

CHAPTER 3

LAND ADMINISTRATION

3.1 Introduction

The aim of this chapter is to give a general idea in land administration, recent developments in land administration system, the changing and complex context that it is facing, and to highlight land administration issues in relation to the cadastre.

This chapter begins with the definitions of land and its rights. Land management and land administration system are discussed and issues relating to land tenure, land value, and land use are investigated. Components of land registration and land information system will be presented in Section 3.5 and Section 3.6 respectively. This is followed by discussions on the cadastral system and the future cadastre in Section 3.7 and Section 3.8 respectively, before the chapter concludes with a summary.

3.2 Land

Real property is most often thought of as a piece of land on the surface of the earth, including or excluding building and other structures permanently attached to the surface, above the surface or below the surface. Throughout history, there were four phases in man's relationship with the land. The first phase was when land was regarded as wealth (before 1800), followed by land as a commodity (1800-1950), then land as a scarce resource (1950-1980), and finally land as a community scarce resource (after 1980) (Ting, 2002). Land is a valuable resource for mankind as life depends on having land in which to live and work (Wallace and Williamson, 2006; Dale, 1995). Without land, there would not be any human activity on the face of this earth because land is both a physical commodity and an abstract concept of rights of ownership and use. According to Williamson (1983), land and its resources have been the basis of wealth for most societies since the beginning of civilisation. However, the management of such land and its resources, while being central to most communities, has seen many varied approaches and systems.

The United Nations Economic Commission for Europe (2005: 99) defines land as "the surface of the earth, the materials beneath, the air above and all things fixed to the soil". In addition, land in modern administration also includes resources like marine environment, buildings, and all things attached to it and under the surface (Williamson *et al.*, 2008).

In Malaysia, the definition of land by the National Land Code 1965 (2010) includes land that is covered by water. The State Authorities control the seas up to 12 nautical miles from the low water mark, while the Federal Government has jurisdiction from that point to the outer edge of the Exclusive Economic Zone up to 200 nautical miles from territorial sea baseline. In addition, the country also has rights to the seabed of the continental shelf up to 350 nautical miles (648 km) from the coastal baseline.

According to Dale and McLaughlin (1988), land is a word with many meanings. Land can be defined as a landscape, the product of geological processes;

a resource with capital and labour to be exploited in order to achieve economic development; a volume of space stretching notionally from the centre of the earth to the infinite in the sky, and associated with it are a variety of rights which determine activity as a reflected in the many different forms of land use. When we talk about land, it will be in terms of its present appearance including all cultivation or development undertaken. The land must be seen not as an isolated physical unit, but as something integrated into the whole of a society with its legal, institutional and socio-economic characteristics (Larsson, 1997).

3.2.1 Defining Rights to Land

The United Nations Economic Commission for Europe (2005) defines the rights to land to include “rights of ownership and rights of use”. According to Larsson (1997: 12), “the definition of rights to land has at least three dimensions”. It encompasses what is included in a certain right, who the holder of this right is, and the extent of the right in a piece of land.

Land ownership is often described as bundles of specific rights defined by law, for example the right to cultivate, build, enjoy production, sell and so on which is not forbidden by law or custom or which must be approved by authorities, and the action shall not be very harmful to neighbours, other citizens or the environment (Larsson, 1997). The rights to land, be it ownership or other interests are vital. It is also significant how such rights are legally defined, whatever they are more or less absolute or limited by specified conditions and rules (Larsson, 1997).

According to Dale and McLaughlin (1988), the term ‘land ownership’ is commonly used in land management to define the rights to use the land that can be owned. Such rights may be held through local customs or the formal processes of the law. In order to prove who owns the rights to any particular area of land, it is necessary to investigate the entitlement where the title is the evidence of a person’s

rights to property. However, the title does not necessarily imply occupation or use (Dale and McLaughlin, 1999).

Dale (1995) also points out that there are many kinds of rights in land, ranging from full ownership to a mere conditional right of access at certain periods and for certain purposes, e.g. rights to water, rights to trees and minerals and so on. Registration of rights is commonly thought of only as the registration of title and rights of ownership, without considering the registration of such rights as mentioned above. This limitation arises from the fact that written registers of rights usually come into being in countries in relatively advanced stages of social development.

According to Dale and McLaughlin (1999), for many of the poor, the right to use the land may be more important than the right to ownership. Allocating land use rights has allowed the occupation and development of the land to proceed without having to address either the legal concept of land ownership or political traditions that have claimed much or all of the land for the State. Therefore, land use rights may entitle the occupier to some or all of the profits that he/she acquires from using the land, which often forms the basis for land taxation schemes. Presently, land use rights are becoming increasingly complex as societies become more educated on the types of activities that are allowed on the land.

Land use rights are an important determinant of property value in the land market. It is important for the landowner and professionals who are undertaking land transactions to know the rights to the land. However, they should understand that many land use rights are expressed conditions and restrictions of interests that forbid certain activities on the land that may not show on the registry title.

In conclusion, a clear definition of rights lays the foundation for good land management, not only from a private perspective, but also from the public point of view. The formalisation of rights to land, which is an integral component of an effective cadastral system, is very important for sustainable economic development and environmental management in both urban and rural areas (United Nations - *Federation Internationale de Geometres*, 1996).

3.3 Land Management

From an institutional perspective, land management includes the formulation of land policy, the legislative framework, resource management, land administration arrangements and land information management. It entails both government and private initiatives.

The United Nations Economic Commission for Europe defines land management as:

... the activities associated with the management of land as a resource from an environment and an economic perspective.

(United Nations Economic Commission for Europe, 2005: 99)

Land administration and land management are very crucial components in land and related issues. Although they are not identical, they are very similar to each other. Modern multi-discipline land administration focuses on land management, delivery and organisation. It also provides the supporting framework for trading in complex commodities. On the other hand, land management is the process of managing the use and development of land resources, and is a key activity of both government and private sector. It is aimed at delivering efficient land markets and effective management of the use of the land in support of economic, social and environment sustainability (Enemark, 2009).

Land management is the process by which the resources of land are put to appropriate use or effect. It encompasses all activities associated with the management of land and natural resources that are required to achieve sustainable development (Enemark, 2005). Effective land management addresses many critical objectives, which include improving the efficiency of the use of land resources and estate management. Therefore, good land management will help to promote economic and social development in both urban and rural areas (United Nations Economic Commission for Europe, 1996).

Similarly, Dale and McLaughlin (1988) define land management as the process whereby the resources of land are put into good effect. The resources and attributes of land need to be carefully managed for proper use to avoid wastage. Land management entails decision making either by individuals or groups and the implementation of decisions about the land. For these purposes, the management of land should include steps starting from a planning phase to an execution phase and to a monitoring phase, followed by a policy making phase and an operational phase. Finally, a further monitoring stage reviews the results of the entire operation.

Hendriatiningsih *et al.* (2007) note that the development of a region could not be disconnected from the growth of a population where it leads to the increasing insistence and peremptory request of settlement and land. On the other hand, the inability to cater to land demand will lead to the improvement of land management. Ossko (2001), and Aydin, Demir and Atasoy (2004) stress that besides overpopulation, increased vehicle usage and pedestrian traffic necessitate the provision of new transportation facilities such as light rail transit, highways, underground stations. Hence, tunnels have to be constructed above and below the surface in urban areas to ease traffic congestion and to improve urban life-style.

In brief, land that is located close to a big city is certainly different from land that is situated far away in a sparsely populated region even if physically it looks exactly the same (Larsson, 1997). Hence good management of land includes taking cognizance of the critical roles of land in the country. It is also places importance on keeping computerised records of all land related data for ease of storage and retrieval (Dale and McLaughlin, 1988).

