MIDLANDS STATE UNIVERSITY

FACULTY OF SCIENCE TECHNOLOGY

DEPARTMENT OF SURVEYING AND GEOMATICS

"INVESTIGATING THE CONFORMITY BETWEEN THE ZIMBABWE LAND ADMINISTRATION SYSTEM AND THE LAND ADMINISTRATION DOMAIN MODEL",

BY

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ABSTRACT

The increase in land utilization has necessitated the devising of more adequate technologies for better management and administration of the nation's most valuable resource. The land administration functions in Zimbabwe are distributed within several departments. This has necessitated the need for effective communication between the departments to ensure effective service delivery. The need for a National Land Information System in Zimbabwe has coincided with the development of the Land Administration Domain Model (LADM). The main goal of the LADM is to improve communication between Land Administration systems locally, regionally and internationally. LADM can be a basis for combining data from different Land Administration systems, for example systems with datasets on formal and informal people-to-land relationships.

The main aim of this study is to investigate the conformity between the Zimbabwe land administration system and the LADM. The first stage in the investigation is to analyze the current land administration system in Zimbabwe. The analysis results are then used to define the current land administration model in Zimbabwe. The model is then compared with the land administration domain model to determine difference and similarities between the models.

The comparison is also a basis for determining the LADM packages that can be directly implemented in the Zimbabwe land administration system, the packages that will not be required and the packages that might need to be modified. In this research project the conceptual models of all the party packages were developed using Unified Modeling Language (UML).

DEFINITION OF TERMS

Term	Definition
Land Administration	Is the 'process of determining, recording and disseminating information about the relationship between people and land' (ISO/DIS 19152:2011).
Group party	Group party refers to any number of parties, forming together a distinct entity, with each party registered.
Responsibility	Responsibilities are formal or informal obligation to do something.
Restriction	Restrictions are formal or informal entitlement to refrain from doing something.
Right	Rights refers to action, activity or class of actions that a system participant may perform on or using an associated resource.
Spatial unit	A spatial unit is a single area (or multiple areas) of land and/or water, or a single volume (or multiple volumes) of space.
Spatial unit group	Spatial unit group refers to any number of spatial units, considered as an entity.

ACRONYMS

Term	Abbreviations

Term	Abbreviation
LA	Land Administration
LADM	Land Administration Domain Model
DSG	Department of the Surveyor General
MDA	Model Driven Architectures
UML	Unified Modelling Language
TC211	Technical Committee 211
GIS	Geographic Information Systems
ZAPF	Zimbabwe Agricultural Policy Framework
UTM	Universal Transverse Mercator
ISO	International Standards Association

Table of Contents

LIST OF FIGURES AND TABLES

CHAPTER 1: INTRODUCTION

1.0 Introduction

In Zimbabwe, land accounts for more than three-quarters of the national wealth. The Zimbabwe economy is based on agriculture and land is the basic input in agricultural production. The government obtains revenue from land transfer taxes and rates. A land owner can acquire loans from financial organizations with land being used as collateral. The past decades has seen an increase in land utilization in Zimbabwe and the world as a whole. Kaufmann (1998) attributed the increase in land utilization to the increase in world population. In light of the increase in land utilization, Lemmen (2011) realized the need for cadastral paradigms to embrace fresh understanding of the relationship between land, property and rights. He highlighted the need to devise land information systems which show the complete legal situation (rights, restrictions and responsibilities) pertaining to a parcel of land and which allow data to be shared in a standardized and coherent manner for effective and efficient land administration.

Dale and McLaughlin (2000) defined land administration as "*the process of determining, recording and disseminating information about land ownership, value and use"*, but for the purposes of this study land administration will be defined as "*the process of determining, recording and disseminating information about the relationship between people and land"*[1]. In Zimbabwe the land administration functions are distributed with land related information being handled at different departments. The major departments involved in the Zimbabwe Land Administration process were identified as the Department of the Surveyor General (DSG), the Registrar of Deeds and the local authorities. The Department of the

Surveyor General is responsible for the quality of all spatial data pertaining to land parcels within Zimbabwe. The Department of the Surveyor General (DSG) is the custodian and supplier of base data in Zimbabwe, however, most of the data is still in analogue format [2].

In 1997, the Department of the Surveyor General in conjunction with the Swedish government developed a land information system called Land Transaction system (LTS). The system contained all properties surveyed including permits, approval date, scanned diagrams and working plans, map compilations on 1:25000 and showed all transactions on a parcel of land. The system servers crashed in 2002 thus the DSG had to revert back to the manual system. The DSG has been for the past few years putting considerable efforts in resuscitating the Land Transaction system. Currently the DSG is working with an IT team from the University of Zimbabwe with the aim of capturing all survey records from 2002 to date. The LTS is being used by few sections within the DSG, thus most of the operations are still mainly paper based.

The cadastral system in Zimbabwe is regulated by statutory instruments such as Statutory Instrument 727 of 1979 (Land Survey Regulations [Chapter 20:12]) which outlines the quality of data to be obtained, procedures and the manner in which spatial information is disseminated to the various clients. All cadastral plans framed after the passing of the Land Survey Regulations statutory instrument of 1979 are linked to the nation grid and all land appear on the plans and on the registers. Most of the cadastral plans framed prior to the passing of Land Survey Regulations Statutory Instrument of 1979 were on the local system. These diagrams and survey records have not been converted to the trigonometrical system, but they have been noted on the hard copy compilation sheets. The Surveyor General is

responsible for the updating of the cadastral plans so that they conform to the correct situation on the ground.

A fixed boundary system is used in Zimbabwe. In this system the boundaries are physically marked on the ground using regulated monuments. The information collected from a survey is then sent to the Surveyor General for approval and upon approval the Surveyor General notifies the Registrar of Deeds.

The deed registry office is responsible for land registration under the Deeds Registration Act [chapter 20:05]. Hennsen (2000) defined land registration as *"the official recording of legally recognized interests in lands".* A hybrid system of title and deed registration is used for land registration in Zimbabwe. This system involves elements of both title and deed registration with title being registered against a parcel of land and in this system diagrams are always annexed to a parcel of land. Land registration in Zimbabwe is not compulsory. Ownership is not absolute as the land can be compulsorily acquired in the interest of the public by the legislated government bodies. All transactions on a parcel of land have to be registered by the deed registration office in order for the transactions to be valid. The land register contains information about individuals or groups who have recognised interests in land, the nature of the rights, responsibilities and restraints, parcel location, value and use. Registration gives public notice of the existence of such legal rights. The deeds office is responsible for the registration of grants or leases issued by the state, transactions where land is security for an obligation (mortgages), servitudes whether personal or praedal. In Zimbabwe a land parcel cannot be registered without a capital gains tax certificate from the Zimbabwe Revenue Authority (ZIMRA) and a rates clearance from the responsible local authority.

The local authorities are responsible for the valuation and planning activities The Local Authority restrict certain activities through the imposing of the restrictive conditions and conditions of title, so as to preserve the general characteristics of an area. The registered owner of a property is responsible for the payment of service fees, taxes and rates. The local authorities and the Deeds Registrar are responsible for the administration of rights on a parcel of land. The Deeds Registrar can only register deeds of transfer on municipal land after the local Authority has issued permits/ approval.

There are various legal bodies that play a critical role in the Land Administration process of Zimbabwe and these include the surveyors, notaries, conveyancers. In Zimbabwe most of the surveys are being carried out by private land surveyors. The private land surveyors have been carrying out the subdivisions of the commercial farms acquired in the land reform. Notaries and conveyancers facilitate the transfer of rights in land.

1.1 The land administration domain model

A good land management system will promote economic and social development both in rural and urban areas. Considering the importance of proper land management, many efforts have been made to provide standardized implementation of Land administration systems. In 1994 the cadastre 2014 was developed (Kauffman and Steudler 1998) and in 1996 the United Nations Economic Commission for Europe (UNECE) published the land administration guidelines. The

Principles of the cadastre 2014 were developed to come up with the CCDM (Core Cadastral Domain Model). The specifications of the CCDM were developed to come up with the Land Administration Domain Model (LADM). The LADM have been the best effort so far, in terms of coming up with a standardized land administration systems.

The LADM was developed by the Technical Committee 211(TC211) of the International Organization for Standardization (ISO, ISO/TC211, 2010) and is identified as ISO 19152. The LADM provides an abstract, conceptual schema with three basic packages parties (such as people and organisations), administrative rights, responsibilities and restrictions (such as property rights) and spatial units (such as parcels, buildings and networks), with the latter having one subpackage surveying and spatial representation [3]. The data model was designed in a flexible way which allows it to be widely applicable. This data model should be able to function as the core of any land administration system. Land administration systems require standards to identify elements. These may include: objects, transactions, relationships between spatial units and persons, classification of land use, land value and map representations of objects [4].

Packages have been introduced in LADM for a proper representation of tasks and responsibilities. The main goal of the LADM is to improve communication between Land Administration systems locally, regionally and internationally. LADM can be a basis for combining data from different Land Administration systems, for example systems with datasets on formal and informal people-to-land relationships. The LADM supports the protection of land rights, efficient land and property taxation. The Land Administration Domain Model provides a comprehensive set of functionality, based on Model Driven Architectures [5].

The land administration domain model addresses the majority of the problems being faced by land administration systems in many jurisdictions. Van Oosterom, (2006) identified poor

communications between land administrative organisations as the major drawback to effective and efficient land administration in many countries.

1.2 Problem definition

The land administration operations in Zimbabwe are fragmented with land information being handled by different departments. Although computerization of documents has been done at most institutes such as the Department of the Surveyor General, the Deeds Registry Office and the municipal offices there has been challenges in linking up the different databases due to the isolated conceptualization, different operating systems and different software. Each department has its own standards for defining geographic datasets which present data integration problems thereby reducing the efficiency of the system and the ability of the system to meet the user requirements, most of the data is in different formats this makes the data acquisition time consuming and tedious

The standards used in the development of the cadastre do not adequately support sustainable development and effective management and utilization of land resources. The Department of the Surveyor General is currently working on reestablishing the Land Transaction System (LTS). The LTS was developed in 1999 and since then there has been great technological advancements in terms of data sharing (use of the internet), manipulation (using GIS technology) and integration. The LTS can no longer adequately meet the requirements of the various clients requiring information from the DSG. This process was described by the Kadaster team (2012), as "re-inventing the wheel", thus re-implementation of the same functionality over and over again. According to Chimhamhiwa (2006) the current land administration system is not able to cope with the increasingly complex range of rights,

restrictions and responsibilities in relation to land and he described the re-implementation of such systems as a means to an end.

The current system being used by the land administration stakeholders is mainly paper based with most of the cadastral plans being in analogue form. This has limited the system's efficiency and has reduced the system's capability to address security and quality features associated with modern day land administration systems.

Mutasa (1999) postulated that the cadastral and land titling system in Zimbabwe is still based on a relatively narrow land administration paradigm centered on land registration and cadastral surveying and mapping. But efficient and effective land information infrastructures are now required to meet the information demands for successful implementation of sustainable development. Kauffmann (1998) proposed the development of broader land administration systems that will be showing the complete documentation of public and private rights and restrictions for land owners and land users. The system will be automated and well co-ordinated, without separation of land registration and cadastral mapping and allow for data modelling.

1.3 Main objective

The main aim of this research is to investigate the conformity between the Zimbabwe Land Administration system and the land administration domain model.

1.4 Specific objectives

1. Carryout an assessment of the current land administration system in Zimbabwe.
2. Determine similarities between the land administration system in Zimbabwe and the Land Administration Domain Model.
3. Determine the differences between the land administration system in Zimbabwe and the Land Administration Domain Model.
4. Propose the Zimbabwe country profile based on the LADM.
5. Propose the Zimbabwe land administration conceptual models for the:
    I. LA_Party,
    II. LA_Administration (RRR),
    III. LA_SpatialUnit and the
    IV. LA_Survey and Spatial Representation.

1.5 Research Questions

1. What are the similarities and differences in concept between the Zimbabwe land administration system and the land administration domain model?
2. What classes of the land administration domain model can be directly applied in the Zimbabwe land administration models?
3. What classes of the land administration domain model will have to be modified?

1.6 Justification

The past few years have seen the growth of the land market in Zimbabwe. The growth has been propelled by government instruments such as the National Housing Policy and “the housing for all” schemes. The increase in the land market activities have placed new demands

on the land administration system in Zimbabwe and it is established that the current system is not able to fully address the increased customer needs, hence there is need to develop systems that are more able to address the customer requirements.

The Land Administration Domain Model (LADM) is a standardized land administration system that allows for data to be shared based on shared ontology. The LADM allows for effective and efficient land administration. The standards ensure that land information systems are developed with the highest levels of quality. This will greatly reduce on duplication of activities. The land information systems based on standards will greatly improve collaboration with many departments and facilitates easy sharing, integration and exchanging of data within the various government departments, this improves the organization client relationships.

The LADM offers data quality auditing and homogeneity in production; this will ensure that different departments produce uniform quality. The system will show lineage and historical data in cadastral data set, this will enable system users to go back and see what the cadastral situation was at any given point in time. The LADM includes all documents; this means building a complete and full digital cadastre. A major advantage in adopting LADM is the classification and structuring of rights, restrictions and responsibilities, where classifications in categories are possible [6].The LADM can be supportive in business process reengineering, with normalised data models to avoid data duplication.

Benefits of the LADM include the improvement in the effectiveness and the efficiency of the land administration system and the expansion of the services provided by DSG, Registrar of Deeds and the Local Authorities to the Zimbabwean community.

1.7 Scope of the research

Land administration is a broad discipline therefore definition of the system boundaries is of paramount importance. The boundary defines what is in the system and what is not. This investigation focused on formal tenure structures in Zimbabwe (customary and informal tenure systems are outside the scope of this investigation). The investigation gave emphasis on the data model behind the land administration domain model, thus the legal/administrative data, survey data and spatial data. The political, economical or financial aspects of the land administration system were not considered in this investigation.

1.8 Methodology

The project comprised of eight stages namely the problem definition, conceptual frame work development, field data collection, field data interpretation and analysis, comparative analysis, conceptual design, conclusion and recommendation.

Conceptual framework development

The conceptual framework was developed through review of literature on the Land administration systems, land administration domain model. Studies were conducted on countries that are implementing the LADM. The studies were aimed at understanding the LADM conceptual modeling strategies and the problems that the countries experienced in the implementation of the LADM.

Field data collection

The data collection was based on personal interviews, questionnaires, review of existing documents. Stratified sampling was used in this research. In this sampling method the

sampling frame was divided into four strata namely, the DSG, the deeds registrar, local authorities and external users. Several viewpoints had to be considered and these include quality requirements, legal requirements and operational requirements. The results of this stage were used in the selection of the standard elements and sub-elements to be adopted in the Zimbabwe country profile.

Field data interpretation and analysis

This stage involved the qualitative and quantitative analysis of the field work results so as to draw up meaningful conclusion for easy and effective comparison between the LADM and the land administration system in Zimbabwe.

Comparative analysis

This stage was aimed at identifying the similarities and the differences between Land Administration System in Zimbabwe and the Land Administration Domain Model (LADM). This will be vital in determining the classes of the LADM that can be applied directly and the classes of the LADM that are not relevant to the land administration system in Zimbabwe.

