SPATIALLY-REFERENCED LEGAL PROPERTY OBJECTS

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ABSTRACT

Delivering sustainable development requires effective management of social, environmental and economic aspects of land. Historically, land administration systems have contributed to this by recording and organising interests in land, primarily through land registration, land mapping, land valuation and land development subsystems. Unfortunately these subsystems have established diversified services and functions to manage interests in land each from their own perspective, and often operate in unconnected information silos. Interoperability between these information silos is impeded by use of often incoherent and unique identifiers in the data models used in each subsystem. Delivery of sustainability in the wider sense is adversely affected by an inability to exchange land information between subsystems.

At the same time, land administration systems are not sufficiently flexible to accommodate or support the growing number of complex commodities (water, biota, mining, carbon credits, etc.) and other interests (environmental, heritage, use restrictions) in land. This inflexibility is caused by traditional concentration on a data model based that is on the physical land parcel (the cadastral parcel) as a single means of organising land information.

To address these problems, this paper proposes that the data model based on the physical land parcel be replaced by a spatially-referenced data model based on the legal property object. The proposed data model is more comprehensive, capable of organising a wider range of interests, and should facilitate wider exchange of information. The legal property object is open-ended and can include complex commodities and all kinds of rights, restrictions and responsibilities. Spatially referencing these objects facilitates interoperability among the subsystems. The key for putting the proposed model into practice is the use of spatial identifiers to regulate relationships among legal property objects.

INTRODUCTION

Land administration systems are evolving from a focus on core functions of regulating land and property development, land use controls, land taxation and disputes (Dale and McLaughlin 1999) to a focus on an integrated land management system designed to support sustainable development (Enemark *et al*. 2005).

Sustainable development requires the management of social, environmental and economic interests in land. However, land administration subsystems use diversified services and functions to manage interests in land (Figure 1). For example, the land registry subsystem emphasises the management of private rights, restrictions and responsibilities (RRRs) related to land parcels. At the same time the land development subsystem is concerned with use restrictions imposed by planning authorities. The valuation subsystem focuses on the economic functions of land. The land tax office requires the change of property use as well as owner updates to calculate revenue and tax.

Figure 1: Relation among land administration subsystems

Although these processes seem to be independent, each relies on, or is related to, land parcels or properties for referencing or indexing. In other words, a limited number of interests in land are generally organised through land parcel or property data models in the cadastral information systems.

This paper encourages the land administration system to take up new opportunities for more integrated management of diverse internal approaches and overall delivery of land administration system policies by adopting a comprehensive and interoperable data model. Comprehensiveness refers to a holistic inclusion of a wide range of interests, each with potentially different dimensions. Interoperability refers to a common and efficient way of organising interests and their spatial dimension to simplify the land administration processes; in particular, data exchange between subsystems.

Each cadastral information system however follows a specific method of data modelling, using specific data elements to manage interests in land. Identification of the main data elements in each land administration subsystem assists to reveal the potential of the data elements (Simsion and Witt 2005) and assists reengineering data models to respond to modern land administration requirements.

LAND ADMINISTRATION DATA ELEMENTS

This section reviews some land administration systems with emphasis on data elements employed. The content, role and potential of important data elements are identified to provide an overall understanding of the arrangements supporting current cadastral data models.

Current data models in five jurisdictions were studied: three Australian states (New South Wales, Victoria and Western Australia), and two European countries (Netherlands and Switzerland). These case studies illustrated a broad range of data elements and their functionalities in different legislative systems.

Australia is a federation which operates separate land administration and cadastral systems in each of its eight states and territories. The cadastral systems in Australia are historically based on registering land transactions generated by land markets. The cadastral systems support the registration of private land parcels for legal ownership, identifying important rights, restrictions and responsibilities. In their fiscal capacity, they facilitate valuation of land and taxation. More widely, in multi-purpose systems, cadastres assist in land management and land use planning for local government, and also emergency response and risk management (Dalrymple *et al*. 2004).