3.3.1 Land Policy

The United Nations Economic Commission for Europe defines land policy as:

... the framework for determining how land should be used and conserved in order to meet social and economic objectives.

(United Nations Economic Commission for Europe, 2005: 99)

According to the above definition, land policy consists of a combination of social economic and legal prescriptions that dictate how the land is to be used and how the benefits from the land are to be shared. Land policies influence the ways in which the development of land is regulated. The revenue generated through taxation and fees from the sale or lease of land can be properly regulated by appropriate land policies. Moreover, conflicts concerning the ownership as well as use of the land can also be resolved where there exist well-defined land policies. Land policies concern both public and private land and impacts all aspects of land administration, including land title formalisation, land survey and property description, land registration, land valuation, land use control and management, and infrastructure and utilities management.

Land policy comprises a complex of social, political, economic and legal prescriptions that dictates how the land and benefits from the land are to be allocated. Land policy principles which are relevant to land administration should include a statement on the rights and responsibilities of the various land related activities such as land management, land reform, land registration, cadastre and, particularly, the role of land administration infrastructure. These principles should be included in the State or national policy, while taking cognizance of the people, land relations in a jurisdiction, the need for appropriate land administration responses and a description of the land administration infrastructure.

Finally, a core principle must be articulated, one that promotes equal access to property for all while respecting the sensitivity to local needs and requirements.

Policies must be formulated to ensure the process for formalising and subsequently transferring property rights are as simple and efficient as possible. From the outset, the policy agenda must ensure that there is a balanced and integrated approach to address the needs of both urban and rural communities, as well as deal with land and other resources.

3.4 Land Administration System

Historically, there have been four processes or components in land administration, namely land registration, land valuation, land use planning and cadastral survey and mapping. For historical, technical and political reasons, the responsibilities of these four processes or components in many countries are carried by different government departments.

The term ‘land administration’, introduced in the 1990’s, probably became more widely used after the United Nations Economic Commission for Europe in 1996 formed an ad hoc group of experts known as the ‘Meeting of Officials in Land Administration’. The importance of land administration increased after 1990, when land administrations in modern democracies shifted their technical focus and began to engage professionals from the disciplines of engineering, economics, political and social sciences, law and computer technology as well as international organisations, and national governments. These bodies and individuals had erstwhile been struggling to deliver land and food security as well as to build land markets (Williamson and Wallace, 2007). The United Nations Economic Commission for Europe defines land administration as:

... the processes of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies. It is considered to include land registration, cadastral surveying and mapping, legal and multipurpose cadastre and land information systems.

(United Nations Economic Commission for Europe, 1996: 14)

Dale and McLaughlin (1999) add that State land administration functions may be divided into four components, namely juridical component, regulatory component, fiscal component and information management component. In Malaysia, these functions of land administration are traditionally organised by the Department of Survey and Mapping Malaysia (DSMM), State Land and Mines Office (PTG)/District Land Office (PTD), and State Local Authority which are responsible for survey and mapping, land registration and valuation respectively. The juridical component places great emphasis on the holding and registration of rights in land while the regulatory component is mostly concerned with the development and use of land. Meanwhile, the fiscal component focuses on the economic utility of the land and finally the information management component is integral to all three components described above. In this connection, the juridical cadastre underpins land registration, zoning and other information systems that facilitate planning and enforcement of regulations. The fiscal cadastre also supports valuation and taxation (Dale and McLaughlin, 1999).

Land administration is concerned with three principals and interdependent commodities, *viz.* ownership, value and use of land. Ownership usually relates to the possession of rights in land; value normally relates to market value; use relates to the rights to use and profit from the land. As a result, land administration is now a multi-disciplinary endeavour, focussing on land management, delivery and organisation. It also provides the supporting framework for trading in complex commodities. An analysis of how modern land markets are able to invent and support a constant stream of new commodities shows how fundamental the infrastructure in the prosaic activities of tenure, use, development and value underpins these wealth-generating activities (Wallace and Williamson, 2006).

Land administration systems initially began because governments needed coherent and fair tax collection systems which they developed to service land markets (Williamson and Wallace, 2007). Their basic functions are to organise processes associated with land tenures, values, uses and development. Their primary tools are surveying, registration systems and databases operated by government organisations. Every land administration system should include land registration to facilitate ownership information of land. The function of the land administration system is to record, maintain and make available information that can create security of tenure and support the land market (United Nations Economic Commission for Europe, 2004). Meanwhile, land registration provides a safe and certain foundation for the acquisition, enjoyment and disposal of the rights pertaining to land, where such right is something to which some person or group of persons is entitled (United Nations Economic Commission for Europe, 1996).

Williamson and Wallace (2007) point out that modern land administration systems in developed economies facilitate sustainable development. This is realized through economic, social and environmental sustainability. It supports public participation and informed, accountable government decision-making in relation to the built and natural environments.

A land administration system provides a mechanism for the management of real estate property, and in particular their central cadastral components which are essential elements of every country's national infrastructures (United Nations - *Federation Internationale de Geometres*, 1999). Land administration facilitates the implementation of land policies in both developed and developing countries. It also provides an infrastructure for the implementation of land related policies and land management strategies. It should focus on the needs of the users of the data by providing spatial integrity and unique land parcel identification in support of security of tenure and effective land markets (Enemark, 2005). The information stored within a system should be sufficient to meet the users' needs and must be kept up to date, and contain only essential data.

The role of land administration systems in developed countries primarily supports the operation of land markets, land use planning and development, land

taxation, urban infrastructure and natural resource management (Williamson, 2001). In addition, Williamson (2001) notes that competing and overlapping concerns in land, economics, social issues, politics and the environment require an ever-changing people to land relationship in order to facilitate complex decision-making and support the implementation of decisions. Together with digital information in modern land administration systems, there has been a vast improvement in the capacity to store and retrieve data, process, transmit and analyse land-related information (Dale, 1999).

In short, land administration systems are the basis of conceptualising rights, restrictions and responsibilities related to people, policies and places in support of sustainability as well as land and property. Property rights are normally concerned with ownership and tenure whereas restrictions usually control the use of the land and the activities on it. On the other hand, the responsibilities in land administration relate more to a social, ethical commitment or attitude to environmental sustainability and good husbandry (Enemark, 2005).

3.4.1 Land Tenure

United Nations Economic Commission for Europe (2005: 99) defines land tenure as “the mode of holding rights in land”.

Another definition of land tenure is given by Dale and McLaughlin:

Land tenure describes the manner in which rights in land are held. It is defined by a broad set of rules, some of which are formally defined through laws concerning property while others are determined by custom.

(Dale and McLaughlin, 1999: 17)

The way in which rights in land are held is called tenure (United Nations Economic Commission for Europe, 1996). In many countries the absolute owner of all land is the State or head of State, but for all normal purposes, two common forms of tenure can be identified, *viz.* freehold and leasehold.

In absolute tenure, the owner can do whatever he or she likes with the land; for example dispose of the land or subject it to any restrictive agreement or planning regulation that is imposed by statute with regard to its use. The freehold status is not absolute since generally the State retains the right to acquire land in the public interest, for example for building highways (United Nations Economic Commission for Europe, 1996; United Nations Economic Commission for Europe, 2005). Freehold is indefinite in duration and is the highest form of tenure that a citizen can hold.

Freehold is the right to enjoy the reversion in a property to hold it with a perpetual right with no limit of time to hold the property. A freehold property lies with the title holder unless the title holder transfers it. Freehold therefore means that the land is held by services that are free in nature, and not necessarily that it is free from all rent and conditions (Simpson, 1976).