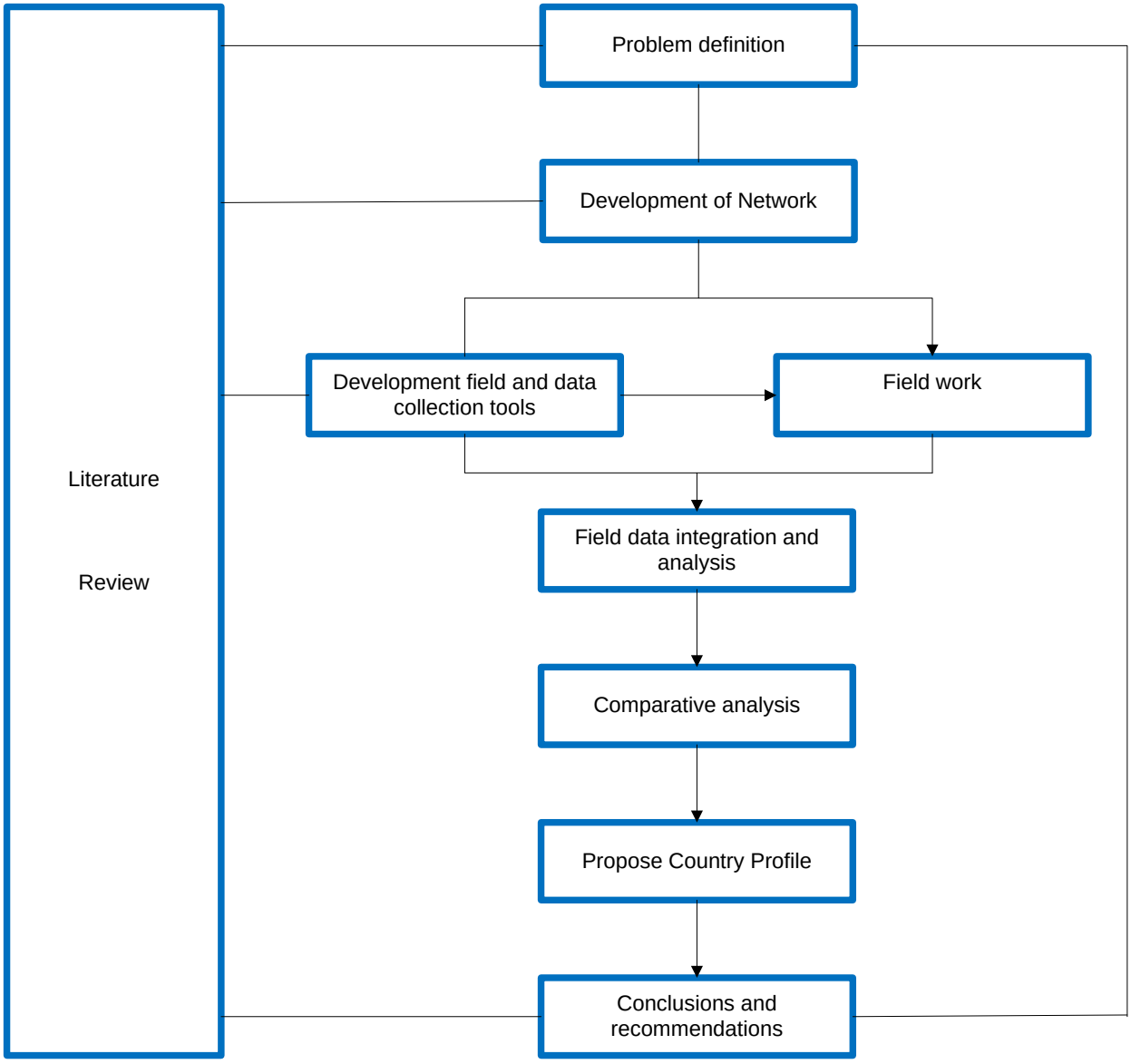


Figure 1.1 Research methodology (adopted from Masariri 2007)

Conceptual Design

Once the required data has been identified and the country profile has been developed the designs of the conceptual models were then be initiated. The Zimbabwe specific models for the LA_Party, LA_Administrative, LA_SpatialUnit and the survey and spatial representation were developed at this stage.

Conclusion and recommendations

This stage will involve evaluation of the land administration domain model and its applications to the Zimbabwe land administration system. The stage will result in the recommendation for implementing the Zimbabwe land administration model.

CHARPTER 2: LITERATURE REVIEW

2.0 INTRODUCTION

This chapter seeks to review critical points of current knowledge including substantial findings related to the land administration system in Zimbabwe and the Land Administration Domain Model (LADM). Literature review can be defined as *the process of reading, analyzing, evaluating and summarizing scholarity materials about a specific topic* [7]. In the

first section of this chapter the researcher will review articles published on the land administration in Zimbabwe. The main focus will be on the land tenure system, institutional, legal and technical framework of the land administration system in Zimbabwe. The second section of this chapter will seek to unveil the trends in the development of the Land Administration Domain Model and will give detailed description of the Land Administration Domain Model. The last section will focus on case studies of the countries that have adopted the Land Administration Domain Model.

2.1 LAND TENURE IN ZIMBABWE

The land tenure in Zimbabwe exists through both customary and statute law. (Burke 1996) defined land tenure as the *mode of holding or occupying land*. The basic forms of land tenure in Zimbabwe include formal tenure, leasehold, customary and informal tenure [8]. The formal tenure mainly comprise of the freehold and leasehold. Freehold is the highest form of ownership, it describes all the bundle of rights privately held. Freehold is prevalent in the urban areas. In Zimbabwe ownership is not absolute the government can still acquire land in the interest of the public (Land Acquisition Act). Chimhamhiwa (2002) described customary land tenure as the oldest form of ownership and is prevalent in the communal areas. Leasehold consists of contractual agreement between the landowner and the leaseholder.

The government of Zimbabwe is granting 99 year leases to the newly resettled commercial farms [13].The resettlement land is classified as A1 and A2 land. The A1 farms were allocated in villages and the parcels were about 5ha in size. The A2 farms were for commercial farming and the parcel have sizes up to 2000ha. The government of Zimbabwe acquired over 5000 farms in the land reform exercise. The ownership of the acquired farms

was vested in the state. The government scrapped title deeds system and replaced it with the 99 year leases. The holders of the 99 year lease are liable to the payment of rentals to the government [14]. Lessees are usually prohibited from transferring their rights without the permission of the relevant minister. The Land Reform exercise was aimed at readdressing the land imbalances that were caused by the colonial era. The reform was facilitated by the Land Acquisition Act (chapter 20:10). There were general contest among civil political and traditional authorities over who has the power register land rights, allocate and administer land in the land reform.

Chimhamhiwa (2006) pointed out that the separation of land by tenure has resulted in the creation of tenure specific land administration systems, which are administered by separate institutions. He went on to conclude that such scenarios have led to isolated land based systems

and disintegrated land information infrastructures, characterized by inefficiencies and lack of adaptability. Chitsike (2003) noted that decision making on land matter is being hampered by lack of good quality information which is supposed to be managed by the Ministry of Lands, Agriculture and Rural Resettlement. In his final remarks, Chitsike highlighted that, the provincial and district structures put in place for land distribution need reform as the endeavors to develop a profession system for land administration.

2.2 LAND ADMINISTRATION IN ZIMBABWE

Zimbabwe is a Southern African country and it shares its borders with South Africa, Zambia, Mozambique and Botswana. Zimbabwe has a population of about 13 million people. The country covers 390760 square meters of which 7% of the land is arable and 22.5% is forests

and woodlands [8]. Approximately 70% of the country has been surveyed. The country is divided into 8 administrative provinces. Zimbabwe attained its independence in 1980.

The land administration system in Zimbabwe operates under the Roman Dutch Law, but however the system have been influenced by the English law such that the system in use is actually a hybrid of the Roman Dutch Law and the English Law. Customary law is also recognized in Zimbabwe. The land administration process is centralized with most of the power and control over land being vested in the state. The Communal Lands act of 1979 vested all the communal lands in the president [9]. The individuals in the communal areas only have land use rights and ownership rights for the buildings and structures they would have erected on the land. Land in Zimbabwe is owned by private individuals or organization, the local authorities, and the state. The land administration system in Zimbabwe has the primary objective of supporting land market operations.

Zimbabwe uses a dual and top-down land administration system [10]. In this system the cadastre is administered by the Surveyor General and the land register is administered by the Deeds Registry Office. In order to have an understanding of the land administration in Zimbabwe the researcher adopted the land administration system evaluation procedures proposed by Sheundler (2006). Sheundler proposed that a land administration system should be evaluated in terms of its institutional framework, legal framework and technical framework.

2.2.1 Institutional framework

In Zimbabwe there are three main ministries involved in the land administration process and these are the Ministry of lands, Agriculture and Rural Resettlement, the Ministry of Justice Legal and Parliamentary Affairs and the Ministry of Local Government, Public Works and

National Housing. The Ministry of lands, Agriculture and Rural Resettlement controls the operations of the DSG and the Ministry of Local Government, Public Works and National Housing, controls the operations of local authorities. The land registrar in Zimbabwe is administered by the Registrar of Deeds which operates under the Ministry of Justice Legal and Parliamentary Affairs. The ministries report directly to the President's office.

Local Authorities

Land use and development in Zimbabwe is regulated by the local authorities through zoning techniques. Land can be used by various individuals, religious organizations, companies (both foreign and local) and communities. There are various restrictions that have been imposed on land so as to preserve certain characteristics of the area. All developments have to be permitted by the Local Authorities and they control the placement of buildings on site and structures are monitored to ensure that structure adheres to general principals of the area.

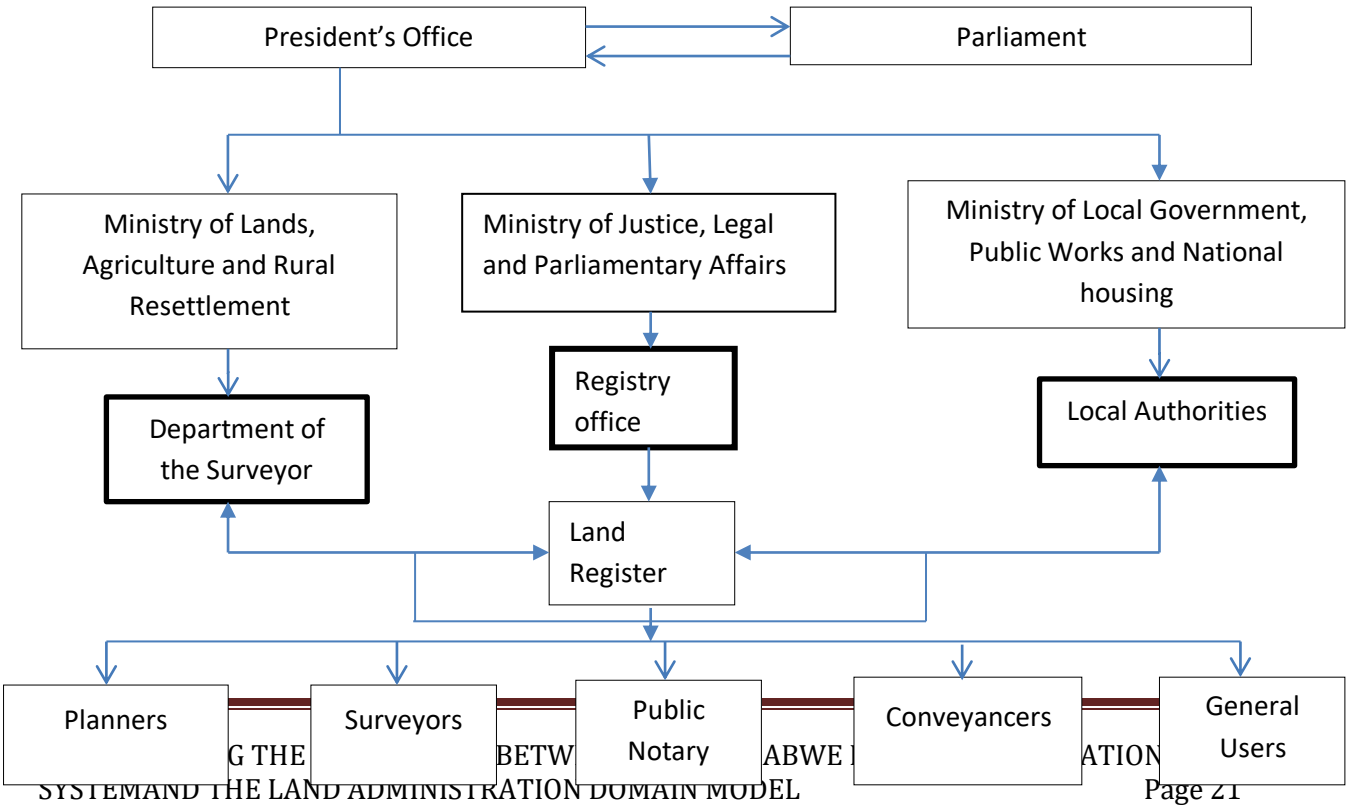


Figure 2.1 the institutional framework for land administration in Zimbabwe.

The local authorities are mandated by the Regional Town and Country Planning Act (Chapter 29:12) to formulate master plans which guide land developments. The local authorities are also responsible for land use planning, land property valuations and land zoning. The zoning process involves the deliberation of communities into zones, where certain activities are permitted whilst other activities are prohibited. The zones in Zimbabwe include residential, industrial, agricultural, institutional, recreational and open spaces.

The local authorities ensure land control by the use of the permits. The local authorities have to permit any activity on land, for example a land owner cannot subdivide land without approval from the local authorities. The Registrar of Deeds in terms of the Deeds Registry Act (Chapter 20:05) cannot register a land parcel without a rates clearance from the local authority. In the Regional Town and Country Planning Act (Chapter 29:12) stipulates that for a survey to be carried out on municipal land the local authority has to issue a permit to the surveyor through the Department of the Surveyor General.

Department of the Surveyor General (DSG)

The DSG was established in 1898, with the aim of promoting a sustainable and a viable agricultural sector and to develop and manage land resources through the provision of appropriate technical administration. The DSG is mandated (in terms of the Land Survey Act Chapter 20:12) to ensure the accuracy of all surveys before approval for titling purposes, ensure the maintenance of survey standards as prescribed by the regulations, depict on

relevant maps all surveyed land parcels, execute all land surveys on state land and maintain all property records. These records include general plans, working plans and sectional plans. The diagram will be showing the verbal and geometric description of the area under survey. The diagrams also show the shape, area and district of the land parcel.

A cadastral plan has to be signed by a registered land surveyor before it can be approved by the Surveyor General. Due to economic challenges that the DSG has been facing, most of the surveys in Zimbabwe are being done by private registered Land Surveyors. The private surveyors have been carrying out most of the surveys on state land. McLaughlin (2000) highlighted that a complete land administration system requires all land to be demarcated and registered. The boundary surveys in Zimbabwe are incomplete and thus there is no seamless cadastral database available [12].

The DSG is also responsible for map production. Maps are produced from topographic survey and aerial images. The maps serve as base maps for all cadastral and planning purposes. Lugoe (1990), highlighted that the status of the control network in Zimbabwe is sufficient to accommodate the nation-wide surveys and currently the whole country is mapped up to 78 % on 1:250 000 and 24% coverage on 1:50 000 map sheets. The DSG supplies topographic maps at scales 1:50000, 1:100000, 1:250000 and 1:500000 for the whole country with larger scale topographic maps available. Approximately 70% of the areas in Zimbabwe have been surveyed. The main coordinate system in Zimbabwe is the Gauss projection system. The ellipsoid WGS-84 system is used for GPS surveys and the UTM (Universal Transverse Mercator) is used for mapping purposes. Most of the surveys done before the passing of the Land Survey Regulations of 1979 were done on the local system.

The difference in coordinate systems has limited the data sharing capabilities in the current system.

The Department of the Surveyor General provides base maps (topographic maps) which are used by planners and engineers. Upon the approval of a survey, the DSG is required in terms of the Land Survey Act (Chapter 20:12) to forward one copy letter of approval and one copy of the dispensation certificate is to the registrar of deeds so that the registrar is aware of the approved survey.