In the Netherlands, a fiscal cadastre was introduced after annexation of the Kingdom of the Netherlands by France (Wakker *et al*. 2003). In 1992, a major revision of the Civil Code (originally from 1838) and the Cadastre Act changed the legal base of the cadastral and land registration (Zevenbergen 2002; Wakker *et al*. 2003). The land registers and cadastral maps assumed a multi-purpose role aimed at providing legal security of tenure, facilitating the land market, and supporting many government activities like physical planning, development control, public acquisition of land, land taxation and management of natural resources.

Switzerland also has a long-established tradition in cadastres. After the introduction of the federal constitution in 1848, all cantons (states) began to implement local land registries (Kaufmann *et al*. 2002). Art. 942 in Swiss Civil Law requires all rights on real estate to be registered in the land registry; thus, the Swiss cadastre has a legal and not fiscal base (Williamson 1981). The land registry is given the joint tasks of land registration and cadastral surveying (Kaufmann *et al*. 2002). The primary aim is to register the title to real estate. However, along with a list of registered proprietors, other information, such as land use, covenants, caveats, restrictions, lease, easements, mortgages and valuation, might appear (Williamson 1981). Furthermore, the Swiss maintain a cadastre of three-dimensional services. All underground services are charted, including all cadastral boundaries, all buildings and structures within the parcel, and all structures and visible utilities within the road reserve.

Within each jurisdiction, various organisations contribute to these data elements. In NSW, for example, valuation data is recorded through land transactions in the land registry subsystem and in local governments or real estate agencies through the land development subsystem. These organisations usually have a range of in-house databases. The data components in the databases used by each responsible organisation are structured through specific data models to suit the internal functionality of the organisation. Communication of data between responsible organisations is typically achieved by adding linking elements to the data models to connect different databases together. In Victoria, different identifiers, such as parcel identifiers, property identifiers, addresses and geographical positions, are used to match databases in different organisations.

Table 1: Important data elements in land administration systems

Table 1 illustrates existing data elements of cadastral information systems of the jurisdictions. The elements are not necessarily integrated into a single database or managed by a single organisation. The data elements are explored below.

Land parcels

The definition of a parcel varies according to the jurisdiction. For practical purposes, a parcel is a closed polygon on the surface of the Earth (United Nations 2004). Although the land parcel is identified as the building block of each land administration system, it might have originally been recorded by non-cadastral organisations. So far, cadastral data models relied on land parcels as their foundation. However, land parcels are a fallible organising tool, lacking sufficient flexibility to incorporate the increasing number and diversity of interests in land.

Property

Properties have different meanings in different countries and are often used in conjunction with land parcels (Steudler *et al*. 2004). Practically, a property is often defined as the building(s) associated with land. A property may also consist of one or more adjacent or geographically separate land parcels. Additionally, a parcel can contain several properties. Land parcels are linked to properties in a one to many, many to one or one to one relation. Multiple interests can exist on a property and the attached interests can be shared between two or many holders in separate titles. Properties usually play a greater role in valuation and taxation data models. However, properties, similar to land parcels, are not flexible enough to provide an effective means for organising interests in land.

Third dimension

The third dimension of height facilitates subdivision into strata, creating separate parcels above or under the original area. The most typical objectss located above the surface are apartments or buildings registered as separate property (Stoter and Oosterom 2003). Increasingly, constructions below or above the surface, such as tunnels and platforms used as foundations for buildings and so on, are also treated as separate objects in a subdivision process, and capable of being registered as separate real property (United Nations 2004). In some jurisdictions, networks such as telecommunication lines may also be registered, either within the cadastre (as has been proposed in the Netherlands) or in a separate register, (as for high-voltage power lines in Norway) (United Nations 2004; Bennett *et al*. 2005). The third dimension also can include interests related to trees, vegetation, minerals, hydrocarbons, as well as water. In current data models, the third dimension is usually modelled as a 3D tag linked to the parcel record (Stoter 2004). The increasing complexity of modern cities suggests that modern land administration systems need an improved capacity to manage the third dimension (Zlatanova and Stoter 2006).