On the other hand, leasehold means that the freehold owner, usually the State, has relinquished most of the rights in the land for a set period. Buying the leasehold on a property gives the right to use the property for a fixed period of time at a given price on the basis of a lease contract, such as 60 or 99 years. During this period, the leasehold owner has the right of use of the land or property but at the end of which the title returns to the freehold owner (United Nations Economic Commission for Europe, 1996; United Nations Economic Commission for Europe, 2005). A leasehold land is for a fixed, define period. Tenure duration terms and conditions may also be set by the sovereign authority. For individual occupants, leasehold has generally been found to provide a sufficient sense of security to stimulate investment and an acceptable level of collateral to permit this.

According to the United Nations Economic Commission for Europe (2005), the forms of land tenure that are recognised will influence the rights in land that are

recorded in the registers. Good practice in land tenure will result in laws that define the forms of land tenure that are legal, such as freehold and leasehold; specifying land and property rights, restrictions and obligations that must be registered; and acknowledging that customary rights may exist outside the formal legal system but can be recognised at the local level.

In short, Dalrymple (2005) summarises land tenure as something that regulates the allocation and security of rights in land, requiring legal surveys to determine the parcel boundaries, enabling the transfer of property or use from one party to another through sale or lease, and is concerned with the management and adjudication of doubts and disputes regarding rights and parcel boundaries.

3.4.2 Land Value

The earliest land records, developed for taxation purposes, were from ancient Egypt, dating back to 3000BC (Larsson, 1991). Historically, taxation was based on very crude, simple records or without any record at all. Experiences from many countries indicate that without full inclusive records, tax collection will be incomplete, resulting in considerable losses in public revenue. An annual land tax is based on land valuation, which depends on reliable land information (Larsson, 1991).

The United Nations Economic Commission for Europe (2005: 100) defines land value as “the worth of a property determined in a variety of ways which give rise to different estimates of the value”. According to Ting (2002), the valuation of land is in itself an exercise reflecting what society deems to be of value. This can be done through planning rules or market forces. A high value is placed on credible property systems within the market and the economy.

Land value may differ according to the method of estimation and assessment. The value and worth of land depends on the purpose of which that value is

determined. The value of a building for insurance purposes may not be the same as the price that it would fetch in an auction or in the open market. The estimation of value or market price of a property is more an art than a science, and it depends on many external factors as well as the physical maturity of the land or property (United Nations Economic Commission for Europe, 1996).

It is necessary to estimate the value of any land or property in any dealing, including the cost of survey of the land (Dale, 1976). Valuations are also needed for investment management, insurance and cadastral survey. Good valuations guide the market towards fair prices and allow informed decisions to be made about the efficient use of resources (Dale and McLaughlin, 1999).

According to Larsson (1991), a good land taxation system may have many advantages in addition to providing the government with more revenue. If some of the revenues are retained locally, they will increase the effectiveness of the local authorities and institutions. Hence an effective land taxation system is a powerful instrument to decentralise administration, strengthen local authorities and provide means for local development.

Land taxation is a tax levied on developed and undeveloped land. For development purposes, land tax plays an important role. In some countries, there is a higher tax on vacant land than on developed land in order to encourage landowners to develop their land. However, while high taxes may discourage land owners from bringing their land onto the market, failure to tax can also have adverse consequences (Dale and McLaughlin, 1999).

From the summary of land taxation by Steudler (2004), it can be seen that the levy of land taxes is based on land information for mainly two reasons. Only comprehensive, trustworthy parcel-based land information can provide the overview that is needed for a fair and complete land tax system.

3.4.3 Land Use

Land use has many different interpretations, but in the present context it may be defined as “the economic and cultural activities practised upon the land” (Dale and McLaughlin, 1999: 73).

Land use varies according to labour capacity, machine and chemical technology options, economics and trade opportunities, environment and landscape conditions, and other user requirements. Land use can be restricted according to planning and development outside the control of the immediate owner or occupier. In some cases where legal definitions are complex and difficult, the implementation of recognised actual use regulates the occupation and development of land (Dale and McLaughlin, 1999). There are two basic approaches to regulate how land is developed and used, namely using legislation which is applicable uniformly to all properties; the second approach is using a permit system whereby the property owner must make an application for the period of the proposed development. In addition, there are four common forms of land use control, *viz.* zoning, site-plan control, building regulations, and development control (Dale and McLaughlin, 1999).

Land use is the interaction between land rights and land management. It includes the enjoyment of land rights. It can be controlled through planning policies, regulations and enforcement, implementation of construction planning of permits, and adjudication of land use conflicts (United Nations Economic Commission for Europe, 1996). As mentioned by the United Nations Economic Commission for Europe (2004), land use control may also be regarded as the process of enforcing real property rights, where each land-related activity is subject to property rights. On the other hand, land use planning is the process of allocating resources, especially rights to use land in particular ways, in order to achieve maximum efficiency while respecting the nature of the environment and the welfare of the community (United Nations Economic Commission for Europe, 2005).

In conclusion, land use here refers to the planning aspect. When the cadastre includes initial land allocation, subdivision or consolidation, the land use planning

aspect becomes very important (*Federation Internationale de Geometres*, 1995). The cadastre, as the record of land parcels and registry of ownership, becomes a useful tool for city planning and the delivery of vital services such as electricity, sewerage, water and so on. As today's society faces continuing land shortages and resource scarcity, it is crucial to improve land management and planning, as well as giving more people the chance to own a property over the same land parcel through strata titles (Williamson, 1983).

3.5 Land Registration System

A land register is a set of records of rights of a person or group of persons entitled to land parcels through deeds or titles. It is a land registration in which ownership of rights to the land is recorded. As stated by Das:

The objects of all registration are, among other things, to afford to the public the means of knowing who are the owners of the land of a country, what are the interests carved out of it and what the charges are upon and encumbrances affecting it so that the owners may discharge the liabilities. Ownership entails that those who deal with owner should be protected, and, in many cases, that the transfer to others of their proprietary interests may be easily and inexpensively effected.

(Das, 1963: 183)

Land registration provides the framework and means for recognising formalised land ownership rights and for regulating the transfer of these rights (Dale and McLaughlin, 1999). Steudler (2004) extends land registration to the documentation of certain interests in the land and the provision of documentary evidence for resolving property disputes as well as information for a wide variety of

public functions. In addition, the function of land registration is to provide a safe and certain foundation for the acquisition, enjoyment and disposal of rights in land.

Traditionally, a land register has two components, *viz.* texts defining the interests and diagrams defining spatial identity. Modern land cadastres supporting registration are highly sophisticated and expensive to design, build and managed because they need to display height, width and depth (Wallace and Williamson, 2006).

According to Enemark (2005; 2009), land registration systems are organised in different ways throughout the world, especially with regard to the land registration component. There are two types of systems that can be identified, namely the Deeds System and the Title System. The differences between these two concepts are related to the cultural development and judicial setting of the country. The key difference is whether only the transaction is recorded (Deeds System) or the title itself is recorded and secured (Title System). The Deeds System is a register of owners focusing on 'who owns what' while the Title System is a register of properties presenting 'what is owned by whom'. The cultural and judicial aspects of the system are based on Roman law (Deeds Systems) or Germanic or Common-Anglo Law (Title Systems), depending on the country's history of colonization.

According to the United Nations Economic Commission for Europe (1996) and Dale and McLaughlin (1999), there are three basic types of land registration system for the recording of rights. They can be distinguished depending on the manner in which transaction of land ownership rights is confirmed and documented, namely private conveyance, registration of deeds and registration of the title.