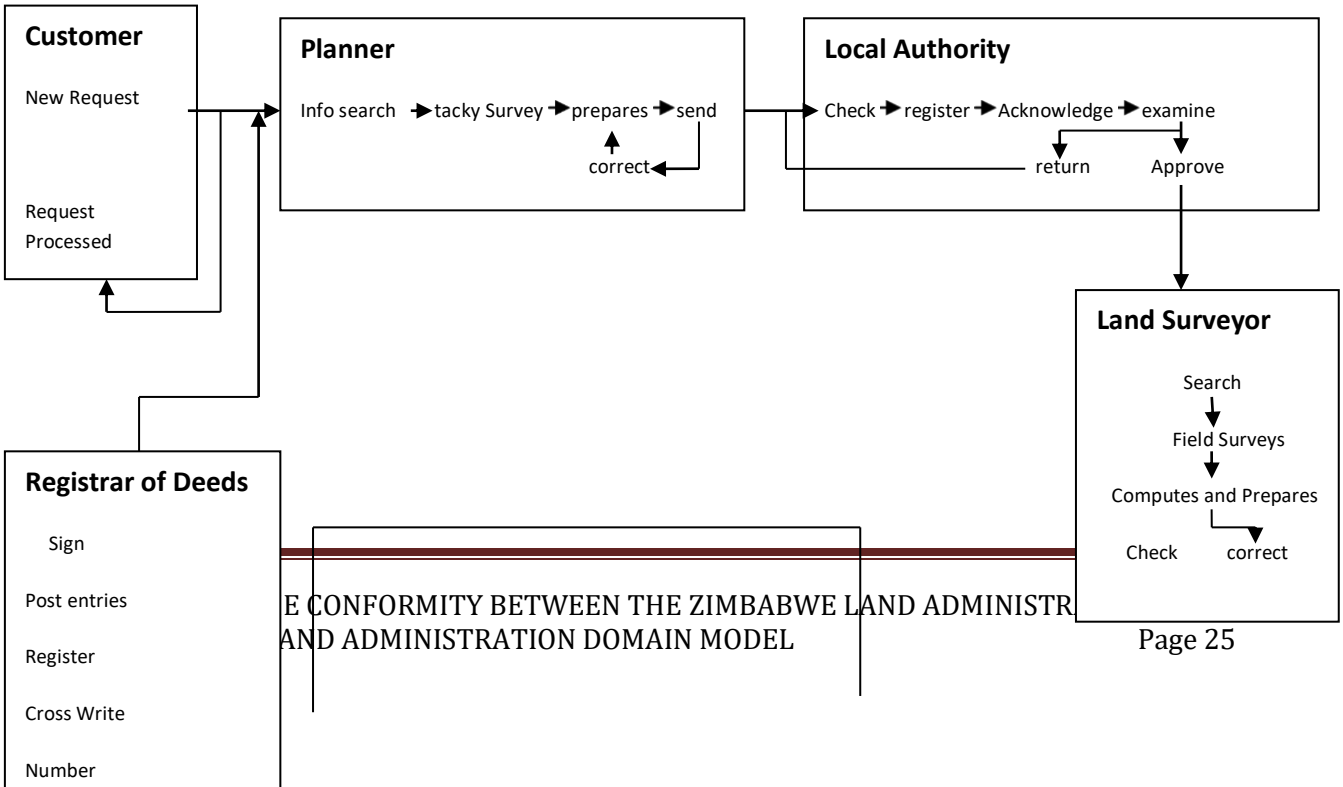
The Deeds Registry Office

Land registration in Zimbabwe is administered by the Deeds Registry office under the Deeds Registries Act (chapter: 20:05). The Deeds office takes charge of all records, register grants or lease issued by state, record transaction where land is the security for an obligation and register any servitude whether personal or praedal. Rights recorded in the Deeds registry include ownership rights, lease rights, mortgage rights, subdivision and consolidation rights and inheritance rights. All Deed of Transfers or Certificates of title subsequent to the Deed of Grant must be prepared by a legal practitioner, so should, mortgage bonds, servitudes and leases. The land can be subject to special conditions which are imposed by virtue of the statutory requirements such as the Town Planning Authority and mostly concern the use of the land. Once a transaction relating to a person has been registered in the Deeds Office, a personal register card is opened for him/her on which is entered the full names, date of birth and marital status. Information recorded also includes parcel area, price paid, previous owner or owners and whether it is subject to a mortgage and the amount thereof.

Normally a woman married in community of property, cannot acquire immovable property or deal therewith as there is a community of joint estate, which is administered by the husband, but there are exceptions, for example, the husband can give consent. In the land registration system in Zimbabwe diagrams are always annexed. The diagrams should be done by a registered land surveyor and approved by the Surveyor General.

The land Registration process in Zimbabwe

Chimhamhiwa, (2001) identified subdivisions and consolidations as the major cadastral activities in Zimbabwe. The owner of a parcel of land can send a request for land subdivision or consolidation to the local authorities directly or through a planner. The planner produces a layout plan from the base maps and tacheommetric surveys. The planner submits the layout to the local authority for approval. Upon approval of the layout, the local authority is required by the Regional Town and Country Act to issue a permit/ Instruction. The local planning Authority is required in terms of the Land Survey Act (Chapter 20:12) to forward a copy of the permit to the surveyor general. In the case of 'state land' the Ministry of Lands/ Local Government issues instruction of survey through the Surveyor General.



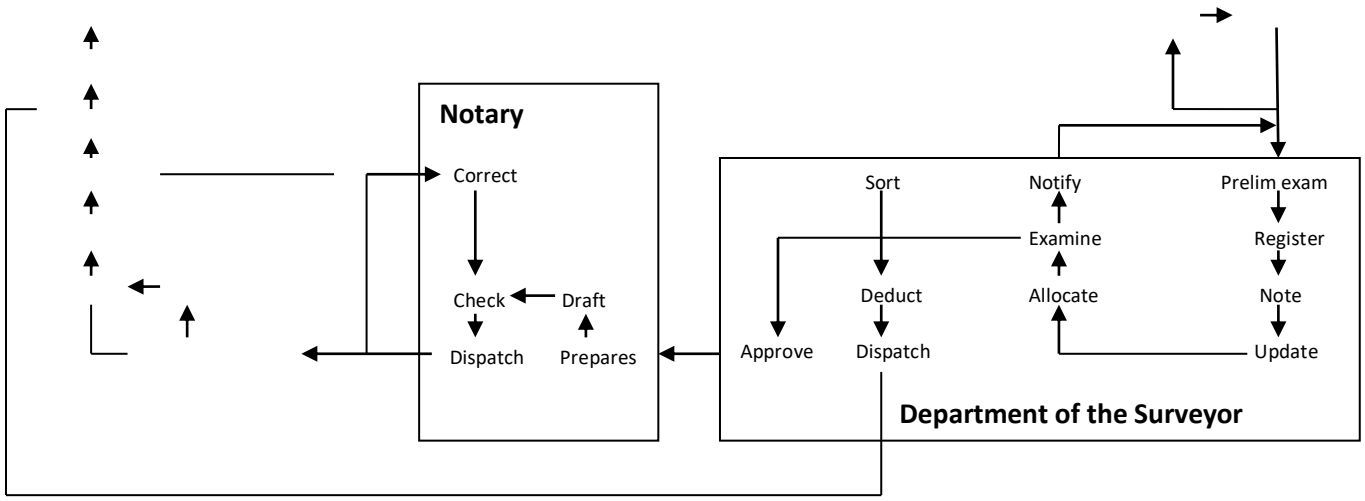


Figure 2.2 the land registration process in Zimbabwe (*adopted from Chimhamhiwa, 2002*).

The approved permit is forwarded to a Land Surveyor who undertakes the new boundary demarcation. A survey record, compiled by the Surveyor, is lodged with the Department of the Surveyor General for examination and approval. An approved diagram is forwarded to a Notary for deed drafting.

The draft deed is then submitted to the Registrar of Deeds for examination and approval. Registration information is sent back to the S.G by the registrar of deeds for noting on the diagram to show that the property has been registered. Once approved ownership is transferred and the new deed handed over to the new owner.

When a land owner wants to transfer a parcel of land he approaches a conveyancer. The conveyance will then prepare a draft deed, the power of attorney and declarations for signing by the buyer and the seller. The conveyance will always make reference to the original holding deed, diagram deed and the agreement of sale. The land owner is required to pay

transfer fees (4% property value +15% VAT). The seller is then required to applies for a capital gains tax clearance certificate which is assessed by the Zimbabwe Revenue Authority (ZIMRA), to determine how much is payable. Documents required by ZIMRA include a copy of title deed, CR6 form, copy of seller and buyer C.R.14, agreement of sale, proof of payment, copies of the ID's of the people mentioned in the agreement of sale and their contact details.

The seller is then required to apply for a rates clearance certificate from the local authority under whose jurisdiction the property falls. The local authority will provide an assessment of how much is payable by way of advance rates and outstanding rates, if any. The rates in Zimbabwe are based on the value of the property, size, location and whether there are improvements or not. The local authority requires to be furnished with details of the seller and buyer and their present postal or physical addresses, and description of the property being transferred. Transfer documents are then lodged for registration of title with the Registrar of the Deeds Office.

The seller is required to pay stamp duty upon lodging at the Deeds Office. The copies of the deeds are lodged with the Registrar of Deeds for examination upon payment of the registration fee and the stamp duty. The documents are then assessed by the deeds registrar to verify their authenticity. If there are no more errors the deed is signed by the Registrar of Deeds. One copy of the deed is filed in the Office of the Registrar of Deed and the second one sent back to the conveyancer for onward transmission the new property owner. The documentation include: rates clearance certificate, capital gains tax clearance, two copies of the draft deed, power of attorney to pass transfer, declaration by seller and buyer and the original holding deed.

Once a transaction relating to a person has been registered in the Deeds Office, a personal register card is opened for him/her on which is entered the full names, date of birth and in the case of married women, their marital status. Normally a woman married in community of property, cannot acquire immovable property or deal therewith as there is a community of joint estate, which is administered by the husband except when there is antenuptial contract.

The Deeds Registry also registers mortgage bonds, leases and servitudes. The registration documents must be prepared and lodged by a legal practitioner. Once registered the information pertaining to the area, price paid, previous owner(s) and whether it is subject to a mortgage, lease or servitude and if subject to a mortgage the amount thereof [13].

The land administration institutional framework in Zimbabwe is fragmented with poor coordination between the institutions involved in the land administration process, this evident by the time taken for a parcel of land to be registered. (Chimhamhiwa and Lemman) reviewed that about 6% of subdivision or consolidation request take up to about 9.25 months to be processed. Rukini (1994) recommended the formation of the Departments of Lands which will be responsible for the land administration in Zimbabwe. The department of lands was to carry out all land administration duties including those being carried out by the various government departments and agents. The department has since been established but the transfer of the land administration duties has been slow and still remains incomplete [14].

2.2.2 Legal Framework

In Zimbabwe legislation is the most important source of law. The legislative power is vested in the president and parliament. All legislation in Zimbabwe must be framed in terms which

do not conflict with the wording of the constitution. Zimbabwe's legislation regarding land rights include the Land Survey Act (Chapter 20:12), the Deeds Registry Act, Land Acquisition Act, Communal Lands Act 20 of 1982, Regional, Town and Country Planning Act, Commercial Premises (lease control) Act 27 of 1983; Protected Places and Areas Act 27 of 1959; and Immovable Property (prevention of discrimination) Act 19 of 1982, Title Registration and Derelict Lands Act (Chapter 20:20), Titles and Registration Act, Prescription Act.

The Land Survey Act stipulates the manner in which surveys are to be conducted and the manner in which such information is furnished the Surveyor General. The Regional, Town and Country Planning Act provided a basis for land planning activities. The Deeds Registry Act prescribes the rights to be recorded in the land registry and the dissemination of such information. The Prescription Acts highlights that when a person has openly possessed land as if he or she were the owner for an uninterrupted 30-year period that individual can acquire the land by prescription.

There are also various land policies that have developed in relation to land rights in Zimbabwe. The most influential policy in terms of land administration is recognized to be the land policy. In Zimbabwe the national land policy was formulated with the objectives of alienating population pressure in the communal areas, resettling landless and deserving people and extending the base for agricultural production [15]. The national land policy also addressed the issue of land subdivision, in-order to allow farmers with access land to dispose of the land. The subdivisions have to be monitored by the State.

The Agenda 21 report (2002), highlighted that most of the existing policy and institutional frameworks were carried over wholesale into the post independence period and need to be reviewed and amended to reflect and respond to current issues. Mutema (2004) concluded that the low levels of policy in Zimbabwe compiled with low public consultation and centralized system of governance have aided to poor land administration system in Zimbabwe.

2.2.3 Technical Framework.

Stubkjarb (2008) articulated that, throughout the whole of Africa there is a general lack of financial, technical, and human capacity required for effective land administration. Musarira (2006) highlighted that the technological infrastructure at the Department of the Surveyor General and the Deeds Registry Office is no longer adequate for effective land administration.

The Department of the Surveyor General (DSG) is currently using a system called the Land Transaction System (LTS). The LTS is based on Water Server SQL which host scanned images of cadastral plans. The system uses Windows NT4 Server, Windows 2000 Server, Windows ME and Windows XP. The Microsoft Access is used as the attribute database and the ArcGIS was proposed to store the spatial components. The ArcGIS component is still underdeveloped [16]. The deeds registry office is currently using an Oracle based system application. The system is based on Oracle database version 6.0 and has a backup server Windows server 2003. The department is using a software called (SARM) System application for Record Management.

Masarira argued that, according to Government IT policy software and hardware at government departments have a life span of 5 years and the software and hardware at the land

administrative organization are approximately 14 years old, thus no longer technologically adequate to copy with the current land administrative demands.

2.2.4 Strengths of the current Land Administration System in Zimbabwe.

The land administration system in Zimbabwe has been able to protect state land, guarantee ownership and security of tenure. The system has been able to support environmental protection as evident by the vast forestry and natural resources in the country.

2.2.5 Weakness of the current Land Administration System in Zimbabwe.

The institutional framework for land administration in Zimbabwe is fragmented with overlapping responsibilities and poor coordination. The approach to land administration is generally centralized, bureaucratic and inflexible. There is no proper legal framework for encouraging the participation of the local people in the Land administration process. This has resulted in an ambiguous definition of property rights, insecure tenure and general failure to utilize land reform as a vehicle for economic growth [17].

The current land administration mainly focuses on the recording of ownership rights, thus does not show the complete legal situation (restrictions and responsibilities) that a parcel might be subject to. Chavhunduka (2003) noted that the poor delineation of lines of responsibilities, poor communication and over roles of legal and administrative mandated

land administration structures. Chitsike (2003) went on further to conclude that lack of good quality information has hampered decision making on land matters there leading to poor administration of land resources in Zimbabwe.

The land administration process in Zimbabwe has also been affected by the lack of adequate resources for supporting effective land administration. All these factors limited the capability of the land administration system in Zimbabwe to meet existing demands for services at all levels.

2.3 LAND ADMINSTRATION DOMAIN MODEL

Most of the principles of the LADM were derived from the cadastre 2014 which was proposed by the Kauffman and Steudler in 1994. The principles of the cadastre 2014 were refined through various works to come up with the LADM.

Cadastre 2014

The cadastre 2014 provided the basic principles used in the LADM. Kauffmann and Steundler defined the cadastre 2014 *as 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*. Kauffmann proposed six basic principles for the effective administration of land resources and four of the six proposed principles were include in the LADM. These principles included the principle of legal dependency, identical procedures for public and private land objects and location of land objects in a common reference system.