Public and individuals

Interests can be held by individuals or groups of individuals, legal persons (organisations such as companies or cooperatives), or by governments (including municipalities). However, historically land registries were involved in registration of private ownership of various interests in land. This trend led most land administration systems to keep separate records of the public and private interests in land. Now modern land administration requires an integrated and holistic treatment of land, including a seamless registration of titles to all public, government and private interests (Bennett *et al*. 2005).

Rights, restrictions, responsibilities (RRRs) on land

RRRs are intangible concepts, even though most of them deal with a tangible object such as a piece of land. Land affected by RRRs can be divided into parts; for instance, possession of land and a right of a way over it. The division of land into separate identifiable RRRs can be further complicated, for example, by sharing of the ownership of various rights, occupancy, tenancy or lease. The consequence is RRRs are broken into smaller parts in which there may be a multiplicity of interested individuals.

RRRs can be presented both spatially and non-spatially. The results of exercise of rights to give, sell or lease land to some one else can be recorded in non-spatial databases linked to individual land parcels. But, the rights of land use or right of a way can be considered as a spatially physical entity on the surface of the Earth regardless of their configuration in relation to or connection with a specific land parcel. In other words, their existence is not necessarily subject to any land parcel. Organisation of RRRs remains an important issue in cadastral data modelling processes.

Land value

Value information is usually captured through the land registration or stamp duty collection processes when the land is transferred. This data is captured and sent to a valuation subsystem. Data models in the fiscal cadastre place emphasise on the land value data element rather than the other data elements. Valuation subsystems are therefore not truly spatially enabled. Valuation or taxation data comes in as attributes associated with property identifiers.

Land use

Physical planning is the process of defining and controlling the use of land to meet sustainable development objectives. Land administration systems employ land parcels to allocate land use information in land. Although from a land resource management perspective, definition and identification of land parcels are fundamentally important, the parcel is not the only unit used in land management. Spatial identification of interests requires a more flexible data element. Land use, in fact, is a form of interest in land and can be incorporated in RRRs data element.

The result of the case studies confirms that each data element in a land administration system has a specific functionality; it is therefore difficult to accommodate the data elements in a single data model. However, an examination of the arrangements among data elements would assist reconfiguration of the current core data model into a single comprehensive and interoperable data model.

CURRENT CORE DATA MODEL

Data elements with different functionalities contribute to a cadastral information system in land administration systems. This section explores how the data elements fit together and identifies the main issues in the current core data model arrangements. Initiatives to improve the current core data model are then reviewed.

Firstly, land parcels constitute the basic building block in land administration systems. Parcels were employed to identify the areas related to interests in land. Besides that, land parcels have been used as indices for organising land information in various land administration subsystems or within other related agencies.

However, an interest in land is not necessarily equivalent in area to an exact extension of a particular land parcel; indeed, it may be applied across several land parcels (Figure 2). Land parcels are therefore not flexible enough to accommodate an increasing number of non-parcel based interests.

Figure 2: An example of non parcel based interests (Bennett *et al.* 2006)

Moreover, it is not the actual spatial dimension of a land parcel which plays the indexing role; rather, it is the parcel identifier employed for organising land information. Non-spatial identifiers remain an issue in land administration systems especially for organising numbers of properties, buildings and apartments in a single land parcel. Advances in spatial and computer sciences now offer various applications allowing spatially enabled indexing methods (Longley *et al.* 2005).

Secondly, interests recorded in land administration systems are traditionally those associated with private ownership. In other words, the most important interest in land is the ownership of land, sometimes represented as a series of opportunities equivalent to “a bundle of sticks”. Ownership is usually recorded along with restrictions, most commonly caveats, mortgages and rights of way.

However, interests in land are now much more diverse that those held in registries. For instance, land use restrictions are recorded by planning authorities, separately from the ownership. Further, for economic purposes, governments have created new commodities such as rights of biota and water. Whether these are managed in land registered or not, they demand flexible systems of recording and identification.