In order to create sustainable development, there must be a secure and complete documentation or representation of legal and physical land objects. Land not only contributes to wealth and economic development, but it is also part of the social and political fabric that sustains all communities. Additionally, land represents a fundamental component of eco-systems. Managing the relationship between land and people inevitably stirs emotions and is the crux of many cultural sensitivities. It is of crucial importance that the issues raised by land management and

administration are openly and sensitively addressed (United Nations - *Federation Internationale de Geometres*, 1999).

3.5.1 Private Conveyancing

Private conveyancing, by which is meant conveyancing without recourse to any public records at all.

(Simpson, 1976: 13)

In private conveyancing, land transactions are handled through private arrangements. The documents agreeing to the transfer of ownership are passed between the seller and purchaser under the guidance of a lawyer. The interests in land are transferred by the signing, sealing and delivery of documents between private individuals without direct public notice, record or supervision (Steudler, 2004). The disadvantage of this private conveyancing is the State has little control over the registration process. This is a potentially insecure method and may be subjected to fraud. Furthermore, private conveyancing is invariably slow and costly, and not conclusive because if the dealing involves more than one lawyer, the process of investigation must be repeated to satisfy both parties. Whether the transaction proceeds as planned depends on the skill and integrity of the lawyers who are conducting the case. Although private conveyancing has limitations, notarial versions of private conveyancing are still found in many parts of Latin America (Dale and McLaughlin, 1999).

3.5.2 Deeds Registration

The maintenance of a public register in which documents affecting interests in land are copied or abstracted is generally known as 'registration of deeds' ...

(Simpson, 1976: 14)

In deeds registration, a public repository is maintained for registering documents associated with property transactions, for example deeds, mortgages, survey plans and so on. A deeds register should ensure that no material factor has been overlooked in tracing the chain of title, thus saving both in time and cost whilst providing a substantial measure of security and protection to the future purchaser of the land (Dale and McLaughlin, 1988). According to Steudler (2004), there are three basic elements in deeds registration, namely the logging of the entry time of a property document, the indexing of the document, and the archiving of the document.

Deeds registration has several weaknesses which have been documented by authors such as Simpson (1976) and Dale and McLaughlin (1988). For example, (i) the deeds merely prove the fact that a transaction took place, without guaranteeing that the intended changes did really occur, (ii) it is not compulsory to register all changes of ownership, so that a correct impression at one moment may become erroneous later on, and (iii) the object the deed refers to is not very well described. Deeds registration is a system for registering legal documents, rather than for registering title to land. In other words, a deed, in itself, does not prove title. It shows that a transaction took place but does not prove that the parties are legally entitled to carry out the transaction.

Nevertheless, deeds registration systems can be improved through the use of better standard procedures such as the improvement of basic records management, standardised forms and procedures, improved physical storage facilities and greater flexibility in survey standards and procedures (Dale and McLaughlin, 1988). These improvements can facilitate the process of title registration. Many of the weaknesses

in deeds-based systems which are currently in operation can be resolved by changing to a system whereby titles are registered.

3.5.3 Title Registration

A register of title is an authoritative record, kept in a public office, of the rights to clearly defined units of land as vested for the time being in some particular person or body, and of the limitations, if any, to which these rights are subject ...

(Simpson, 1976: 15-16)

The best known title registration system is the Torrens registration system which is introduced by Sir Robert Torrens from Australia in the 1850's. It is based on the Mirror Principle, the Curtain Principle and the Insurance Principle (Dale and McLaughlin, 1999).

Title registration was designed to overcome the defects of deeds registration and to simplify the process of executing property transactions. The registration of title is the registration to the land parcel, not the deed. Each parcel is identified on a cadastral map that is cross-referenced to the register that lists the name of the owner, the nature of the tenure, and other ancillary information. The registers must be kept up to date at all times and be a reflection of the legal position on the ground. It is then only necessary to consult the current entry on the proprietorship register to find the name of the owner. Under most systems of title registration, the information on the registers is guaranteed so that, in the unlikely event of fraud or error, anyone inadvertently suffering from the incorrectness of the information will be compensated (Dale and McLaughlin, 1988).

3.6 Land Information System

A key component of land administration is the management of land and property-related data within land information systems. The *Federation Internationale de Geometres* (FIG)'s definition includes spatially referenced, resource, environment and social economic information (Larsson, 1991).

Many formal definitions of a land information system have been proposed but the best known is the one adopted by FIG:

The Cadastre is a land information system, usually managed by one or more government agencies. Traditionally the Cadastre was designed to assist in land taxation, real estate conveyancing, and land redistribution. The Cadastre helps to provide those involved in land transactions with relevant information and helps to improve the efficiency of those transactions and security of tenure in general. It provides governments at all levels with complete inventories of land holdings for taxation and regulation.

(Federation Internationale de Geometres, 1995: 8)

According to Williamson (1983), land information systems can take on many forms depending on the purpose for which they are designed. He further observes that the major problem with the introduction of a land information system is coming up with an economically justified system which will produce a complete up-to-date register or cadastral map. Dale and McLaughlin (1999) also hold the view that land information systems must have detailed information recorded at the local level so that they may be mapped on larger scales.

Land information systems may be designed to serve one primary function or multiple functions. Some have been developed to support strategic planning, others to provide for management control, or operational control so that specific tasks can be carried out effectively and efficiently (Dale and McLaughlin, 1999). Within any

land information system, there are many possible types of data that may be recorded and many different activities to which they may be applied. According to Dale and McLaughlin (1999), there are at least four different types of land information systems, namely the environment systems, infrastructure systems, cadastral systems and social economic systems. However, this research focuses on the cadastral systems only, covering the recording of land and property rights, responsibilities, planning restrictions, and land values that apply to all land areas. These include the multipurpose cadastre that encompasses a more comprehensive set of parcel-related data and that is associated with land ownership, land taxation and land use.

The output of land information system can be maps, reports, statistics or diagrams in hardcopy or digital copy. These attributes, textual and spatial data can be used to describe features of the land, for example soil characteristics, land use, location and geometrical features on the landscape (Harcombe, 2001). Today, land information systems have become powerful tools for collecting, managing, analysing, and distributing of land related information.

Land is related to land registration and cadastre, and in general to land information systems. The category of land registration and cadastre concern not only physical, spatial or topographic attributes such as location, dimensions, but also the abstract or thematic aspects, such as legal situation, tax data and value. Larsson (1997) likens land to the physical appearance of the area. It is the soil and what lies beneath, and its characteristics include the water environment. Nowadays most lands have changed from their original forms and may have been developed into arable land or cultivated forest. In urbanised areas, land may have been developed for settlement, industrial, commercial or transportation and traffic use, or may have been kept as recreational areas. The ability to present spatial characteristics of land parcels allows a better definition of cadastral spatial subdivision with three-dimensional presentation. Such a development provides better results for inspection and analysis of data.

To conclude, the land information system which is used in a particular country is a product of historical and economic development, and thus is a unique system in each instance. That is why the land information system chosen by each

country is one that is deemed most suitable for its political, social and economic conditions. To define the concept and strategy of such land information system development from almost the beginning is a crucial task. Without a clear understanding of the tasks and purposes of the land information system, it would be time-consuming and costly to improve or even change it after it is implemented.

3.6.1 Categories of Cadastre

The *Federation Internationale de Geometres* (FIG), at its Permanent Committee meeting in Berlin in 1995, established the “Statement on the Cadastre” by defining it as follows:

A cadastre is normally a parcel-based, and an up-to-date land information system containing a record of interests in land (e.g. rights, restrictions, and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of interests the ownership or control of those interests, and often the values of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyancing), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection.