The principle of legal dependency propounded the idea of designing data model organized according to the legislation of the different legal land objects in a particular country or

district. Legal land objects, being subject to the same law had to be arranged in one individual data layer. The cadastre 2014 was proposed to show all rights adjudicated for a parcel of land. In most land administration systems the procedure for private land registration and public land registration is different. Private rights on a parcel of land are defined by contracts between the land owners and the public rights are defined by the legislated procedures established by the public law. Kauffmann and Sheudler (2002) proposed that the cadastre 2014 would not interfere with the forms of land tenure for a particular jurisdiction. To ensure that legally independent organized land objects can be combined, compared, and brought into relation to each other, it was proposed that common reference system be adopted. The principles of title registration system and fixed boundary system were not included in the LADM as they limited the flexibility and adoptability of the model.

Objectives of the cadastre 2014 included the abolishment of the separation between maps and registers. The unification of the maps and the registers reduce data redundancy and inconsistency. The cadastre was to pave way to cadastral modeling and bring an end to cadastral mapping. Cadastral modeling also allows for easy exchange of data. The cadastre 2014 was to be highly privatized with the public and private sector working together [18].

The land administration domain model

The LADM must be based on the Cadastre 2014 [19] but however not all principles of the cadastre 2014 were included in the LADM, for example the principle of fixed boundaries and title registration were not included as they limited the flexibility of the model. The LADM was to be as flexible as possible in order to applicable within a wide variety of jurisdiction thus it had to accommodate as many systems as possible.

The LADM is a spatial domain model and the model is not complete for any country. The main aim of the LADM is to improve communication between local, regional and international Land Administration systems.

The LADM is based on three classes

1. Spatial unit
2. RRR (Rights, restrictions and responsibilities)
3. Party (persons and organizations.) [20]

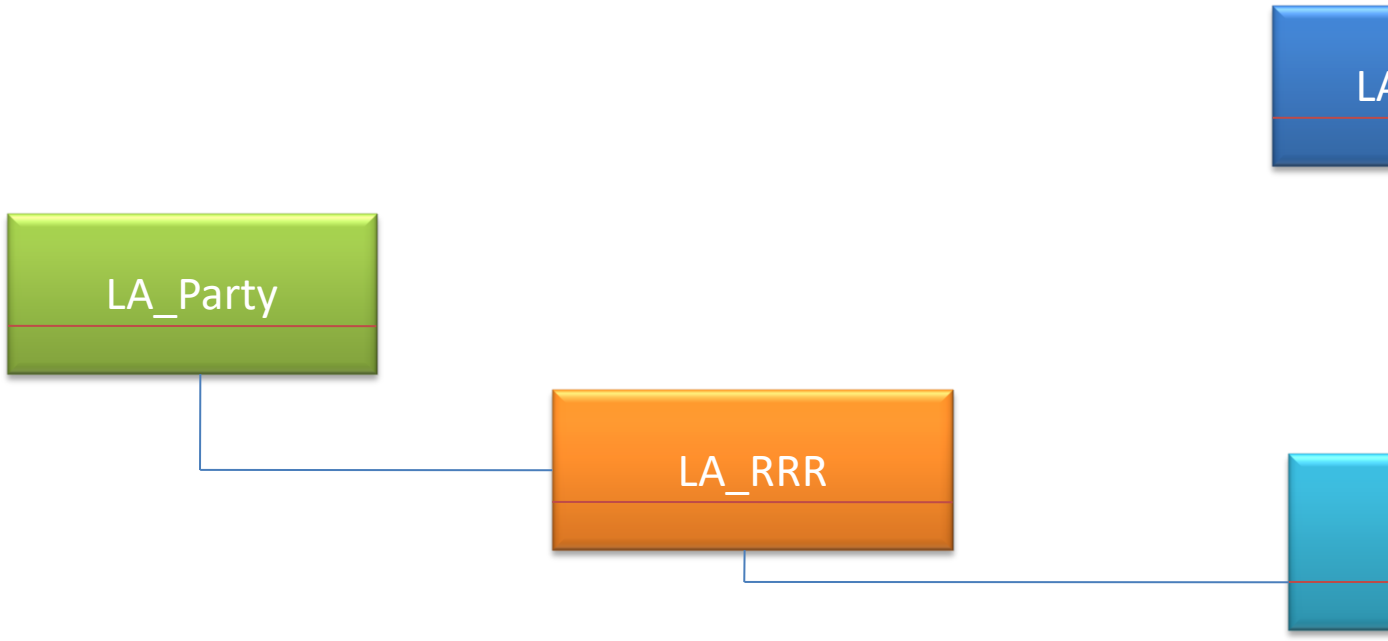


Figure 2.3 the basic classes of the Land Administration Domain Model.

2.3.1 Party Classes

A party refers to a person, group of persons or judicial persons that plays a role in a rights transaction. A juridical person may be a company, a municipality, the state or a church community. The main classes of the party package are the class LA_Party, LA_GroupParty

and LA_PartyMember. Examples of 'group party' include households or communities. A 'party member' is a constituent of a party or group party. Attributes of the party class are: partyID, type, role [21].

2.3.2 Administrative package

This package contains the classes LA_Right, LA_Restriction, LA_Responsibility and LA_BAUnit (basic administrative unit). The LA_Right class is concerned with the activities that can be carried out on a parcel of land. The LA_Restriction deals with restrictions in land use for example the Local Authority may prohibit the building of residential house too close to a river or dam. A "BAUnit" is the set of zero or more spatial units against which (one or more) unique and homogeneous rights, restrictions, and responsibilities, e.g. an apartment unit with three spatial units (the apartment, a garage, and a laundry room) [22].

2.3.3 Spatial unit package

A spatial unit is an area of land and/or water, or a single volume of space. A spatial unit can be represented as a point (the coordinates of a single point), line (spaghetti), text-based units (descriptive text), area or volume. The spatial unit package is concerned the classes LA_SpatialUnit, LA_SpatialUnitGroup, LA_Level, LA_LegalSpaceNetwork, LA_LegalSpaceBuildingUnit and LA_RequiredRelationshipSpatialUnit. A 'spatial unit group' is a group of spatial units, e.g. spatial units within an administrative zone for example the municipality, a province or a country [23].

2.3.4 Survey Package

The surveying package is a subpackage of the spatial unit package. The survey package has classes such as LA_ SpatialSource, LA_Survey point, Source document and survey document, LA_Point, LA_BoundaryFaceString, LA_LegalSpaceBuilding, LA_BoundaryFace. The package also has non-LADM classes, such as Survey Project.

A Parcel has the attributes (computed Size, dimension, spatial Description). A survey point is defined by the attributes (dimension, locationOrig, locationTransf, pointType, quality, and transformation). The class Source Document contains the attributes (acceptance, submission, and registration of type *DateTime*, as well as an electrSignature of type). SourceDocument has the attributes (measurements, number, quality, surveyDate, and type). The class LegalSpaceBuilding, and contains the attributes (complNum, dimension, and extAddressId.) [24].

External Classes

The land administration domain model provides stereotypes for the construction of external classes which will deal with other land administrative activities such as land taxation, valuation, address data and physical utility network data. External classes are outside the scope of the LADM, however the LADM indicate data sets elements that are expected from the external classes [25]. In this research, external classes will be represented by the prefix "Ex_".

2.3.5 Design of the Land Administration Domain Model

The development of a standardized domain model began in 2002 at a FIGURE congress held in Washington D.C. Various versions of the LADM have been developed with version 1.0 being the Final. Version 1.0 of the LADM was presented at a FIGURE conference in Munich

October 2006. The Model is currently in the process of being registered as an ISO standard (ISO19152). Several countries including Cyprus and Portugal have adopted the LADM and are in the process of implementing the Model. Other countries such as South Africa and Vietnam have developed their country profile based on the LADM.

The Finland government is currently funding the development project of computerized Land Administration systems for Ghana, Nepal and Samoa based on the LADM. The project is known as SOLA (FOA Solutions for Open Land Administration). The pilot project is aimed at making the implementation of cumputerised systems more affordable for developing countries. The project is using open source software such as PostGis, QuantumGis, Postgres [26].

Implementing LADM involves analysing of the existing land administration elements in Zimbabwe (institutional, organisational, legal, procedural and technical), getting to know the LADM standard itself (the international ISO definition is expected by the beginning of 2013), getting familiar with the Unified Modelling Language (UML), which is the key IT-programming language for any land administration system. Zimbabwe is still a developing country and since it has been facing some financial constraints it is more feasible for the LADM to be implemented using open source software, thus PostGis and PostgresSQL.

2.3.6 Model driven architecture

A model of a system is often presented as a combination of drawings and text. The Model Driven Architecture describes three levels of abstraction (viewpoints) namely: Computation Independent Viewpoint, Platform Independent viewpoint and Platform Specific Viewpoint [27].

2.3.7 Unified Modelling Language (UML)

The Unified Modelling Language (UML) is a standardized language used for the collection, analysis and processing of requirements as well as for the specification message exchange and overview of architecture and behavior specification. The UML offers sequence diagrams, collaboration diagrams, activity diagrams and class diagrams [28].

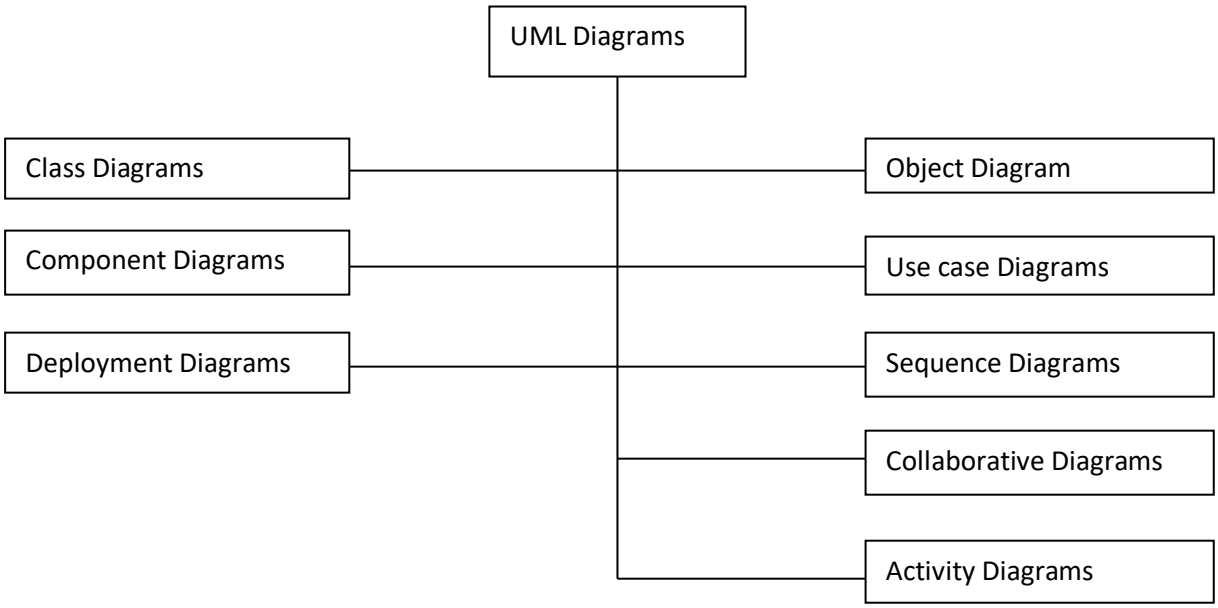


Figure 2.4 Types of UML Diagrams.

Class Notations

Rumbaugh (2004) defines class as the descriptive set of objects that share the same attributes, operations, relationships, behavior and methods. A class notation consists of three components the name, attribute and operation compartment. The name compartment contains the title case. The attribute compartment contains the class descriptive information. An attribute can the prefix +, - or #. The + sign indicates that the attribute is a public attribute and can be accessed by any element within the package and the – sign indicates that the attribute is a private attribute and can only be accesses by operations within the class. The #

sign indicates that the attribute is protected and can only be accessed by operators within the class [29].

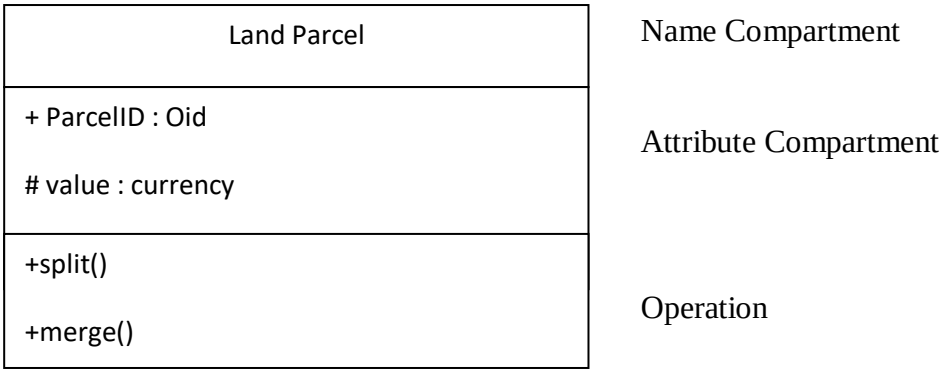


Figure 2.5 the class notation

Associations

An association implies two model elements have a relationship usually implemented as an instance variable in one class. This connector may include named roles at each end, cardinality, direction and constraints. Association is the general relationship type between elements. For more than two elements, a diamond representation toolbox element can be used as well. When code is generated for class diagrams, named association ends become instance variables in the target class.

Generalizations were used to indicate inheritance drawn from the specific classifier to a general classifier, the generalize implication is that the source inherits the target's characteristics. A generalized relationship does not have a names or multiplicity.

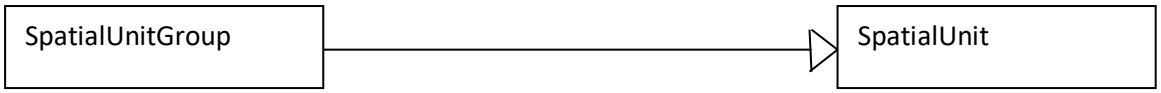


Figure 2.6 Generalized relationship between the spatial unit and the spatial unit group.

Aggregations were used to depict elements which are made up of smaller components. Aggregation relationships are shown by a white diamond-shaped arrowhead pointing towards the target or parent class

2.3.8 Challenges of Land Administration Domain Modelling

Great efforts have been put in standardizing the operations of Land Administration systems, so as to facilitate easy sharing and exchange of data between departments and organizations nationally, regionally and internationally. There are still challenges being faced in the representation of different responsibilities for different organizations for example the Surveyor General, local authorities, private surveyors, the registrar of deeds. These departments deal with different datasets and have different administrative responsibilities. Other organizations such as conveyancers, notaries and government departments require rapid advancements in technology so as to be able to fully cater for the ever increasing requirements of their clients. Other organizations do not require such advancements thus creating problems in consistency and up-to-dateness of land information for other sectors using the Land Administration System.

The other notable challenge is on spatial data management. Currently spatial data management is being handled by GIS software outside the Data Base Management System (DBSM). There is need to make DBSM more spatially enabled to enhance GIS and database application development [30].

2.4 CASE STUDIES

2.4.1 Cyprus Land Administration System

In Cyprus the Department of Lands and Survey (DLS) is responsible for the operations of the cadastre. A title land registration system is used and ownership is absolute, thus once registered the person is considered to be the undisputed owner. Any change in rights has to registered in the DLS in order to be valid and the Lands and Surveys Department has the power to correct errors or omissions. The activities of the DLS include the maintenance of the state survey infrastructure; the definition, identification, demarcation, measuring and mapping of parcel boundaries; the investigation of title; the registration, conveyance, valuation, compulsory acquisition, requisitions and imposition of encumbrances. The ownership relation is used to record the owners of all properties recorded in the system.