Thirdly, land administration systems have so far focused on private interests rather than public interests. Land registries and cadastres constitute the basic records of private land holdings. Although, some government agencies are responsible for management of public lands, their systems are usually not as mature as those used for managing records of private land and are usually separately maintained. Distinctions between private and public interests still challenge the capacity of land administration systems to manage all land in a jurisdiction.

Finally, in view of the above, the current core data model consists of the parcel or property and the owner, with a private ownership linking these together (Figure 3). Other information mentioned earlier is centred on the core functionality of the cadastre. This model describes how a piece of land or property relates to a person via the ownership right held.

Figure 3: Current core data model

World wide initiatives have attempted to improve the current cadastral data model in order to address these issues. The core cadastral domain model (CCDM) developed by (Lemmen and Molen 2003; Lemmen and Oosterom 2003; Oosterom *et al.* 2004; Lemmen *et al.* 2005; Lemmen *et al.* 2006; Oosterom *et al.* 2006) is the most outstanding effort in the area of cadastral modelling. The heart of the model is its three components: registered objects, RRRs, and persons. The model is then expanded with specialisation of each component. However, in the model, the spatial reference system, for example, does not play a key role. This results in loss of potential to improve interoperability by spatial enablement.

Paasch (2004) also suggested that a legal cadastre model is needed which focuses on the right of ownership (to a property) and on restrictions and responsibilities that reduce ownership. Additionally Zevenbergen (2004) suggested development of an open-ended packaging method, avoiding restriction of particular RRRs into particular real estate objects. Kaufmann & Steudler (1998) proposed legal independence for legal land objects. Stubkjaer (2004) thought that cadastral modelling should include not only the physical objects, agents, and information sets of the domain, but also the objectives or requirements of land administration systems. Finally, Roux (2004) invited cadastral modelling efforts to expand current cadastral infrastructure to become global. The more inclusive data model described below addresses these issues and suggestions.

IMPROVING THE DATA MODEL

Two changes are proposed in order to re-engineer the current core data model. One involves using legal property objects, not physical land parcels as the basic building blocks of land administration. This facilitates incorporation of a broader range of RRRs and land related commodities into the cadastral fabric, as well as the broad range of land information mentioned earlier. The second is to make the spatial referencing system the centre of the cadastral information system by using it to identify property objects. This change promotes interoperability and simplicity in data exchange processes, particularly regarding upgrading and updating cadastral databases.

Legal property object

The earlier discussion about the current data elements revealed that the core cadastral data model is based on three important data elements: person, land parcel or property and the rights. However, in current thinking and literature on cadastral and land administration issues, usually the rights are replaced by three R's of Rights, Restrictions and Responsibilities (Lemmen *et al*. 2005). Beside that, to improve the capacity of land markets, new interests in land and commodities like biota, water and mining, are being recognised.

The key questions then are how and why new interests and RRRs might be incorporated into a cadastral fabric, especially when they are remote from physical objects or even spatial identification (Wallace and Williamson 2004). RRRs are a result of cultural, social and political activities in each country and describing the variety of existing rights and restrictions in a common model is difficult (Ottens 2004; Paasch 2004).

From an administrative modelling viewpoint where the focus is on abstracting the real world as a principle, land is not a legal entity until an interest is attached to it. Any kind of interest whether a right or a restriction, has the same logical construction for purposes of spatial identification. Therefore answers to the above questions involve applying this principle to the modelling processes. For example, a biota right exists as an interest that often appears to be attached to land parcels , but the commercial exploitation of the opportunities arising from biota may not neatly align to individual land parcels (Sheehan and Small 2004). Nevertheless, the biota right could be identified within a spatial dimension.

For this reason, the very close relationship between each interest and its spatial dimension in the real world should also be recognised in information systems. To put it another way, they should be maintained together as a unique entity in a cadastral information system. This unique entity must define both the interest and its spatial dimension. The interests are open-ended and can include all political, environmental, social and economic interests. Spatial dimension of the interests can include a variety of shapes, limited by the ability of computer systems to present them.