(Federation Internationale de Geometres, 1995: 1)

This declaration by the FIG highlights the importance of the cadastre as a land information system for social and economic development. It offers an international perspective of the cadastre as a land information system for social and economic development. The declaration also describes some of the different roles

that surveyors play in the management and operation of a cadastre. However, this declaration does not recommend a uniform cadastre for every country or jurisdiction.

Thus, a significant outcome of this publication is not only an increased awareness of cadastral and land information issues, but also the realisation that cadastral systems are dynamic. They represent the many facets of society and are intrinsically influenced by historical developments and future directions, as indicated by governments and society.

Williamson states:

... it is difficult to give an absolute definition of a cadastre since the systems differ between countries due to varying historical development and local laws and customs. In the same manner it is difficult to classify cadastres into different types ...

(Williamson, 1983: 4)

Many authors writing on land administration have attempted to define what a cadastre is. A definition which would have general acceptance is as follows:

A cadastre is a complete and up-to-date official register or inventory of land parcels in any State or jurisdiction containing information about the parcel regarding ownership, valuation, location, area, land use and any buildings or structures thereon.

(Williamson, 1983: 1)

A cadastre is required in a wide variety of activities by existing or prospective landowners, lawyers, surveyor, valuator, real estate manager and all levels of government agencies. The cadastre generally pertains to the proprietary land unit that is organised around the cadastral parcel, which is part of an estate and has a separate identity. The principal function of a cadastre is the provision of data concerning proprietary land unit as land ownership, value and use which provides the

information component of land registration. The information in a cadastre is collected, stored, referenced and retrieved primarily at the land parcel level while its coordinates may then be added to facilitate data manipulation as well as exchange of information with other systems.

With regard to the statement above, the cadastre's primary means is to provide the private and public sectors with information about property rights, restrictions and responsibilities, the interests in parcels of land and its location, size, improvement and value. Cadastres are registers of rights over attributes of definable area of land (Ting, 2002). There are three categories of cadastre, namely the juridical cadastre, which serves as a legally recognised record of land tenure as well as a register of ownership of land parcel; the fiscal cadastre, developed primarily for property valuation, is a register of properties recording their value; and the multipurpose cadastre, encompassing both parcel related information, is a register of attributes of parcels of land (Dale, 1976; Dale and McLaughlin, 1988).

With different countries interpreting the term 'cadastre' in different ways, there is bound to be confusion in analysing land information systems. In some countries, the cadastre contains relatively few items of information while others are more complex. There are cases where countries operate several cadastres, each with a different objective, and this has resulted in the duplication of information (United Nations Economic Commission for Europe, 2004). Nevertheless, the commonly accepted understanding of a cadastre is that it is a form of land information system with up-to-date information on the ownership, value and use of land parcels and buildings, together with environmental and social economic data (United Nations Economic Commission for Europe, 2005).

Again, the United Nations Economic Commission for Europe (1996) and the United Nations Economic Commission for Europe (2005) note that a land information system is not necessarily land parcel based. It may be an inventory of forest resources, soils, geology and may incorporate a variety of data. On the other hand, a cadastre is more specifically focused on the ownership, value or use of land parcels. The data which may appear in a cadastre include coordinates, maps,

property addresses, land use, real property information, the nature and duration of the tenure, details about the construction, population and land taxation values.

3.6.1.1 Fiscal Cadastre

The fiscal cadastre has been defined by Dale and McLaughlin as:

... an instrument for administering land tax policy. Although primarily a support for land value and property taxes, the data that it records can be used in the determination of other form of tax, such as those imposed on personal wealth or income derived from real estate. The data also provide fiscal information for the expropriation of land for government purposes and for revenue transfers between different levels and departments of government.

(Dale and McLaughlin, 1988: 53)

Dale and McLaughlin (1988) also define the fiscal cadastre as an inventory of land parcels that provides the information necessary for determining the value of each parcel and the tax due on it. As a result, in operating the fiscal cadastre, it is necessary to identify all the parcels that are to be valued, before classifying and valuing them, followed by taxes to be collected from those who are responsible for the property.

Lastly, the information required to develop and maintain a fiscal cadastre may be collected directly or indirectly through surveys or from other sources, for instance details of land ownership and their property boundaries. Furthermore, although the fiscal register may already be a source of evidence of the rightful owner, it is commonly acknowledged that there should be a connection to the juridical cadastre since the proprietor's name is considered to be as integral part of the record.

3.6.1.2 Juridical Cadastre

According to Dale and McLaughlin, the juridical cadastre:

... is concerned with documenting rights and relating them to the land with which they are associated. It is concerned with all forms of property rights.

(Dale and McLaughlin, 1988: 19)

Historically, when land for settlement and cultivation was plentiful in proportion to the size of the population, there was less of a need for stringent land management or administration. With the growth of sedentary agriculture and competition for available space, however, land rights and controls over land use began to emerge. The cadastre is often the principle source of information about ownership of rights in land. The basic unit of cadastral record is the land parcel, known as a lot, or plot or a volume, of space recognised for recording purposes. In the context of juridical cadastre, a land parcel is defined by a set of property rights. It extends notionally from the centre of the earth to the infinite in the sky.

Williamson (1983) points out that other records, for example, records of land use, valuation or utilities are secondary, and any future land information system should have the juridical cadastre as the central component. In regard to the juridical cadastre, the modern cadastre contains both fiscal and juridical records that are paramount in the system as they provide the basic data for the maintenance of the records (Nordin, 2001).

Dale and McLaughlin (1988) also define the juridical cadastre as the information system which underpins land registration. Indeed, land registration cannot operate effectively without some form of cadastre. The juridical cadastre has two parts. The first is a written record or register containing information about each parcel, such as the spatial information and the rights which appertain to the land.

The second is cross-referenced to the first and contains a detailed description of the parcel, in the form of either survey maps or measurements.

3.6.1.3 Multipurpose Cadastre

The primary objective of the land register is to record land rights. Economic considerations suggest that the cost of establishing and maintaining a register can be significantly reduced if multiple uses of the recorded information can be satisfied. Cadastral surveys in many countries are moving towards multipurpose records; there is growing evidence of the necessity for such an approach (Dale, 1976).

Besides recording land rights, the function of a cadastre is also to support the values associated with the land. Each set of land records can be expanded into a multipurpose cadastre. The development of a multipurpose cadastre has, in general, been evolutionary, based on the refinement or improvement of existing land records as well as surveying and mapping base. According to Dale and McLaughlin (1988), within the multipurpose cadastre, there should be maps showing the location and different types of physical features; such information can also be processed on-line. While the multipurpose cadastre is in part concerned with physical attributes such as man-made objects and natural features associated with each land parcel, abstractions, surveying and mapping data can also be referenced to the parcel.

According to Williamson (1983), with such high expectations of the uses of multipurpose cadastre, it is not easy to quantify all its benefits. However, the major advantages that are directly beneficial from multipurpose cadastre are: (i) an improved conveyancing system, (ii) an improved cadastral survey system, (iii) improved land use planning, land management and environment management, (iv) improved management of publicly owned lands, (v) reduction of duplication, and (vi) better control of land transactions.

It is noteworthy that the multipurpose cadastre, being an extension of the basic cadastre, is an essential tool that can include other information from various databases or registers, and can be adapted for local needs. As such, it is a basis for planning for utilities, land information and development management.

3.7 Cadastre System

The basic building block in any land administration systems is the land parcel as identified in the cadastre. However, since the concept of a cadastre is difficult to define, it would be better to discuss cadastre systems rather than a cadastre because cadastre systems include the interaction between the identification of land parcels, the registration of land rights, the valuation and taxation of land and property, and the present and possible future land use (Enemark, 2005). Therefore, it is noted that even though cadastre systems around the world are clearly different in terms of structure, processes and actors, their design is increasingly influenced by globalisation and technology, moving towards multipurpose cadastres (Molen, 2003b).