The DLS is currently using a land information system [Cyprus Land Information System CLIS) which was established in 1999. The system has managed to meet the majority of its intended objectives, however the system's underlying architecture has reached the end of its life and does not the requirements for being implemented as a National Land Information System. The DLS has unanimously agreed to adopt the LADM.

The Cyprus country profile, based on LADM

The CLIS mainly focused on recording ownership rights, with other rights, restrictions and responsibilities being recorded as contractual agreements. Most of these rights were recorded in an unstructured format. The CLIS application could not efficiently handle the legal documents which were stored in paper form. The enhancement of the CLIS to comply with the LADM required the migration of the CLIS classes into LADM classes.

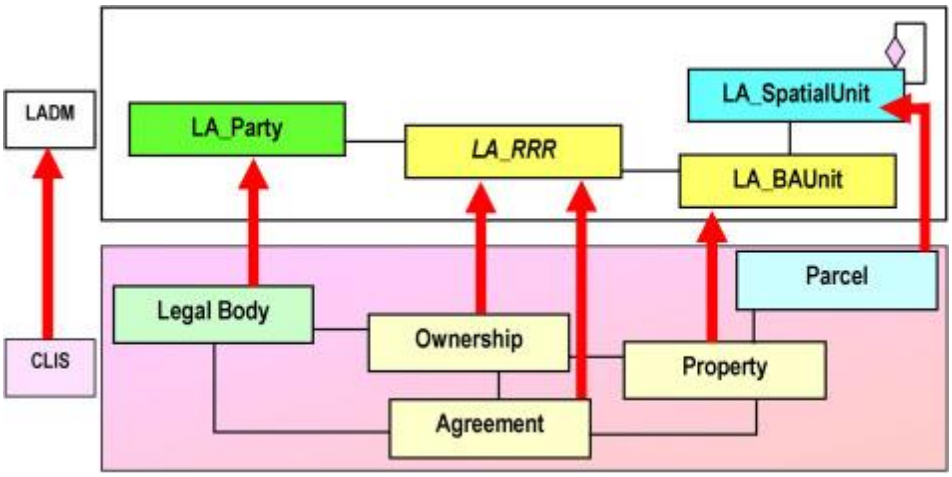


Figure 2.7 the migration of the CLIS to the LADM .

The legal body was converted to LA_Party class. The LA_Party hosted legal bodies stored in the CLIS and these included natural persons and non natural persons such as companies.

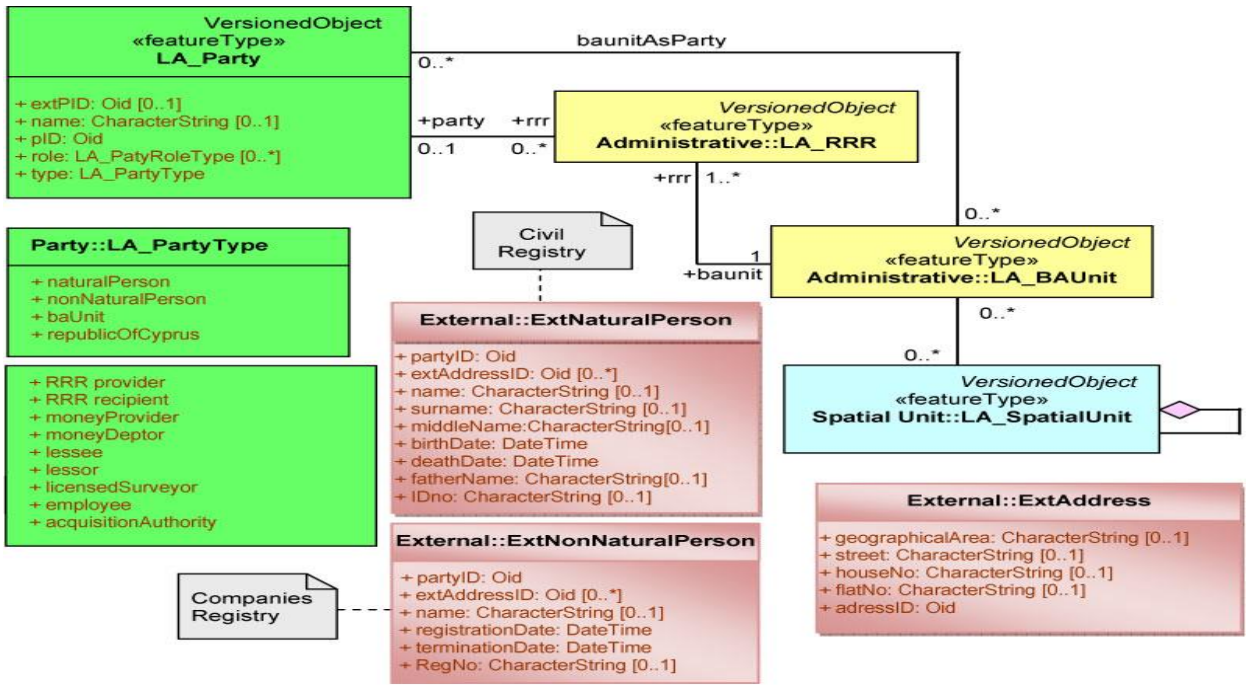


Figure 2.8 the party class proposed in the CLIS, based on the LADM .

The ownership rights and contractual agreements recorded in the CLIS constituted the LA_Right and the LA_RRR respectively. The legal paper documents are in the process of

being converted into electronic forms for easy accessing, sharing and archiving. The property entity was converted to the LA_BAUnit.

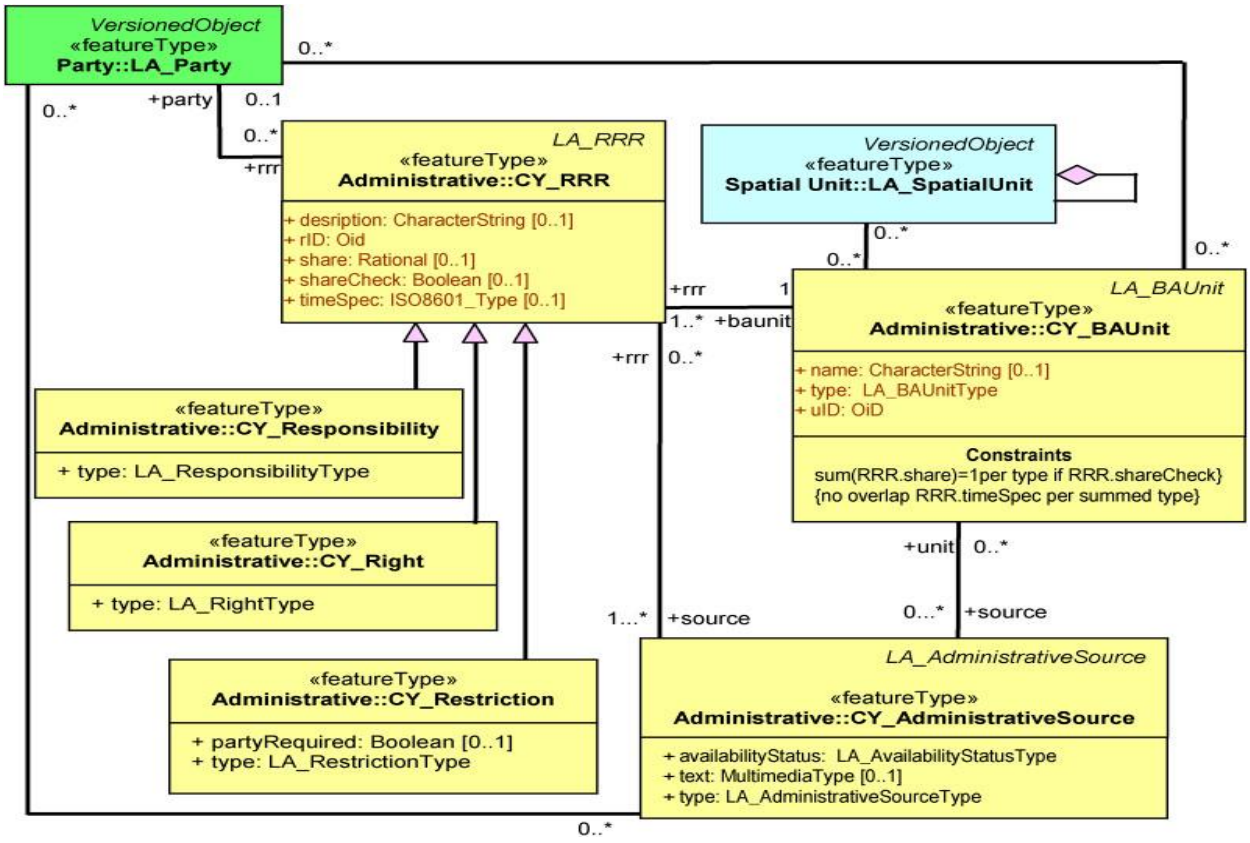


Figure 2.9 the administrative package as proposed for the CLIS based on the LADM.

The parcel entity was converted to the LA_SpatialUnit. The LA_SpatialUnitGroup was identified as subdivisions and planning zones. The LA_LegalSpace-BuildingUnit was used for the building registration.

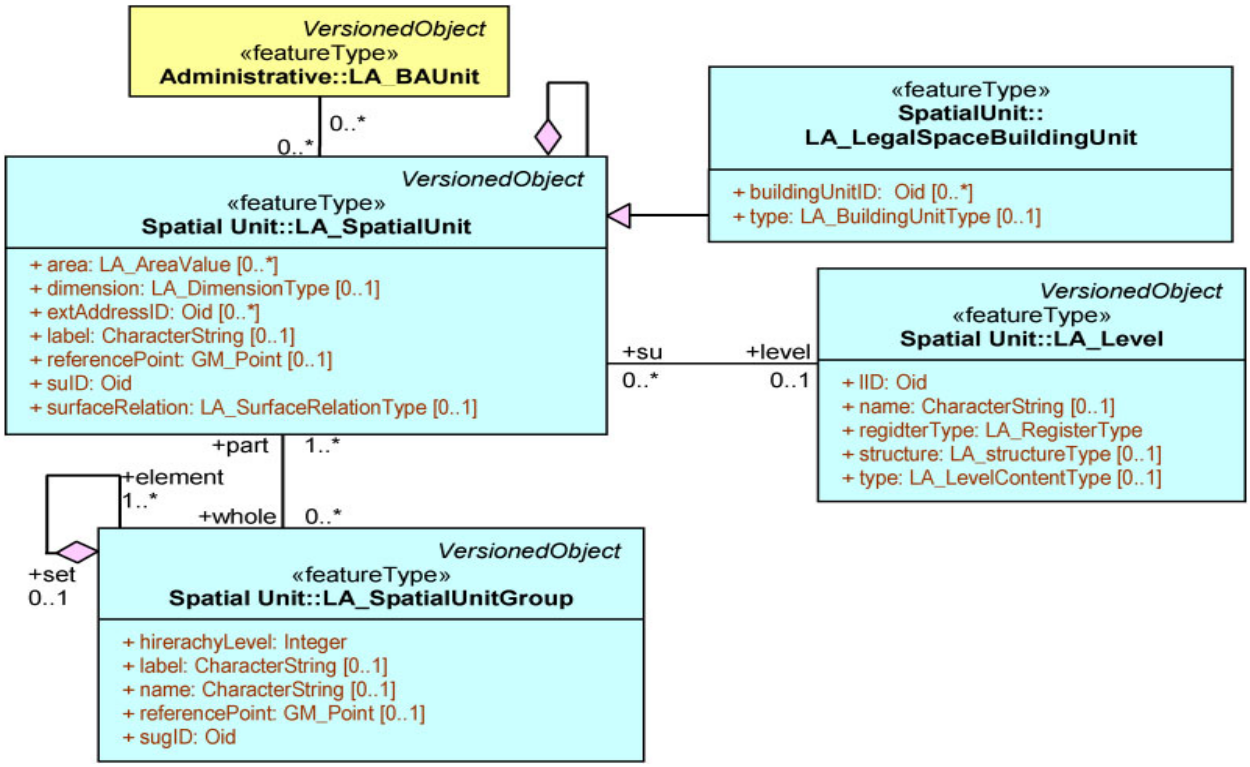


Figure 2.10 The Spatial unit Package proposed for the CLIS, based on the LADM.

The DLS concluded that they were going to implement the LADM based on the proposed models but however additional data model have to be developed so as to enhance management of data, reduce data duplication and improve data integration [31].

2.4.2 Land Administration System in Indonesia

The land administration system in Indonesia is arranged in a hierarchy and the system is ruled by the Basic Agrarian Law (BAL). The law (BAL) defines the legal bodies that can hold rights in land and these include religious groups, state owned groups, social groups and agricultural cooperatives. The law also defines the maximum area that a group can hold. Land registration in Indonesia is based on the deeds system. Land registration serves to provide security of tenure and can also be used as collateral to access loans from the banks. The land

registration in Indonesia does not guarantee security of tenure as land can be expropriated by courts and there is no guarantee that the land right holder will be compensated.

The land tenure system in Indonesia is strongly influenced by the social community structure. Adjudication in Indonesia covers activities in surveying and parcel boundary determination, right verification, physical and judicial data presentation and storage of public register and documents.

It is estimated that more 60% of the country has been surveyed. The surveyed properties are represented on cadastral index maps. The cadastral index maps represent parcel boundaries, streets, rivers and buildings.

The government has made provisions for increasing women's access in land. This has seen women having registered rights in land and the system has also made provisions for the registration of both spouses in the case of married couples.

Indonesia Land Administration System profile Based on the LADM.

The classes LA_Right, LA_RegisterParcel, LA_SurveyDocument, LA_Mortgage, LA_Survey point and LA_GroupMember were found to be compatible with the already existing class models of the Indonesian Land Administration System. Restrictions and responsibilities were also indentified in the current land administration system. The government in Indonesia has imposed restrictions on building site location. It is prohibited in Indonesia to erect structures to close to rivers and dams and these regulations are enforced by the Local Authorities. The holders of rights in land are responsible for the protection of that land from degradation and the general maintenance of the land. Classes such as LA_legalNetwork, LA_AdminParcel could not modelled since they did not conform to the legal framework and institutional arrangements. Comparisons of the land administration system in Indonesia and the LADM revealed that most of the classes, associations and

constraints of the LADM were valid for the Indonesian land administration system. There was need to extend the LADM code list so that it reflects specific requirements for Indonesian community.

Challenges in implementing the LADM in Indonesia.

Most of the challenged faced in the implementation of the LADM in Indonesia were mostly technical. There were challenges in developing a technical team to develop and maintain the LADM. Some of the LADM classes were not supported by the Indonesian legal framework, thus the classes could not be implemented [32].

2.4.3 South Africa Land Administration System

The South Africa land administration system operated both under the Roman Dutch law and customary law. Land tenure system in the country works under four different systems, namely grant rights, leasehold rights, real rights and freehold ownership. Prior to the attainment of independence black people in South Africa were not allowed ownership rights. The current land reform process aims to reverse the inequality of the past by introducing the redistribution, restitution and tenure reforms. Restitution aims to return land that was lost because of discriminatory policies while redistribution allows the poor to purchase land through land acquisition grant. Tenure reform is the process of bringing all land holders under a unified landholding system. More recently, the government has implemented a new law that seeks to limit land ownership by the country's citizens. Under the system, the government hopes to transfer a third of all farmland to the country's blacks by 2014 [33].