Thus, introduction of the concept of legal property objects can combine an interest and its spatial dimension into an entity: an entity defined by a law or regulation which relates to a physical space on, below or above the earth. This can apply to a new land related commodity, a land parcel with ownership right, or an interest within a particular dimension in land. The challenge of organising interests in land, such as biota, lies in harnessing these departures from the land parcel without producing such a degree of independence as a legal entity. A further instance of this is a tax responsibility (Meyer 2004). A tax assessment classification usually employs an aggregative method for calculation of dispersed taxable land related commodities. A combination of all taxable land related commodities of a particular person into a single legal property object would facilitate tax assessment process.

As a consequence, different kinds of interest in land are reflected in various legal property objects layers in a cadastral information system. This definition creates virtual information layers out of intangible RRRs and new commodities. The legal property object allows users to visualise both the interest and its spatial identification. Instead of using land parcels to find out the related interests, the point is to use the spatial dimension of each legal property object to provide the basic functionality. Additionally, this facilitates incorporation of RRRs and new commodities into the cadastral fabric and their spatial representation in a cadastral information system.

Figure 4: New core cadastral data model

The concept of the legal property object changes the current core data model from three components into two components: legal property object and the person (Figure 4). The legal property object includes a particular interest with its spatial dimensions. The legal property object will be the basic building block and is the centre of the model for organising land information. The person includes all the private, natural and non-natural individuals as well as the public.

The advantage of this model is the comprehensive inclusion of all interests in land. Currently, the existence of a hierarchy of rights over private lands complicates the tenure system in many countries. As many of the rights are for specific and temporary use, the need for renewal, or conversion to a higher right, adds to the bureaucratic chain (World Bank 2003). The proposed model addresses this issue and shifts the whole land administration functionality to be based on a data model with legal property objects at its heart. In short, ultimately the system allows all rights, restrictions and responsibilities and commodities to be registered spatially in a holistic way as illustrated in Figure 5.

Furthermore, the new model facilitates the land administration system to be more extensible and scalable in terms of new legislations and land related laws. The new laws can be applied to individual legal property objects. Therefore the relationship between various legal property objects, like relationship between a water right and a land right on a specific location, can be formulated using specific rules in the data model.

Figure 5: Spatially registering legal property objects

Incorporation of this change into a cadastral data model faces some practical challenges. The first is the conversion of the attributed RRRs into their respective spatial dimensions; this involves differences between spatial characteristics of RRRs. The legal property object might be a polygon or a 3D object. It can be a line or a point. An easement of way over land in a parcel, for example, can be represented by a line with associated attributes or as a polygon. The next challenge is the relationships among legal property object layers. In other words, how can we connect them together in a spatial database? The use of a spatial referencing system in the data model helps address these challenges.

Spatial identifiers

Every land parcel or property recorded in a land registry or a cadastral information system must have an identifier (Meyer *et al*. 2002). In fact identifiers are the most important linking data element in the land administration databases. There are various ways for referencing of land parcels and property based on historical evolution and geographical location. The known identifiers, namely addresses, cadastral maps and coordinates, are examples.

One method for identifying a basic property unit is to use the name of the owner in what is sometimes called a grantor/grantee index. The grantor is the person by whom a grant or sale is made, while the grantee is the recipient - as in vendor/vendee or seller/buyer (United Nations 2004).

Another method relies on title numbers, similar to references on letters. Some geographic filtering may occur by providing a regional or municipal name or code number, but essentially the system is designed to support document retrieval.
In many land book registers, a single page entry is used for each real property. Each basic property unit can then be referred to as the volume and folio or book and page

number on which the information is recorded. The volume refers to the particular registry book in which the entry is made, and the folio is the page on which the details of the real property are recorded (Meyer *et al.* 2002).

Many cadastres use a block-and-plot numbering system, the block being an administrative area, or an area marked on the map for the convenience of registration. Another identifier, the street address, is the most common form of real property referencing system that is used by the general public. Street addresses are easy to understand but depend on the existence of consistent street naming and building numbering systems. Street address is used increasingly by government departments.