The cadastre system comprises the map, real estate and land register. The map shows the boundaries of real estates and location of the parcels. Real estates and changes are entered into the cadastre. The land register based on the cadastre contains a list of titles for real estate. Today's cadastre registration not only focuses on property registration but also serves other tasks used by private and public sectors in land development, urban planning, land management and environment monitoring (*Federation Internationale de Geometres*, 1995; Williamson and Ting, 2001).

The central components of the cadastre systems are adjudication, demarcation, survey and preparation of boundary descriptions (Dale, 1976). The overall cadastre systems are administered or controlled by the State or federal government, either on its own or in conjunction with the private sector. The outputs

of the cadastre system are the boundary descriptions that can be used for the production of cadastral maps, recording titles or boundaries, valuation and taxation or planning and development.

Nevertheless, it is more important to examine the key processes with the cadastre systems which are associated with adjudicating, transferring and subdividing land rights, rather than look at a free standing concept of a cadastre (Williamson, 1983). It is important to recognise the flexibility of a cadastre. It can record a continuum of land tenure arrangements from private and individual land rights to communal land rights as well as have the ability to accommodate traditional or customary land rights. Additionally, Williamson (1983) suggests that the success of a cadastre system can be measured on how well it achieves these broad social and economic objectives, not the complexity of its legal framework or the technical sophistication of the cadastral surveys or cadastral maps.

3.7.1 Cadastral Survey and Mapping

A section of the United Nations Economic Commission for Europe reads:

Cadastral surveys are concerned with setting out and recording the turning point or corners along property boundaries. A variety of techniques may be used, each having its own inherent accuracy and cost. The necessary and sufficient accuracy that is needed for any survey depends on the purposes for which that survey is conducted.

(United Nations Economic Commission for Europe, 2005: 90)

In addition, *Federation Internationale de Geometres* states that cadastral surveying:

... is the definition, identification, demarcation, measuring and mapping of new or changed legal parcel boundaries. It usually includes the process of re-establishing lost boundaries and sometimes resolving disputes over boundaries or other interests in real property.

(Federation Internationale de Geometres, 1995: 5)

The United Nations Economic Commission for Europe (2005: 8) states that “the basic features that are recorded in a cadastre are the land parcels and their boundaries. Good practice will result in laws relating to parcels and their boundaries that: (i) provide a legal definition of a land parcel; (ii) recognize that boundaries may be vertical (for most surface areas) or horizontal (for strata titles); (iii) differentiate between the legal position of a boundary and the physical position of objects such as fences or hedges; (iv) define the priority of evidence, such as survey measurements versus monuments, when re-establishing a boundary line, and indicate whether marks on the ground take precedence over measurements recorded in the registers in the re-establishment of boundaries or whether data on the plans must be followed; and (v) avoid getting into detail over the precision with which boundaries should be surveyed for the purposes of land titling”.

In order to guarantee the accuracy of boundary surveys and to apply quality controls to the work of the cadastral survey, it is common for survey regulations to be introduced. These often prescribe the manner in which surveys are to be carried out as well as the standards that must be achieved. Survey regulations may also prescribe the necessary qualification for the granting of licence to undertake cadastral surveys.

Cadastral surveying is a general term applied to several different types of survey. It is mentioned here only to make the reader aware of the expression and broad aspects of its use. A rigid definition of a cadastral survey involves only the

information required to define the legal boundaries of a parcel of a land, whether it is rural or urban. Therefore, the documentation, bearings, distances and areas would be shown. This definition has now been expanded through common usage to include cultural features, such as building location, drainage features and topographic information, such as spot elevation or contours.

Cadastral and cadastral surveys are aspects of land administration. The primary object of a cadastral is to determine for each land parcel, its location, the extent of its boundaries and surface area, and to indicate its separate identity, both graphically on a map or in a record as well as physically on the ground. Its secondary objective is to provide information for a multipurpose cadastre to fulfil the overall information requirements of land administration (Dale, 1976). Cadastral plans can fulfil many of the functions of large-scale topographic maps, not only serving such purposes as boundary control, registration of title and valuation but also forming a basis of planning and development (Dale, 1976).

The function of the multipurpose cadastre is to bring together all relevant land information in a compatible data form. The objectives of cadastral surveys are to acquire information, process it, coordinate and finally to present the vital information. Cadastral surveying is an expensive process not only in its execution but also in the loss of capital from delays in development and investment which may arise owing to inefficiency. The challenge is how to meet the short and long term requirements of the fiscal, juridical and multipurpose cadastral at minimum expense with maximum efficiency.

The existence of up-to-date maps and records of all existing rights in land provided to every branch of the government that deals with the administration of land is helpful. For instance, the simplification of courts/judicial processes; improved land acquisition for public purposes; and improved administration of forests and other public land are the results of good cadastral maps and a good system of registration of rights to the appreciation of a national agrarian situation and to the elaboration of measures for its improvement and reform.

It is mentioned by Rabley and Falk (2004) that cadastral surveys and cadastral maps are fundamental to an efficient and speedy land registration process. They are needed to ensure that rights and restrictions about properties can be quickly identified by referring to the same unique place on the earth. In addition, they all work to define the boundary of real property. In order to speed up and streamline the process of property registration, it is important for cadastral surveys and mapping to emphasize reliable cadastral surveying information, which adds to the security of titles.

As Dale and McLaughlin (1999) point out, cadastral surveying is the term generally used to describe the gathering and recording of data about land parcels even though the records do not form part of an official cadastre. When properties are initially registered, government officials have traditionally undertaken the processes of cadastral surveying and land title adjudication.

In many countries, the techniques that are used in cadastral surveying are prescribed in the law and in the regulations that specify the standards that are to be achieved and the methods that must be used to deliver them. Surveyors may also need to be licensed in order to carry out their work. Regulations and legislation for licensed surveyors have been introduced in many countries to ensure that quality reliable data is collected. These standards, in many cases, are still monitored by the central government cadastral mapping agency, which are responsible for the accuracy of the work (Dale and McLaughlin, 1999).

In conclusion, the methods and precision of cadastral surveys are often prescribed in survey-related laws and regulations although the final standard of the product is not normally defined in laws relating to the registration of titles (United Nations Economic Commission for Europe, 2005). From the legal perspective, it is necessary to prescribe the qualification of those who may conduct cadastral surveys. It is also essential to establish the legal liability of the surveyors for work undertaken and for the consequences in the short and long term of any errors in measurement. The definition of legal liability is important, since quality control is most cost effective when it is undertaken by sampling. Since this implies the risk of failing to identify incorrect data, the level of risk and consequences of mistakes must be clear

in order to prevent expensive, unnecessary and time consuming checking of surveys (United Nations Economic Commission for Europe, 2005).

3.7.2 Boundary

The need to indicate boundaries on the ground came long before the practice of title registration, survey, mapping, or conveyancing (Simpson, 1976). In a legal sense, a boundary is a surface which defines where one landowner's property ends and the next begins. Normally, this surface is vertical and intersects the ground along the legal boundary line (United Nations Economic Commission for Europe, 2005).

It may be likened to a bead curtain suspended from the sky such that anyone passing through it from one side to the other passes from one set of property rights into another. The legal boundary is an infinitesimally thin surface extending from the centre of the earth to the infinite in the sky and is essentially an abstract concept (Dale and McLaughlin, 1988). Exceptions lie in three-dimensional property rights or strata titles where the boundary may be horizontal as well.

There are three categories of fixed/specific boundaries, namely boundaries that are (i) defined on the ground prior to development and identified; (ii) identified after development; or (iii) defined by surveys to specified standards. A fixed boundary is one that has been accurately surveyed so that any lost corner monument can be replaced precisely from the measurements.