The land administration domain model and its application to South Africa.

The party package

In the South African land registration system, the LA_Party, LA_GroupParty and well as LA_PartyMember can be identified. The party types are identified in the deeds registration systems as including the following: natural persons (with name, identify number, marital status as key attributes); companies (with company registered name and company registration number as described in the Companies Act); trust (with its trust name); partnership (with full names and marital status of all partners to such partnership). In South Africa, persons married in community of property (i.e. both spouses share each other's property) both need to be registered in the deeds or documents tendered for registration or execution in the deeds office.

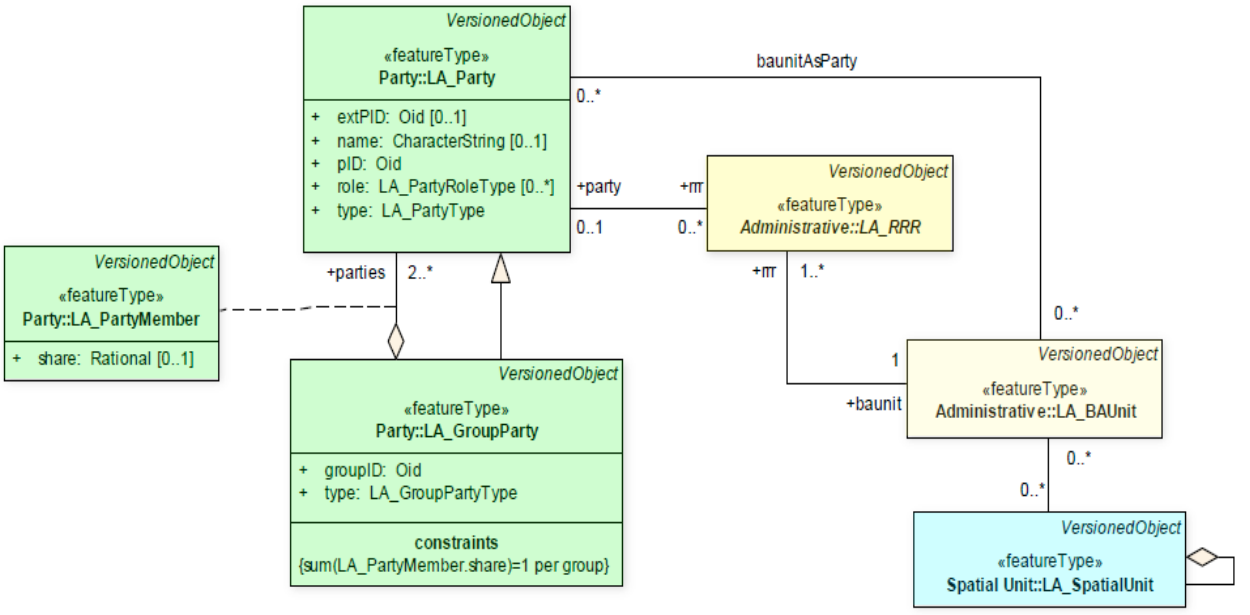


Figure 2.11 the land administration party package and associations to other basic packages (ISO/DIS 19152)

The administrative package

In South Africa, each municipality is allowed to develop town planning schemes to control land use rights. These schemes restrict certain activities or use over land or property. The

land owner is responsible for rates and taxes and service fees (such as water, electricity or refuse removal). In order for property to be transferred from one owner to another, the deeds registries office requires the clearance certificates for municipality within which the land is situated in order to approve the deeds of transfer. Mortgage class is regarded as restricted real rights.

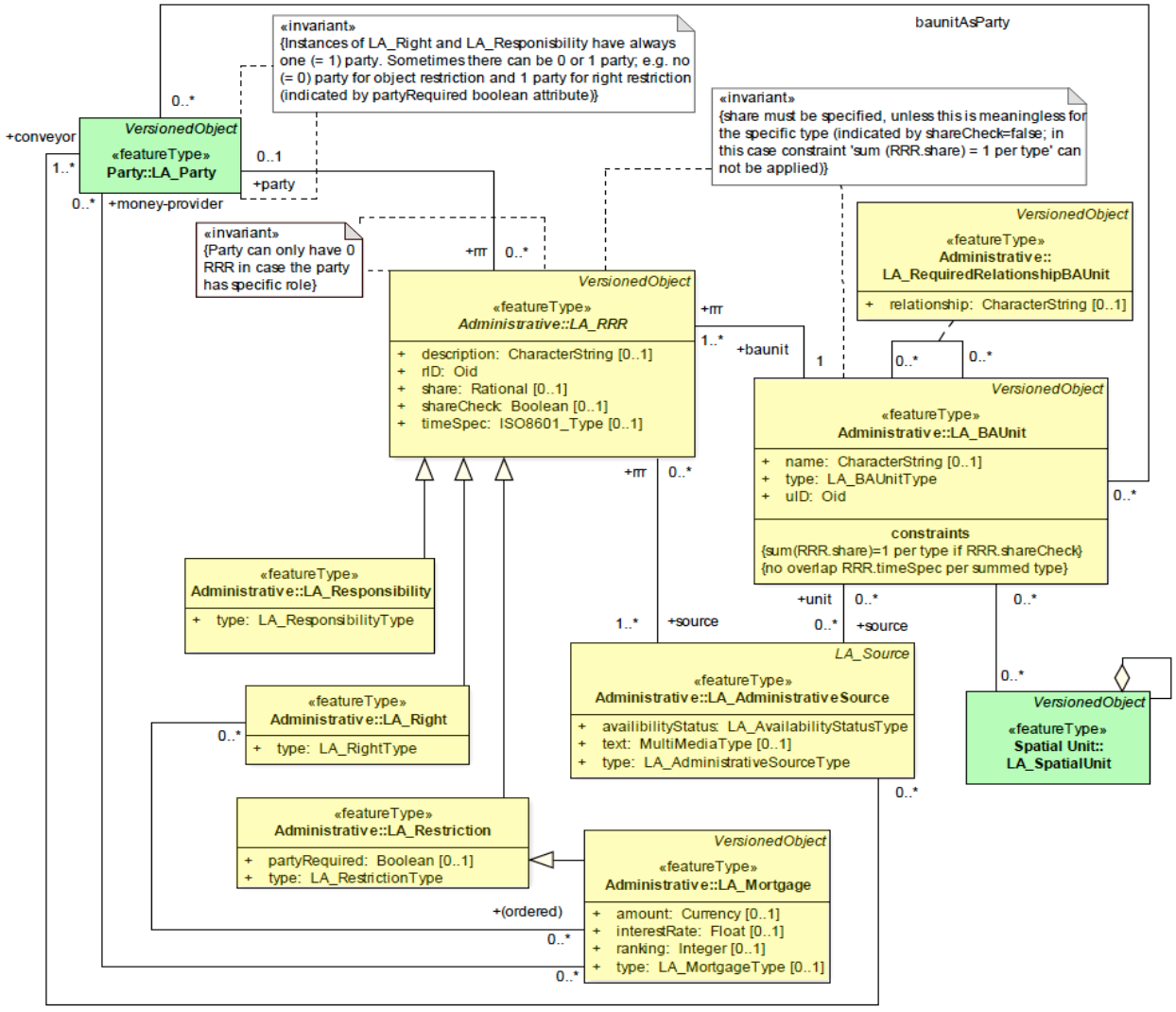


Figure 2.12 the administrative package and associations to other basic packages (ISO/DIS 19152)

In South Africa the deed of transfer establishes who the registered owner of a property is and gives a description and extent of the property. Title deeds may contain conditions which restrict the land uses. For example, the height of a building on a subdivided portion of land

may be restricted. The title deeds may contain that gives the owner the responsibility to retain the property in condition or rehabilitate the land (as in mining). In terms of the law, no registration of land can take place without diagrams prepared and approved by the Surveyor General Office. These diagrams are annexed to the deeds or documents.

Spatial Unit Package

Spatial Unit class in the South African cadastral system can be related to cadastral map. Cadastral maps are compiled by registered surveyors. The cadastral map shows the relative portion or portions and boundaries of surveyed land parcel or parcels. The main types of cadastral maps are diagrams, general plans and sectional title plans. LA_SpatialUnit in the South African land registration is applicable. The LA_LegalSpaceBuildingUnit class can be related to sectional title units as these units are surveyed and registered. In a local municipality, other building plans are approved by municipality. LA_SpatialUnitGroup can be related to land use schemes (zoning) prepared by municipality. LA_LegalSpaceUtilityNetwork class in a case of South Africa, includes, for example, the servitudes that relate to the right of way or servitudes in favour of municipality for service area.

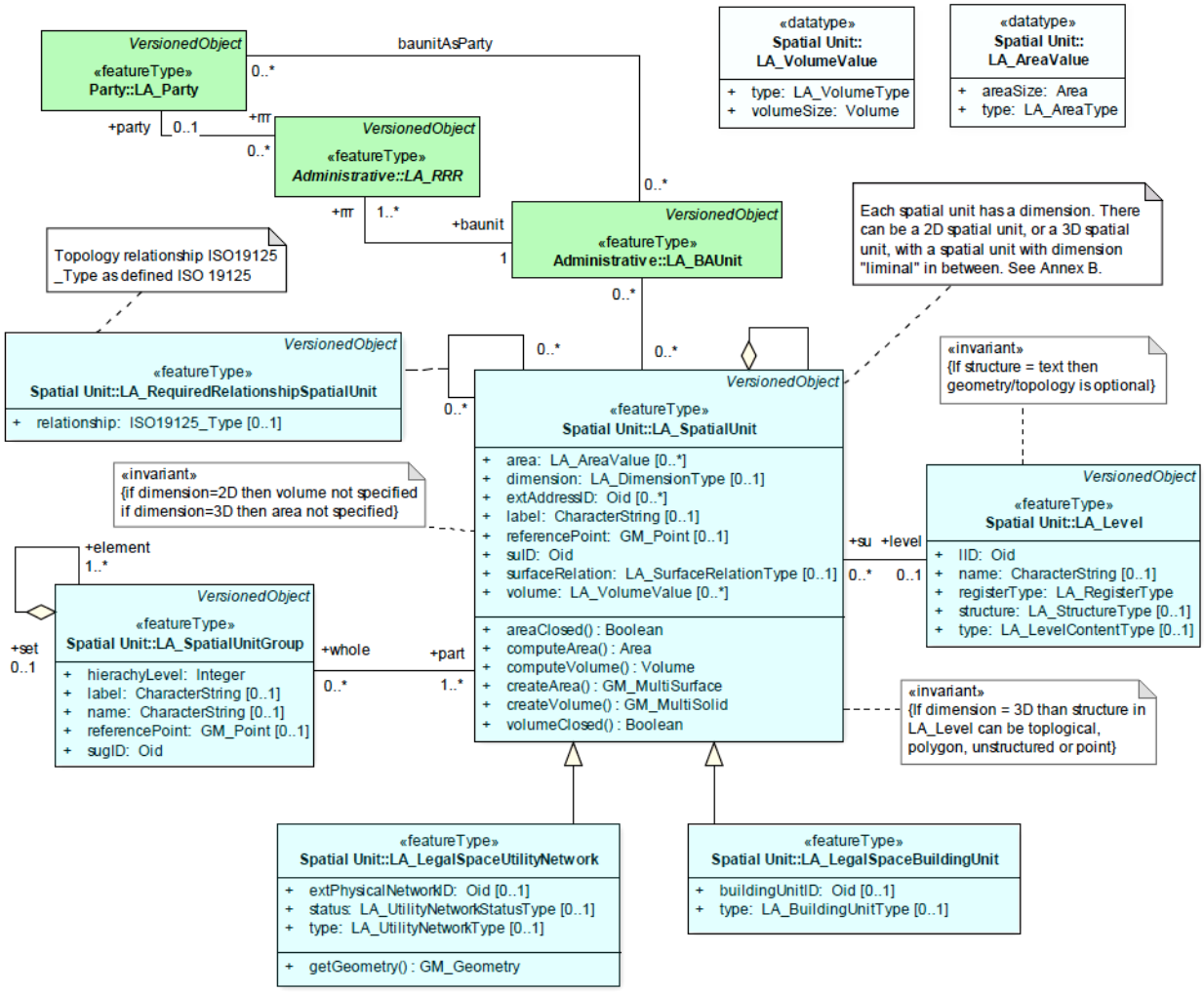


Figure 2.13 The SpatialUnit package and associations to other basic packages (ISO/DIS 19152)

It was concluded that it was possible to develop a profile for land administration for South Africa based on the LADM. Most of the classes of the LADM could be applied in the South Africa land administration system. There the LADM is applicable to the South Africa land administration system [30].

2.4 Comparison between the LADM model for Cyprus, Indonesia and South Africa

Cyprus uses a combined land administration system in which the deeds registers are combined with the cadastral system and South Africa is currently using a dual system in which the surveying and the deeds registering are done separately. The South Africa land administration is still based on the colonial laws whilst the Indonesian government and the Cyprus government have amended their legislation to enable them to better administer land resources.

The legal body in the Cyprus land administration system the legal body was converted to the party package. Party types in both the Cyprus and the South Africa land administration system was related to the natural persons and non-natural persons (companies). In South Africa the LA_PartyMember was related to the partnerships. The LA_Party and its attribute the party type, role of party, share PID and name were relevant to the Cyprus, Indonesia and South Africa land administration system. In all the systems mortgages and contracts of sale were recorded as restrictions as they resulted in the prevention of the transfer of immovable. The restrictions also included easements, usufructs, lease rights, utilities. The LA_SpatialUnit group was related to municipality zones in all the three countries. It was also noted that in both systems the land owner was responsible for the payment of rates, taxes and service fees.

In South Africa local authorities restrict certain activities or land use. For property to be transferred from one owner to another, the deeds registry office require Clarence letter from the municipality on which the land is situated. In South Africa the deeds contains restrictive conditions for example building height restrictions, condition to rehabilitate the land. In order

for registration to take place there should be a diagram prepared a registered land surveyor and approved by the Surveyor General. These conditions were related were related to the LA_Rights Restrictions and Responsibilities in the South Africa land administration model. In Cyprus ownership and agreements were converted to LA_Rights Restrictions and Responsibilities.

Cyprus is divided into districts, quarters and parcel blocks. The parcel entity was converted to the LA_SpatialUnit while in South Africa the spatial unit was related to the cadastral map. The cadastral maps are compiled by registered land surveyors. The cadastral plans include the diagrams and the general plans. The LA_LegalSpace-Building Unit was used for the buildings registration in South Africa the LA_LegalSpaceUtilityNetwork was related to servitudes, rights of way that forms municipality service areas. The LA_LegalSpaceUtilityNetwork was not included in the Cyprus model and the LA_LegalSpace-Building Unit was not included in the South Africa model. Sucaya (2009), indicated that some extensions of the LADM were needed in order to accommodate the frequent land disputes in Indonesia, he further highlighted the need to modify the LADM code list. In his prototype the versioned object and quality labels were use to support the resolving of land disputes and manage the quality of geometric data respectively.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

This chapters sets out to provide an overview of the methodology employed in this research study. The main focus of this chapter will be on research design, data sources and data collection methods. A description of the data processing and analysis will be included in this chapter and this will include aspect of the data comparisons, country profile development and conceptual schema modeling.

3.1 Research design

Research design encompasses the methodology and procedures employed to conduct a scientific research [34]. Both qualitative and quantitative research methods were employed in the research. According to Creswell (2003) qualitative methods yield large volumes of exceedingly rich data obtained from a limited number of individuals. Qualitative data collection methods include the use of interviews, group and/or individual, observation and field notes. Quantitative methods include a representation of an empirical system in a numerical mathematical system for the purpose of reasoning analytically within the mathematical system [35]. The research design focused on which data are relevant, what data to collect and how to analyze the results. The descriptive research design was used in this research. This method was chosen mainly because of its numerous advantages which include cheapness and effectiveness.