Also, buildings may or may not be recorded in the land registers. For the purposes of land administration, generally it is not appropriate to number buildings by using the postal address since not all buildings will have an address. Identification of buildings by their street addresses makes it easy for people to identify properties on the ground, but creates problems in a land administration system if, for example, street or building names are changed. Land administration requires stable addresses. By contrast, postal addresses often change.

Traditional identifiers, like grantor/grantee indices, title numbers and volume and folio systems, can all operate without maps or any other spatial connotation apart from an indication of the local administrative area. They are commonly found in land registers and can be applied to both basic property units and parcels. In the cadastre, the focus tends to be specifically on the land parcel (United Nations 2004).

In addition, land administration organisations link their databases together using the identifiers. The most common identifiers are volume–folio in land registration subsystems, parcel identifiers in land mapping subsystems and property identifiers in valuation and development subsystems.

Spatial referencing systems are generally not used as identifiers for matching various databases together. Use of relational or object oriented databases is the common way for integrating various databases, but a spatial referencing system could simplify land administration database management. The new model therefore, requires the coordinates of all legal property objects to be linked via geocodes.

A spatial referencing system for legal property objects that includes some form of geographic reference has many advantages. It facilitates the management of various layers of information related to legal property objects, and facilitates spatial presentation of rights, restrictions and responsibilities. Finally, setting the related legal property objects on top of each other facilitates the institutional data exchange process between those responsible and optimises the interoperability among organisations.

Introduction of legal property objects and use of spatial identifiers require far-reaching change in cadastral information systems.

REGULATING LEGAL PROPERTY OBJECTS USING SPATIAL IDENTIFIERS

The key to implementing the proposed data model based on its two components of the property object and person is the use of spatial identifiers to regulate relationships among the objects. These relationships allow the possible changes in one legal property object to affect other legal property objects in a cadastral information system.

Four types of relationship exist among the legal property objects in a cadastral information system: topological, spatial, general and vertical.

Topological relationship

Topology is a relationship existing among objects (Rigaux *et al*. 2002). This uses spatial identifiers in a cadastral information system to define the relationships among legal property objects. One advantage of using spatial identifiers is the efficient computation of topological queries. For example, when the dimension of one legal property object, such as an owned land parcel, is changed, the neighbouring legal property object will be affected. Another advantage is related to update consistency. Object sharing makes maintenance for consistency and updates easier. The topological relationship can quickly find neighbouring legal property objects.

Spatial relationship

The spatial relationship can be defined by a set of spatial operations to determine whether one legal property object touches, coincides with, overlaps, is inside or is out side of another legal property object (Worboys and Duckham 2004). Exploring spatial relationships between legal property objects is a challenging task that requires spatial identifiers in a cadastral information system. For example, one might want to determine which car space footprints fall inside a particular land parcel.

General relationship

The general relationship is not physically explicit; for example, the relationship between the owner(s) with an apartment (Zeiler 1999). In this relationship, spatial identifiers play the important role of defining the people interested in a particular way in a specific position. For instance the same position may involve complex relationships among persons, each interested in a different way, for example as a car space, a water catchment, or as owner of the parcel.

Vertical relationship

In addition to these three relationships, a cadastral information system should deliver vertical integrity to be the most successful land administration tool. Vertical integrity is the ability to relate legal property objects from one data set with legal property objects from another. Practical instances include utilities overlaying their facilities (gas lines, water pipes, electricity cable runs, etc) over a property base. When vertical integrity delivers highly accurate spatial identifiers for legal property objects, the replication alignment between the two legal property objects and the maintenance process can be streamlined. For example, automatic realignment of the gas line through its topological link to the property boundary is possible (VGIS 2003).

With four relationships in place, maintenance of a cadastral information system will be straightforward. Spatial identifiers, the key for all the relationships, need to be taken into account in all land administration organisations. Having these relationships in cadastral information systems promotes the data interoperability between various organisations. Once the data interoperability becomes uncomplicated, the workflow between organisations will be simpler.