There are also three categories of general boundaries, namely (i) the situation where the ownership of the boundary feature is not established, so that the boundary may be one side of a hedge or the other or down the middle; (ii) the indeterminate edge of a natural features; or (iii) the situation where the boundary is regarded as approximate so that the register may be kept free from boundary disputes. The third

type of general boundary is suitable in the determination of actual forest or watershed boundaries, or even lot parcels in some countries using aerial photographs or space satellite techniques to define an accurate boundary line that it can be mapped in the register or document of title. However, under the English system, a boundary is fixed when agreement is reached between adjoining owners and the line of division between them is recorded as fixed in the register.

The actual physical location of a boundary line is normally demarcated in one of two ways (i) by point features such as pegs the straight line between which marks the divide between two properties, or (ii) by linear features such as walls, hedges and fences. Such an approach works equally well with three-dimensional properties such as apartments since their construction defines their effective limits. In the case of strata titles, for example where there is separate ownership of an apartment within a block of flats, the ownership of parts of buildings can be defined and guaranteed with determination of where, within the walls and floors, one set of property rights changes into another.

On one hand, an advantage of fixed boundaries is that landowners can have confidence in where their property limits lie since these are formally recognized within the system. On the other hand, for general boundaries, the precise line of the legal boundary between adjoining parcels is left undetermined. The ownership of the land can be guaranteed up to the bounding feature, the ownership of which is left uncertain. Information about the location of parcels and their boundaries is an important part of a land information system, the only differences being the precision with which the location of boundaries is recorded and the extent to which this information can be used as legal evidence.

3.8 The Future Cadastre

Intended as the replacement for traditional cadastral institutions, Cadastre 2014 is the result of a study by the Working Group 7.1 (Commission 7) of *Federation Internationale de Geometres (FIG)*, and a land recording system. Developed between 1994 and 1998, it took into consideration social, legal, economic, and technical developments in the domain of cadastral systems worldwide. The mission was to develop vision statements, where the cadastre as a concept might be in 20 years' from 1994 (Kaufmann and Steudler, 1998). It sought to deliver certainty of rights and peaceful coexistence as well as wider economic aims of internationalisation (Ting, 2002).

Based on studies of existing cadastral systems, the Working Group introduced six statements on the envisaged characteristics of development for Cadastre 2014. These six statements dealt with the technical development, institutional and financial structures, mission and purpose that formed the definition of Cadastre 2014 as follows: (i) Statement 1: Cadastre 2014 will show the complete legal situation of the land. Private and public rights and restrictions on the land will be systematically documented; (ii) Statement 2: The separation between maps and registers will be abolished; (iii) Statement 3: The cadastral mapping will be dead. Long live modelling; (iv) Statement 4: Paper and pencil-cadastre will be gone; (v) Statement 5: Cadastre 2014 will be highly privatised. Public and private sectors will work closely together; and (vi) Statement 6: Cadastre 2014 will be cost-recovering.

Clearly, a major aim of the Cadastre 2014 proposal was to improve information about the legal situation of land so as to strengthen legal security. Of direct relevance of these statements to the Malaysian Cadastre System are the development of the integration of Computerised Land Registration System (CLRS) and Cadastral Data Management System (CDMS), e-Land (*e-Tanah*) and e-Cadastre (*E-Kadaster*), and the Electronic Strata Module.

Kaufmann (2004), in elaborating on Cadastre 2014, states that the three-dimensional aspect is not of primary interest. From the point of Cadastre 2014, the

introduction of the three-dimensional aspect depends on the legal framework. If the law defines land objects as being three-dimensional, it is represented in the Cadastre 2014 concept simply with its three-dimensional coordinate values. If the effects of the right or restriction have a spatial significance, the three-dimensional objects should define clearly the space of impact, describing the outlines of the effect of a right or restriction. If spatial impacts are to be evaluated, the functions of spatial exploitations should be developed and used for analysis.

According to Tse and Gold (2003), Cadastre 2014 introduces a more general definition of a land object with homogeneous conditions inside its boundaries. It matches representation of the real world, where one land parcel may have one or more different ownerships, especially for multi-storey buildings and constructions at the underground surface where people need to have access to some part of its visible exterior.

According to the report of Cadastre 2014 by Kaufmann and Steudler (1998), future cadastres will show the complete legal situation of land, including public rights and restrictions. All these rights, restrictions and responsibilities (RRR) related to land are often overlapping. Current legal cadastre systems have shown limitations in some 3D situations. In areas with an increasing pressure on land, there is a growing interest in using space under and above the surface. Therefore, three-dimensional information has become increasingly important in registering today's world (Stoter, 2004). Since the beginning of the twenty-first century, three-dimensional registrations in both technical and institutional issues of multi-storey developments and complex constructions have become more widespread. Purcell, Murray and Prendergast (2006) believe that many countries such as Norway have looked into the various components associated with three-dimensional registrations. In this regard, Malaysia should also start to look into the legislative aspects of these limitations and come up with a principal framework for 3D property objects.

At the FIG 2010 Congress in Sydney, Australia, Bennett and co-authors from University of Melbourne described six design elements relating to the role and nature of future cadastres, as presented in Cadastre 2034. One of these design elements was 'survey accuracy'. However, Cadastre 2034 has still a long journey to go before

implementation and circumstance are bound to change. Land and Jones (2012) in the FIG Working Week 2012 at Rome, Italy presented another future cadastral system, *viz.* Cadastre 2.0. This system was intended to: (i) be multipurpose in nature, meeting a wide range of needs beyond simply recording land ownership of defining parcels for taxation; (ii) enable the full spectrum of rights and parcel definitions to be modelled and managed within the system; and (iii) be truly three-dimensional, to reflect better the real three-dimensional overlapping rights, and the registration of multi-level properties.

It may be concluded that future cadastre is a methodically arranged public inventory of data concerning all legal land objects in a certain country or district, based on a survey of their boundaries. Such legal land objects are systematically identified by means of separate designations. They are defined either by private or by public law. The outlines of the property, its identifier together with its descriptive data, may show each separate land object in nature, size, value and legal rights or restrictions associated with the land object.

3.8.1 3D Cadastre

Multiple use of land is increasing. The owner of a parcel of land may possess the rights to the column of air above and the column of soil under that land. At ground level, multiple use of land has resulted in the multiple exercises of rights of the use of the regions above and below ground level and in the division of rights in the ownership column.

Basically, the purpose of 3D cadastre objects modelling as proposed by Stoter (2004) is to provide boundary certainty of 3D cadastre objects, particularly regarding 3D strata and stratum objects of ownership. Stoter asserts the need of a 3D cadastre:

Pressure on land in urban areas and especially their business centers has led to overlapping and interlocking construction Even when the creation of property rights to match these developments is available within existing legislation, describing and depicting them in the cadastral registration, poses a challenge The challenge is how to register overlapping and interlocking construction when projected on the surface in a cadastral registration that registers information on 2D parcels. Although property has been located on top of each other for many years, it is only recently that the question has been raised as to whether cadastral registration should be extended into the third dimension ...

(Stoter, 2004: 3)

The consideration which is studied in most countries for the achievement of an unambiguous determination of 3D cadastre issue starts gradually from the existing 2D cadastre system, leading to a better understanding of the legal, organisational and factual situations above and below the ground surface. Moreover, as mentioned by Aydin, Demir and Atasoy (2004), the use of three-dimensional data in applications to register properties, property rights of objects in geometrical and legal situations, parcel based three-dimensional information systems should be supported by three-dimensional information. Hence, legal and organisational aspects in the 3D cadastre system are preliminary to other aspects.