The survey design method involved, revisiting the objectives of the research and ensuring that the research is in line with the research objectives and questions. The next stage involved

the identification of the sampling frame, the sample sizes and selecting an appropriate sampling technique so as acquire as much information as possible. After the identification of the sampling frame the research methods were then determined. The research methods implemented were face to face interview, questionnaires and telephone interviews. The research tools were then designed and this involved the structuring of the interview questions, determining whether to use open ended or closed ended questions in the interviews. The final stage was the analysis of results. The results were reviewed in line with the research questions and objectives.

3.1.1 Study population

Wharton (2002) defined study population as a group of individuals or items that share one or more characteristics from which data can be gathered and analyzed. The population in this research comprised of the entire stakeholder involved in the land administration process in Zimbabwe. The stakeholders included real estate agencies, surveyors, planners, conveyencers, notaries and land administration officers from the Department of the Surveyor General (DSG), the Deeds Registry Office and the local authorities. The information obtained from the study population together with the information obtained from the literature review was used in the comparison of the land administration domain model (LADM) and the land administration system in Zimbabwe.

3.1.2 Sampling Method

Sampling *is the process of selecting a sample of elements from a target population in-order to conduct a survey* [36]. Stratified random sampling was employed in this research. Three main strata were identified and these were; the Department of the Surveyor General, the registrar of deeds, the local authority. Simple random sampling was used to gather data from

the private sector. This group included the surveyors, conveyencers and notaries. After determination of the sampling methods the researcher then proceeded to collect data from the identified strata.

3.1.3 Data Collection

Data was collected from the identified strata. Both primary and secondary data was collected during the field work.

Primary data

Primary data was obtained from face to face interview, telephone interviews and questionnaires. Data was mainly collected from the three identified strata (Department of the Surveyor General, local authorities and the Deeds Registry Office). The researcher first sought out permission from the responsible authorities and briefed the authorities on the purpose of his study. The authorities then selected the most suitable respondents to be interviewed. Appointments with the selected respondents were made and the interviews were conducted in the comfort of the respondents' offices. Semi-structured questions were used to solicit information from the respondents (see appendix i for the interview guide). The structured questions allowed a two way communication between the respondents and the researcher. The interviews were 30 minutes on average per session. Telephone interviews were used to get further information or clarification of issues that the researcher might be interested in.

Questionnaires allowed the researcher to collect facts from a large number of people while maintaining uniform responses. Both open ended questions and closed ended questions were formulated. Each questionnaire had a letter attached to it explaining the purpose of the study. The questionnaires were left at the respondents' respective offices to be collected by the

researcher after a period of two days. This allowed the respondents to answer the questionnaires at their own free time (see appendix ii for the questionnaire).

Secondary data

Secondary data was obtained from reviewing existing documents and observations. A number of documents that describe the land administration processes at the Department of the Surveyor General (DSG), the Deeds Registry Office and the local authorities were collected and reviewed. The documents included performance reviews, complaints reports, annual reports, information service requests reports and other documents that gave insight into the land administration processes and the associated challenges. The researcher went on to study documents that described the business functions and these included the vision statements, organization mission, objectives and strategic plans of the departments involved in the land administration process in Zimbabwe. Standard operating procedures, job outlines and task were reviewed.

Observations

This involved the analyst placing himself at a strategic position where it was possible to see the proceedings of the current system from the data capturing, storage and retrieval. Active balanced participation was used in this research. This method maintains a balance between the researcher being an insider and an outsider. The research could observe and participate in some of the activities being a carried out at the organization. Observations allowed the researcher see exactly what was being done and how it was being done and determining the tasks and activities that users accomplish in meeting their functional requirements.

3.1.5 Validation and reliability of information

The information obtained from the field work was validated by sending the scripts back to the interviewees so they can access if their views have been correctly portrayed. Some of the respondents gave references to the information that they were giving. Most of the respondents showed the researcher reports, documentations and other relevant material to support the information that they were giving. Wolcott, H.R. (1999) pointed out that in study it is the duty of the research to properly maintain and interpret the responses of the subject(s). This ideology led to the researcher recording and maintaining all information obtained in the study in form of notes and these notes were interpreted soon after the interviews so that no data would be lost or forgotten.

3.1.6 Data analysis

The researcher analysed the data obtained from the field work using data coding. This involved the assigning a numerical numbers to each response and organizing the data into groups. The groups were formulated in relation to the land administration domain model so as allow for easy analysis of the results and comparison of the systems. The results of the data analysis were used to determine the user requirements of the land administration system (section 4.2).

3.2 Similarities between the Zimbabwe land administration system and the land administration domain model

In-order to come up with a comprehensive comparison of the land administration system in Zimbabwe and the land administration domain model the researcher first identified the relationship between the systems. The process involved the identification of the land

administration domain model (LADM) classes, subclasses, attributes and associations in the Zimbabwe land administration. The results of the comparison are summarized in section 4.3. The LADM classes that proved to be in conformity with Zimbabwe administrative functions, were directly adopted into the Zimbabwe land administration model.

3.3 Differences between the Zimbabwe land administration system and the land administration domain model.

The assessment for the differences between the Zimbabwe land administration system and the land administration model was performed in two categories highlighted in sections 4.3. The first section presented the classes that are present in the LADM, but not relevant to the Zimbabwe system (LADM Specific). The second section highlighted the land administrative functions in the Zimbabwe system that are not included in the LADM (Zimbabwe Specific). The analysis paved way for the modification of the land administration domain model class attributes and code lists, so as to adapt them to the Zimbabwe situation. Additional classes for the Zimbabwe model were proposed after the identification of the Zimbabwe specific functions. Holistic

3.4 Zimbabwe land administration model concept

The results of the comparison between the land administration domain model (LADM) and the Zimbabwe land administration system were used to determine the classes, attribute and associations of the LADM that could be directly applied into the Zimbabwean land administration model. The comparison also provided the basis for determining classes, attribute and associations that required modification. The country profile for Zimbabwe was developed using unified modeling language (UML). The Unified Modeling Language (UML)

is a graphical language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system (section 2.3.7) [37]. UML was used to define the software system and it acts as a blue print to software implementation. Enterprise Architect (version 10.0) was used to develop the conceptual schema for the Zimbabwe country profile (see section 4.4). The conceptual model for the party (section 4.4.1), administrative (section 4.4.2), spatial unit (section 4.4.3) and the survey and spatial representation (section 4.4.4) were developed.

CHAPTER 4 : ANALYSIS OF RESULTS

4.0 INTRODUCTION

This section is mainly aimed at analyzing the current land administration system in Zimbabwe and determining the requirements of the external and internal users of the land

administration system. Land administrators from the Department of the surveyor General, Deeds Registry Office and the local authorities were interviewed together with clients/customers of the organizations. The results of the surveys are presented in this section in form of graphs which are used to elucidate the meaning of the data presented. The land administration system in Zimbabwe was evaluated in terms of its ability to meet the user requirements, processing time, functions, technical capabilities, human and financial resources available, the need for change and the best possible methods for introducing the change and the readiness of the clients and land administrators to such changes.

4.1 Survey results

Personal interviews, telephone interviews and questionnaires were the main survey instruments used in the research. The table below shows the number of people interviewed and the distribution of questionnaires to land administrative organizations which were the Deeds Registry office (DR), the Department of the Surveyor General (DSG) and the local authorities (LA). The table includes the number of clients/customers interviewed.

Table 4.1 the distribution of the questionnaires and the responses percentages to the questionnaires.

	DR	DSG	LA
People interviewed	4	5	3
Telephone interviews	2	3	1

Questionnaires	10	10	10
Questionnaires responses	7	8	6
Questionnaire Response Percentage	70%	80%	60%

4.2.1 User Requirements

User requirements were determined from the interviews and the questionnaires administered during the field work. Land administration officers highlighted the need to eradicate the separation of the survey documents and ownership information thereby enhancing tenure security. Planners require accurate and up-to-date land information for efficient land use planning. The interviews indicated the need to review the current legislation pertaining to land administration in Zimbabwe. The review of the legislation will result in the reduction of the land administration procedures. One stop shopping was considered a necessity for efficient functioning of the land administration system. It was suggested that there be established a land administration department under the Ministry of Lands, Agriculture and Rural resettlement that will administer a land information system for Zimbabwe. The idea to involvement more of the private sector in the land administration was endorsed as the private sector was viewed to be more efficiency and quickly respond to the user requirements. The land administration authorities cited the need for an online land administration system which will allow users to view basic information pertaining to a parcel of land and to carry out other processes such as land transfers online. This would save clients time, money labour of visiting the numerous offices involved in the land administration system in Zimbabwe. There is need to device a means for dealing with the storage and archiving of land administrative documents. Tracking of documents was advocated for as this would reduce time spent searching for documents within the system.

4.2 Similarities between the Zimbabwe land administration system and the land administration domain model.

The basic similarity between the Zimbabwe land administration system and the land administration domain model lies in the representation of the relations between people and land through rights, restrictions and responsibilities. Packages and subpackages of the land administration domain model can be identified in the current land administration system and these include the spatial unit package, the administrative package and the party package.

The party package classes: the LA_Party, LA_PartyMember and the LA_GroupParty and the elements of the code list LA_PartyRoleType, LA_GroupPartyType and LA_Party type can be identified in the Zimbabwe land administration system. A party is natural person holding rights in land. The LA_Party can be related to the land owner (with key attributes being: name, ID number, marital status and date of birth) recorded in the deeds registry office, companies (with attributes company name and company registration number) recorded in the company registry. In Zimbabwe, individuals married in community of property must both be registered in the deeds registry thus husbands and wives can be related to the LA_PartyType. According to the interview results, the LA_PartyGroup relates to communities, organizations, cooperatives and partnerships that represent social structures in Zimbabwe.

LA_PartyRoleType identifies all the persons and organizations that play a part in the Zimbabwe land administration system and these include surveyors, conveyancers, local authorities, notary public, farmers, land owners, Surveyor General, banks, planners, employees and the Deeds Registrar. LA_Party attributes partyID, type, role and signature are applicable to the Zimbabwe land administration system.

The LA_administrative package comprise of LA_rights, LA_restrictions, LA_responsibilities, LA_DocumentSource, LA_LegalDocument and LA_Mortgage. In Zimbabwe land related rights are recorded in the deeds registry and these rights are: ownerships rights, leases, usufructs, fidei commissum, usus, habitation, mortgage bonds and antenuptial contracts. A right represents a social relationship between a parcel (spatial unit) and the land owner (party). In-order for a right to be valid in Zimbabwe it has to be registered by the Registrar of Deeds. Upon the registration of a parcel (spatial unit) the land owner is responsible for the payment of rents, rates and taxes (Title Registration and Derelict Land Act Chapter 20:20). According to the Land Survey Act (Chapter 20:12) the land owner is responsible for the maintenance of property beacons. The land owner is also responsible for the rehabilitation of the land parcel.

The Local Authority restricts certain activities through the imposing of the restrictive conditions and conditions of title, so as to preserve the general characteristics of an area. Zoning mechanisms by the local authorities restrict certain activities in specific areas for example commercial and industrial areas cannot be used for residential purpose. The local authorities have created buffer zones around areas which are considered to be inhabitable for example there buffer zones around river networks and it is not allowed to build structures within 15m from a river network. There are restrictions pertaining to the registration of land parcels in Zimbabwe. A land parcel is only registered after the issuing of rates clearance certificate by the local authorities and a capital gains certificate by the Zimbabwe Revenue Authorities (ZIMRA) (see land registration procedure section 2.2.1). All the restrictions on a parcel of land including building height restrictions and restrictions on subdivisions are endorsed on the title deed. In Zimbabwe diagrams approved by the Surveyor General are always annexed to the title deed.

The Deeds Registrar is mandated by the Deeds Registry Act (Chapter 20:05) to register mortgage bonds, were land is used to secure a debt or an obligation. In Zimbabwe when a property is mortgaged the mortgage value and the conditions imposed by the bank or money lender are endorsed on the title deed. No transaction pertaining to the property will be processes without the knowledge of the bank or money lender. When a property is transferred to another person the mortgage bond is also transferred to the new owner. The LADM has a LA_mortgage class which deals with property mortgaging. LA_LegalDocument comprise of documents providing legal evidence of the party rights. Legal documents were indentified to be title deeds, antenuptial contracts recorded in the Deeds Registry Office. LA_DocumentSource refers to a document providing facts, and these documents were related to agreements of sale, local authority subdivision permits, approved diagrams, capital gains tax clearance certificate, rates clearance certificates. In summary, the LA_Rights, LA_Responsibilities, LA_Restictions, LA_Mortgage, LA_LegalDocument and LA_DocumentSource are applicable to the Zimbabwe land administration model. Attributes of the LA_Right LA_AdministrativeDocument and LA_Responsibility were all relevant to the Zimbabwe land administration model.

LA_SpatialUnit can be described as an area of land or water where rights apply. In the Zimbabwe Land Administration system LA_SpatialUnit can be related to land parcels appearing the cadastral maps which would have been complied by land surveyors, approved by the Surveyor General and registered by the Registrar of Deeds. The cadastral maps comprise of diagrams sectional plans and general plans. According the Land Survey Act (Chapter 20:12) a diagram is a document containing geometrical, numerical and verbal

representations of a piece of land or a line, feature or area forming the basis for registration of a real right which has been signed by a registered land surveyor. A general plan is a plan which represents the relative position and dimensions of one or more pieces of land, has been signed by a registered land surveyor.

LA_SpatialUnitGroup can be related to land use zoning and LA_LegalSpaceUtilityNetwork include rights of way, way of necessity and other servitudes prepared by the Local Authority to accommodate service areas. LA_LegalSpaceBuilding is the legal space or legal surface around a building. LA_LegalSpaceBuilding comprise of two or more BuildingUnits. LA_Building units can be related to the sectional titles (apartments) recorded in the deeds registry. LA_SurveyDocuments were identified as survey records (field books, diagrams, general plans, survey reports, working plans) at the Department of the Surveyor General. LA_SurveyPoint is an observed point and was related to the calculated coordinates in the survey coordinate files.

The surveying and spatial unit package is a subpackage of the spatial unit package. The subpackage includes LA_Point, LA_BoundaryFaceString, LA_BoundaryFace, and LA_SpatialSource. LA_Faces is used to describe the boundary of a spatial unit using 3D surfaces and LA_BounadaryFaceString is used to describe a spatial unit using the linestring in 2D. This class can be related to the geometric representations of spatial units on diagrams and general plans.