CONCLUSIONS

This paper described cadastral data modelling based on the modern land administration concept with four subsystems; land registration, land mapping, land valuation and land development to support sustainable development.

The main data elements in land administration systems as well as current core cadastral data models were described. The reliance of the current core cadastral data model on three main data elements -land parcel or property, the ownership right and the private interested person- reflects the historical function of the systems. These parcel based models are challenged by a need to accommodate the growing number of interests in land and new commodities out of land. More importantly, non-spatial parcel identifiers employed in the models do not facilitate interoperability among land administration subsystems.

To address these issues, the paper proposed two changes in current core cadastral data models. One change is to modify the building block for land administration systems from physical land parcels into legal property objects. This facilitates the incorporation of a wide range of rights, restrictions and responsibilities into the cadastral information system. The second change makes the spatial referencing systems the centre of the cadastral information system as the legal property object identifier. This change promotes interoperability and simplicity in data exchange processes, particularly upgrading and updating cadastral databases.

The paper proposed that four types of relationships should be assumed among the legal property objects in a cadastral information system: topological, spatial, general and vertical. These relationships require spatially-referenced legal property objects. Finally, the paper concluded that, with these relationships in place, data interoperability between various organisations is promoted. Once data interoperability becomes uncomplicated, the workflow between organisations will be simpler.

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TABLES

Data Element	**VIC**	**NSW**	**WA**	**Netherlands**	**Switzerland**
Land Parcel	*	*	*	*	*
Property	*	*		*	*
Third dimension	Some	Some		*	*
Public	Some	*	*	*	
Individuals	*	*	*	*	*
Rights	*	*	*	*	*
Responsibilities					
Restrictions	Some	Some	Some	Some	*
Land Value	*	*	*	*	*
Land Use				*	*

