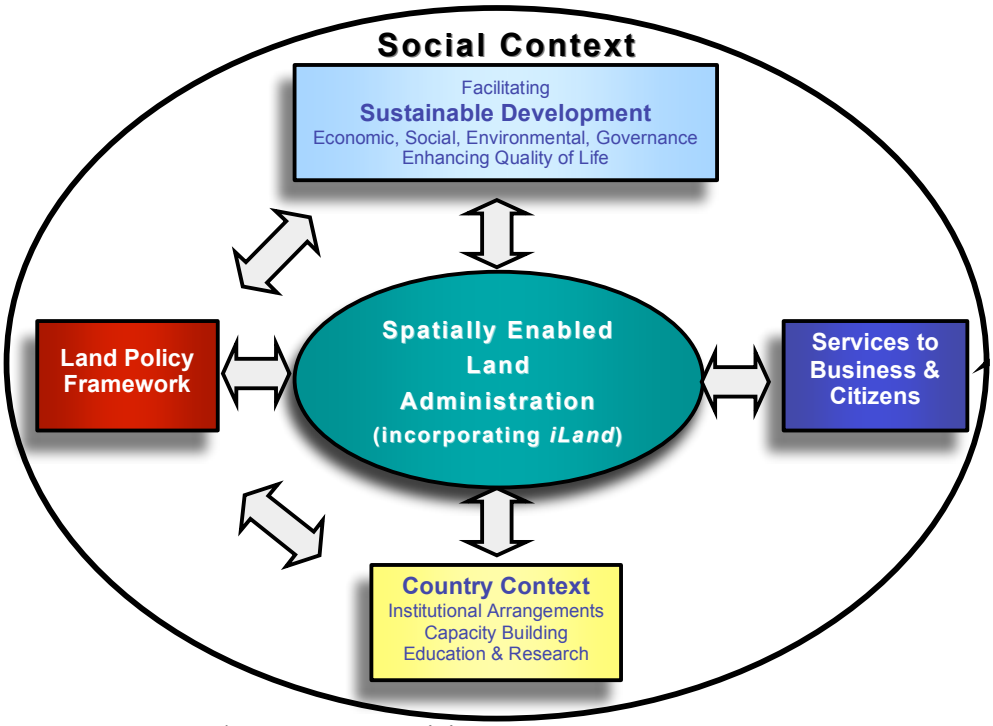

Figure 11 - Land management vision

The EGM developed a vision for future LAS sufficiently flexible to adapt to this changing world of new technology, novel market demands, and sustainable development, as shown in Figure 11. This vision incorporates and builds upon the above vision of *iLand* and can be considered an infrastructure or enabling platform to support spatial enablement of government (Wallace et al. 2006; Williamson et al. 2006a and 2006b)

Conclusion

People to land relationships are dynamic. The land administration and cadastral responses to managing these relationships are also dynamic and continually evolving. For developed countries, a central objective of a LAS is to serve efficient and effective land markets. Because of sustainable development and technology drivers, modern land markets now trade in complex commodities, however existing LAS, and the companion skills of land surveyors, lawyers and LA administrators, remain focused on the more traditional processes supporting simple land trading. The growth in complex commodities offers many opportunities for LA administrators who are prepared to think laterally and more strategically.

The importance of land information has grown over the last few decades. It is now more important and useful to government than merely providing traditional support for security of tenure and simple land trading. LAS, and their core cadastral components, are evolving into an essential infrastructure embracing SDIs, *iLand* and new technologies to spatially enable governments, and to identify the "where" for all government decisions, polices and implementation strategies. Eventually, although probably sooner rather than later, spatial enablement of governments and societies will provide links between land administration and sustainable development so that sustainability accounting measures are fed into monitoring and evaluation systems.

This brief account of the future challenges land administration officials to design and build modern land administration and cadastral systems capable of supporting the creation, administration and trading of complex commodities, and providing reliable land information to spatially enable governments and societies in general. Unfortunately, unless LAS are refocused on delivering transparent and vital land information and enabling platforms, modern economies will have difficulty meeting sustainable development objectives and achieving their economic potential.

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NOTE: Most referenced articles that have been authored or co-authored by the author (I.P.Williamson) are available at http://www.geom.unimelb.edu.au/people/ipw.html

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