3.8.1.1 The Importance of 3D Cadastre

Current cadastre registration systems, bound to ground surface topological and geometrically described parcels, have shown limitations in providing an insight into three-dimensional location of three-dimensional constructions as well the vertical dimension (depth and height) of rights established for three-dimensional

constructions (Stoter, 2004). In addition, the cadastre should be able to describe property ownership, including Strata Title ownership.

A 3D cadastre is defined as a cadastre that registers and gives insight into rights and restrictions not only on parcels, but also on 3D property units (Stoter, 2004). Thus, a 3D cadastre would be able to handle such conditions as overlapped buildings and utilities that prohibit the property from being registered according to legal and organisational aspects using a 2D cadastre.

In the near future, the cadastre will contain updated documentation of public and private rights, ownership, land use and real estate in various spaces. Concurrently, Benhanu and Doytsher (2003) contend that the 3D boundaries and parcels in space will be determined by the 3D cadastre that serves the legal and physical objectives. A modern cadastre system should always reflect the existing situation of all property rights, including a mixture of private and public properties. It should provide a better-rationalised management of the built environment, including regulations of legality of use or of economic application (Dimoponlou, Gavanas and Zuntelis, 2006).

In order to better represent this evolving situation, it is necessary to develop a 3D cadastre with its own legal solutions that meet its specific needs. On the other hand, the content and role of a cadastre that is related to three-dimensional properties have not changed significantly, notwithstanding the substantial impact on the cadastre system. These impacts come mostly from global economic, social, technological factors as well as the need for sustainable development. The 3D cadastre system should provide information beyond the typical planning data and ensure registered rights above, on and below the surface of a property. Hence, land will be more optimally developed and utilised.

Valstad (2006) notes that no country has fully established and implemented the required legal and organisational requirements to accommodate 3D cadastre comprehensively. At present, there are countries that have developed infrastructures that are based on 3D cadastral systems within their legal systems, organisational and technical needs. Valstad asserts that a few countries have new laws that provide for

the registration of specialised three-dimensional parcels although the cadastre system itself is still of a two-dimensional nature. Norway and Sweden have passed laws that make it possible to register three-dimensional construction parcels. The same is true for the Netherlands, but registration does not apply to separate units. British Columbia in Canada and Queensland in Australia have provisions in their laws to subdivide properties situated on the same 2D coordinates.

3.8.1.2 Practical Solutions

Rapid urban development today is increasing the demand for three-dimensional boundaries to support the volume parcels in real property objects. However, problems may arise from the registration of 3D properties. Stoter (2004) proposes three fundamental concepts to cater to and resolve such problems, albeit with minor modifications to suit or match the cadastral survey, mapping registration system and land registration system to that of each country. The three fundamental concepts with several options are as follows:

(a) Full 3D cadastre

- Option 1: Combination of infinite parcel columns and volume parcels, i.e. a combined 2D/3D alternative.
- Option 2: Only parcels that are bounded in 3D volume.

(b) 2D/3D hybrid cadastre

- Option 1: Registration of 2D parcels in all cases of real property registration, and additional registration of 3D legal space in the case of 3D property units.
- Option 2: Registration of 2D parcels in all cases of real property registration, and additional registration of physical objects.

- (c) 2D cadastre with 3D tags linked to parcels in current cadastral registration.

i) Full 3D Cadastre

The concept of a full 3D cadastre introduces property rights in three-dimensional space, which is being subdivided into volume parcels partitioning the three-dimensional space. To support this hypothetical concept and final solution, the legal basics, property transaction protocols and cadastral registration should corroborate with the establishment and conveyance of three-dimensional rights. In this approach, the traditional cadastral map does not have any bearing on the three-dimensional rights that entitle persons to volumes. In other words, rights and restrictions are no longer established only on 2D parcels, but are explicitly related to well-defined volume parcels. Examples of real property objects that are defined in three-dimensional are strata and stratum units. However, to realise this full 3D cadastre solution, significant changes are required in the cadastral survey and mapping registration, land registration, as well as the technical and legislative frameworks.

In conclusion, it is possible to establish parcels that are defined with boundaries on the surface because the volume parcels are only established in three-dimensional situations. The first option is to convert the conventional parcels representation into three-dimensional; a parcel is defined by the boundary on the surface, which is converted into an indefinite parcel columns and volume parcels that intersects with the surface at the location of the parcel boundary. With the second option, the only property objects that are recognised by the cadastre become volume parcels, forming a complete partition of space. Therefore, it is no longer possible to entitle persons to infinite parcel columns defined by boundaries on the surface, but only to well-defined, totally bound and surveyed volume (Stoter, 2004). The implementation of three-dimensional volume parcel full 3D cadastre solutions challenges the traditional doctrine of land ownership as a cone reaching down to the centre of the earth. In order to define the extent of ownership in the vertical plane, it requires extensive and complicated overall three-dimensional land title settlements

prior to the cadastral survey. Moreover, the relevant land laws need to be amended, and this usually takes a long process.

ii) 2D/3D Hybrid Cadastre

The 2D/3D hybrid cadastre solution refers to the integration of the 2D cadastre with the factual situation in three-dimensional space in registering the three-dimensional objects within the three-dimensional cadastral registration. This solution requires the separate legal registration of on-surface parcels and of the three-dimensional situations, which are combined and integrated. The hybrid solution of cadastral registration of the three-dimensional situation is not judicially binding. This means that the exact legal situation still depends on reliable documents like those recorded by Certified Plan in the land registration, with the description of the volume agreed upon in the three-dimensional registration. The three-dimensional representation is the volume to which a person is entitled, i.e. the registration of the three-dimensional object defined by the surface parcel and that is bound by the upper and lower limits. Such registration can also refer to the three-dimensional physical object itself.

To conclude, the first option refers to the 3D registration of rights that are already registered with the 2D parcel as the starting point of registration. The second option is the registration of 3D physical objects themselves, which a physical object as the starting point of registration. Constructions (e.g. buildings) are integrated in the cadastral data in the current cadastral registration. The juridical and cadastral concept of ownership and property will remain the same.

iii) 2D Cadastre with 3D Tags

In this solution where 2D cadastre is supplemented with three-dimensional tags solution, the existing 2D cadastre is maintained in its original state, but with external references linking to three-dimensional digital drawing or three-dimensional analogue to represent three-dimensional situations. In this solution, complex three-dimensional situations are registered using ad hoc solutions within current registration possibilities, while every right that is registered can be attributed with a

reference to a three-dimensional representation. The difference between 2D/3D hybrid cadastre and 2D cadastre with three-dimensional tags is that the three-dimensional representations in the second approach are maintained separately and not integrated with the cadastral data.

3.9 Summary

It is important to distinguish between cadastre and land administration. The former is a type of land information system that records land parcels as part of a country's land administration, conveyancing or land registration system. The cadastre registers the ownership of parcels of land with the value and attributes of land parcels. On the other hand, land administration involves the processes of regulating land and property development and the use and conservation of the land, the gathering of revenues from the land through sales, leasing, taxation, and the resolving of conflicts concerning ownership as well as use of land. These processes include data collection, the most important one being the cadastre. In short, land administration is the processes of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies.

It is important to note that, depending on the jurisdiction, the definition of land may or may not include everything that is attached to it such as the building on the surface or vegetation growing on the land or minerals below the ground surface. Furthermore, from an institutional perspective, land management includes the formulation of land policies, legislative framework, resource management, land administration arrangements, and land information management as well as entailing both government and private initiatives. As has already described earlier, the modern cadastre replaces traditional concepts of the cadastre and land registration with a comprehensive land recording system and introduces the concept of legality in property.