Table1

FIGURES

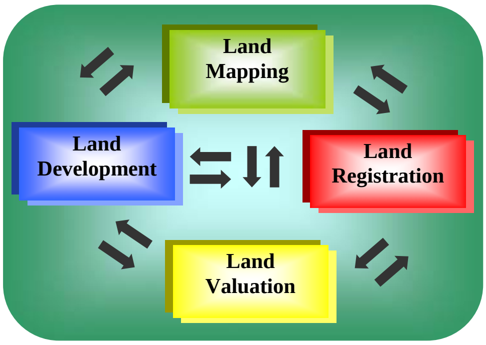

Figure 1

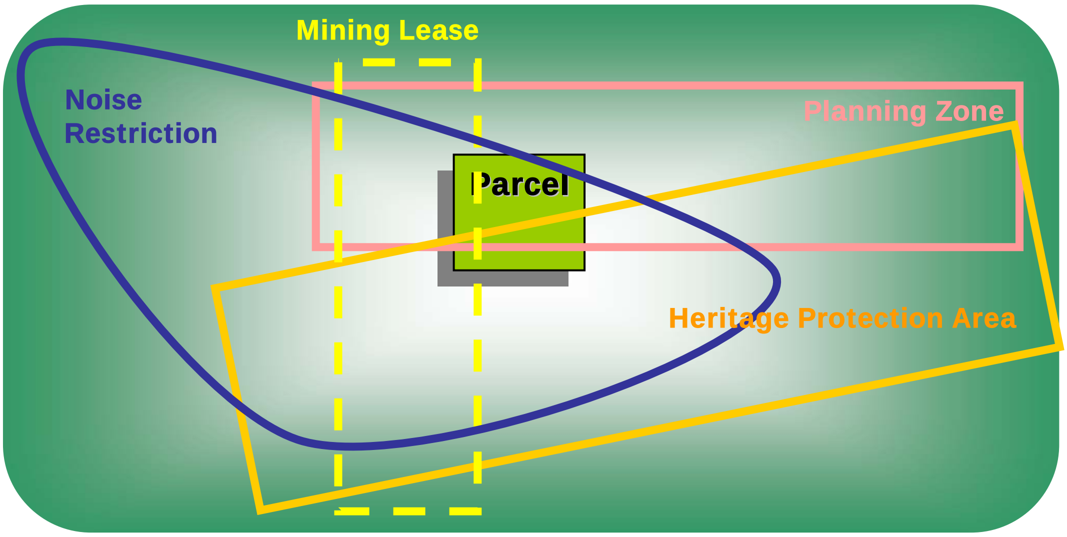

Figure 2

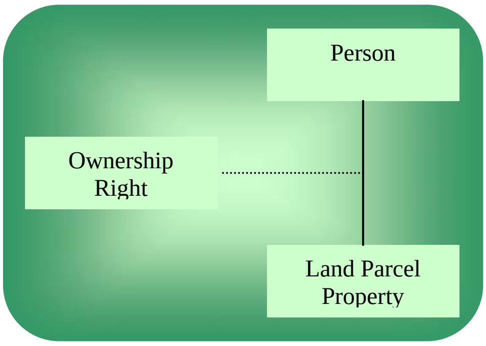

Figure 3

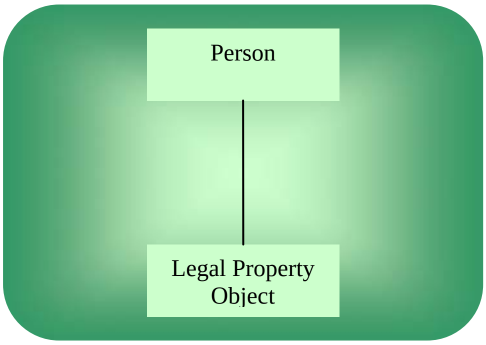

Figure 4

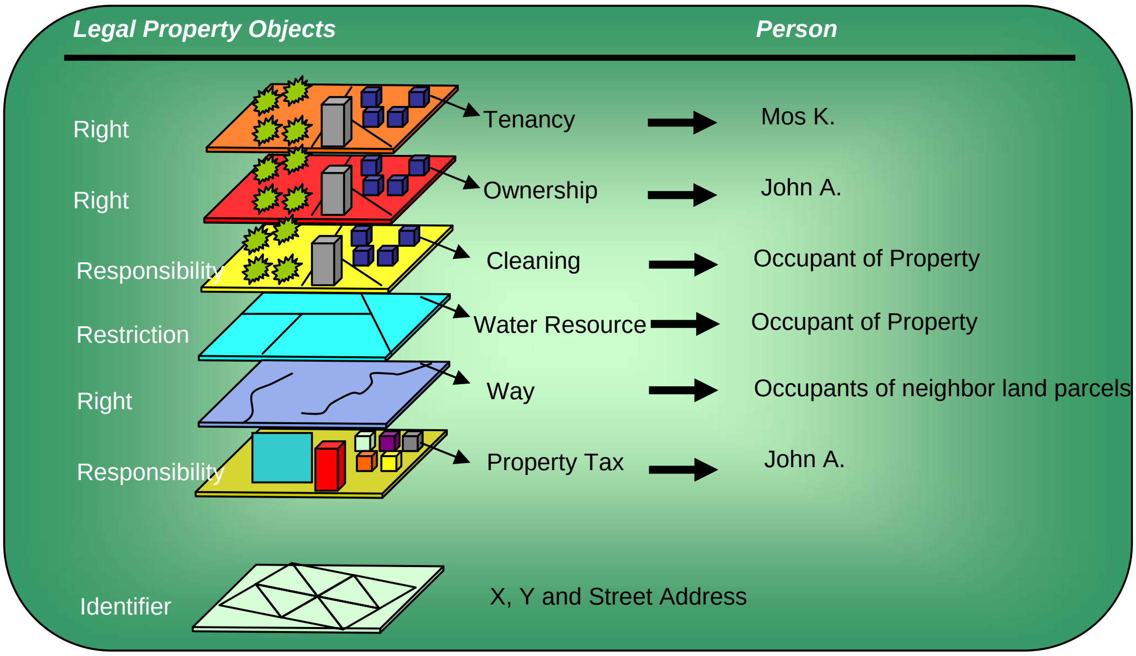

Figure 5