Table 4.3 Relationship between the Zimbabwe land administration system and the land administration domain model

LADM Class	Class in the Zimbabwe land administration

	system
LA_Party,	Land Owner, Surveyor, Surveyor General, Registrar of deeds, Planner, local authorities, conveyance, Zimbabwe Revenue Authority, Department of the Surveyor General, banks, Notary, land administration officer, high court and the state.
LA_GroupParty	communities, organizations, cooperatives and partnerships
LA_Right	Ownership rights, lease rights, habitatio, usus, usufructs.
LA_Restriction	Endorsement on title deeds such as mortgages and servitudes. land use and building restrictions. Consolidation and subdivision restrictions
LA_Responsibility	Rates and taxes payment. Maintenance of property beacons and land rehabilitation.
LA_SpatialUnit	Land Parcel
LA_SourceDocument	Client application documents, power of attorney letters, agreement of sale, holding deed, diagram deed

LA_SurveyDocument	Field books, diagrams, general plans, survey reports, working plans
LA_AdminSourceDocument	Capital gains clearance certificate, dispensation certificates, rates clearance certificate, permit.
LA_Facestring	Property Boundary
LA_SourcePoint	Coordinates
LA_Mortgage	Mortgage right
LA_BuildingUnit	Buildings
LA_LegalSpaceBuilding	BuildingPlans
LA_LegalSpaceUtility	Servitudes
LA_LegalDocument	Title deeds and Approved diagrams
LA_SpatialUnitGroup	Land zones

4.3 Differences between the Zimbabwe land administration system and the LADM.

4.3.1 Land administration domain model Specific classes

The spatialUnit class LA_Network and the survey and spatial representation class LA_Face were not relevant to the Zimbabwe system as they deal with three dimensional spatial information. The Zimbabwe land administration system is still based on two dimensional spatial representations. The LA_Party attribute partyID and fingerprint could not be integrated into the Zimbabwe model due to lack of technological advancements in the

country. The partyID in terms of generic name was found to be irrelevant to the Zimbabwe land administration system, the partyID can however be related to the party identification number.

4.3.2 Zimbabwe Specific classes

Most of the elements of the LA_Party package were identified in the Zimbabwe land administration system but however difference were noted on attributes for the LA_Party. The codelist LA_PartyType, LA_PartyRoleType and LA_GropuPartyType have to be modified to include party members that were within the Zimbabwe land administration system. All the classes of the administrative package were relevant to the Zimbabwe land administration model, but there is need to modify the attributes of the LA_RRR, LA_Mortgage, LA_Restriction and the LA_LegalDocument. There is need for the LA_RRR attributes to include right descriptions and the LA_Restriction attributes should incorporate parties involved. Respondents highlighted the need for the tracking of documents within the land administration system so as determine the exact person responsible for the document at a particular time. This implies the need to create a class for the management and tracking of documents as this is not catered for in the current land administration domain model. The respondents indicated the need for effective management of archived documents. Primarily the LA_VersionedObject provides for the management of history and allows the reconstruction of the contents of the database for a specific time. The LA_VersionedObject only manage data organized in a database, thus cannot address the complex document management requirements for the current land administration system in Zimbabwe.

The land administration domain model does not include land use and land use types. In Zimbabwe land use management is handled by the local authorities and there are seven land use types in Zimbabwe, and these are: agricultural, commercial, forestry, institutional, residential, recreational and industrial.

Classes to be included in the Zimbabwe land administration model

The comparison clearly highlights that most of the classes of the land administration domain model can be directly implemented in the Zimbabwe land administration system. These classes are LA_Mortgage, LA_LegalDocument, LA_LegalSpaceUtility, LA_LegalSpaceBuilding, LA_UtilityNetwork, LA_BuildingUnit, LA_Party, LA_PartyMember, LA_GroupParty, LA_Right, LA_Restriction. It was however observed that there is need to modify the code lists. External entities were indentified and these included were included in the land administration model in Zimbabwe. The classes were Ext_Archieve, Ext_Valuation, Ext_Taxes.

Additional classes were proposed for the Zimbabwe land administration system and these included the LandUse, Archieve and DocumentStatus.

Rational for the additional classes

Archieve

This class will be responsible for the management of information that is not required often in the land administration system. The requirements stage reviewed that most of the data at the organizations involved in the land administration system in Zimbabwe is not properly achieved. This external class will aid efficient storage and facilitate easy retrieval of the information. This will solve the problems associated with storage space at the organizations.

Attributes of the class will be acceptance date, recordation date, submission date and data type.

LandUse

The LandUse class was suggested in response to the user requirements. In Zimbabwe there are seven land uses which are residential, recreation, agricultural, institutional, forestry and commercial. The landuse class will be under the spatial unit package and will be having the attributes: landuse type.

DocumentStatus

Land administration in Zimbabwe includes a number of organization. This class was suggested in response to the clients who highlighted the need to be able know where are particular document will be. A lot of time is spent trying to locate document positions. This class will reduce time required to track a document and will help in location of missing documents by identifying the last individual or organization that had the document. Attribute of the class are: document name, date or receiving, date of dispatch, name of document holder.

External classes to be included in the Zimbabwe model

External classes are outside the scope of the LADM, however the LADM indicate data sets elements that are expected from the external classes. The external classes aids in the incorporation of all activities related land administration within a specific jurisdiction. According to the researcher, basing on the information obtained from the interviews the inclusion of the external classes for valuation, taxation, party, address, natural and non natural person will aid in the development of an effective and efficient land administration system.

Rational for the external classes

Ext_Valuation

This class will contain valuation information. The valuation is mainly carried out by the Estate and Valuation section under the local authorities. Valuation information is required when mortgaging a property. Attributes of the class are: Value, Valuation Date and Valuation type.

Ex_NaturalPerson

A NaturalPerson refers to a human being or legal person holding rights or a social tenure relation. The External database will contain land information recorded in the deeds registry. Attribute of the class are partyID, name, surname, date of birth, date of death, alias, marital status and address.

Ex_NonNaturalPerson

A NonNaturalPerson refers companies or cooperatives. The external database will contain information recorded in the company registry. Attribute of the class are partyID, name, address, registration number, termination date, registration type.

Ex_Address

The external database Ex_Address will contain location information for the parties involved in the land administration system. Attribute of the class are partyID, street name, building number, building name, addresseID, postal code, postbox, city, country.

Ex_Party

The external class will contain historical information of a party. The information can be used to verify the authenticity of a party for example, verify if a survey is surveyor, conveyance or natory is allowed to practice.

4.4 Proposed Zimbabwe country profile based on the land administration domain model (LADM)

The user requirements (section 4.1) and the similarities and differences identified in section 4.2 were the basis for developing the Zimbabwe country profile based on the LADM. The profile include additional classes required by the land users in Zimbabwe, new attributes and code lists were determined so as to come with a distinct Zimbabwe specific model which caters for all the functional requirements of the land users in Zimbabwe. The prefix "LA" for the land administration domain model classes was changed to "ZW" to indicate that the classes have been inherited or proposed for the Zimbabwe land administration model.

Zevenbergen (2012) noted that an enhancement of existing model to comply with the LADM requires the migration of the current models to the LADM classes. The migration was based on the comparison between the land administration system in Zimbabwe and the LADM. The ownership entities recorded in the Deeds Registry Office can be related to the LA_Party and the endorsements on the title deeds can be related to LA_Right, Restrictions and Responsibilities. The endorsements include mortgage bonds, leases, servitudes and special conditions imposed by the local authorities on the land parcel. Building plans were related to LA_LegalSpaceBuildingUnit, land parcel was related to LA_SpatialUnit, servitudes were related to LA_LegalSpaceUtility and land zoning was related to LA_SpatialUnitGroup.

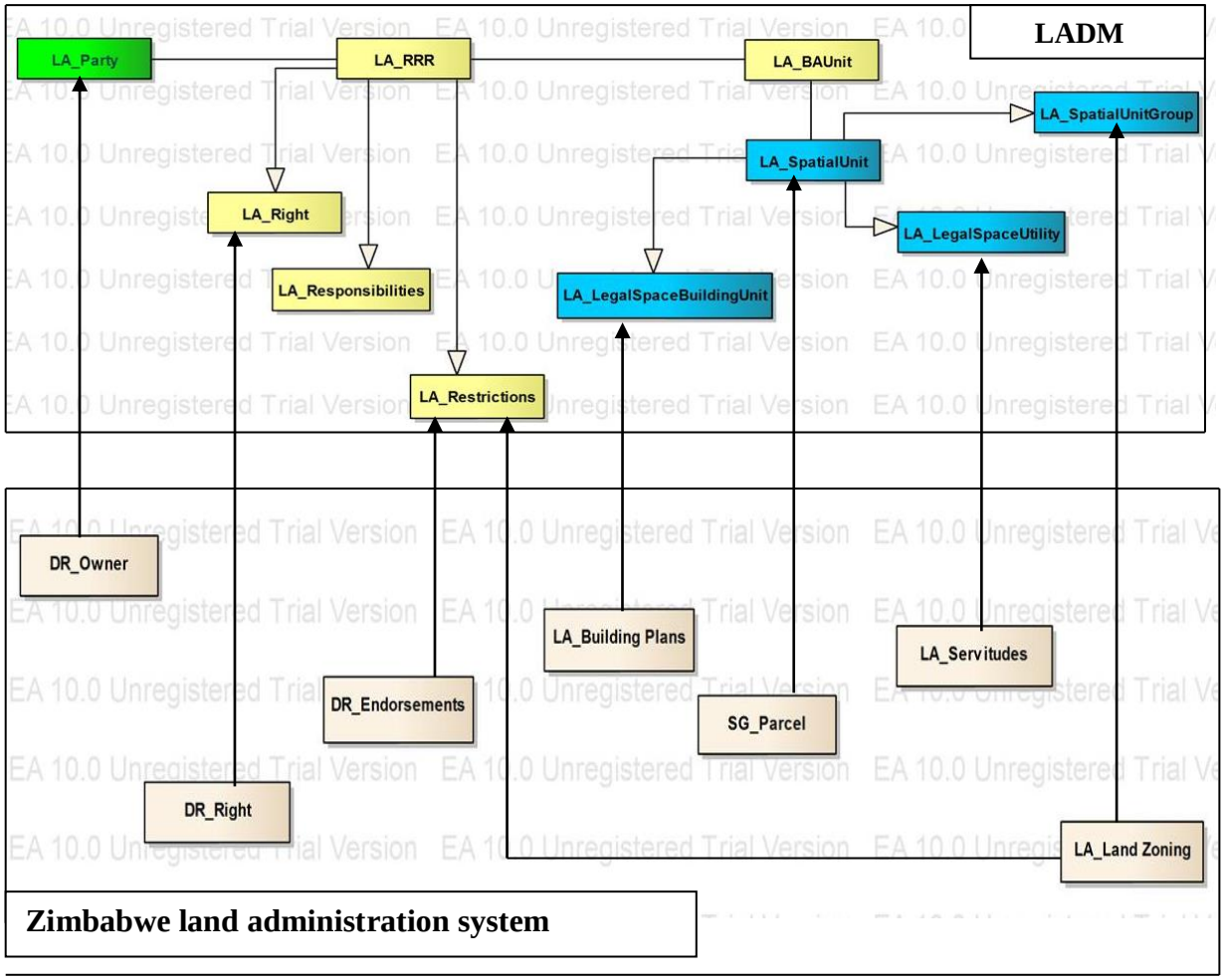


Figure 4.1 Proposed migration from the Zimbabwe land administration system to the LADM.

4.4.1 Party Package

The party package presents all the stakeholders involved in the Zimbabwe land administration. Figure 4.2 shows the contents of the proposed party package with the code list PartyType, GroupPartyType, PartyRoleType.

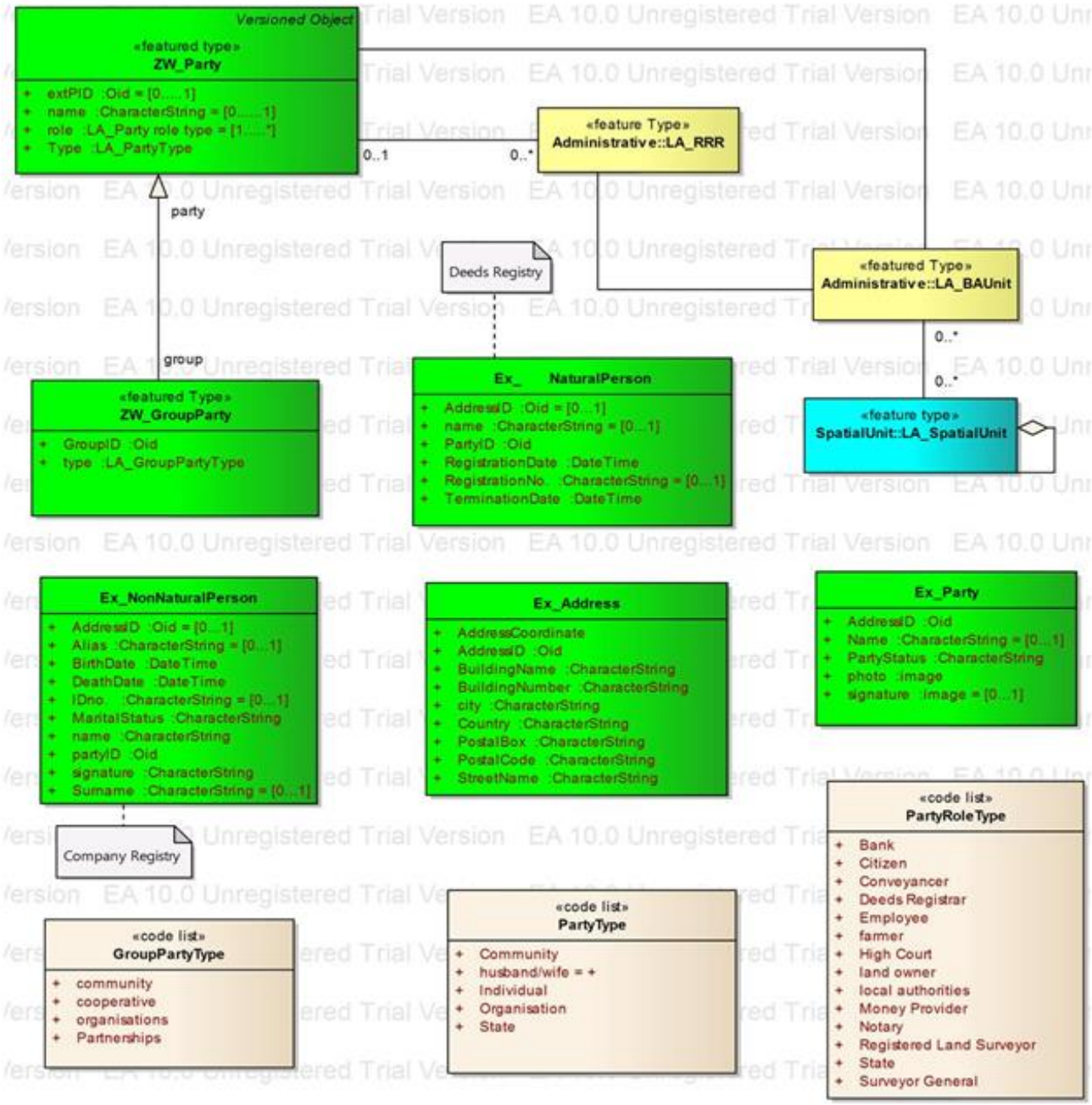


Figure 4.2 Proposed Zimbabwe party package based on the LADM.

The classes of the party package and their relationships were adopted from the land administration domain model ISO19152 standard package (described in section 2.3.1). The code lists for PartyType, GroupPartyType and PartyRoleType were modified based on the information obtained from the investigation on the current land administration system. The modifications necessitated by the need to make the model Zimbabwe country specific. The

external class Ex_Party was introduced for the maintaining of the party historical information. The external class will contain the name, photo and scanned image of the party. The party status will be used to describe the status of a party for example a surveyor can be in training, practising or non practising. This class can be used verify if a party (surveyor, notary, conveyance) is authorized play a particular role in the land administration system. The Ex_Address is used to provide directions to a party. A NaturalPerson refers a legal person recorded in the deeds registry and a NonNaturalPerson refers a company or cooperative recorded in the company registry.

4.4.2 Administrative Package

The administrative package deals with LA_RRR (LA_Rights, LA_Restiction and LA_Responsibility), LA_BAunit, LA_AdminSource and LA_Mortgage. The land administration packages ZW_Right, ZW_Restrictions, ZW_Responsibilities ZW_Mortgage and ZW_AdministrativeSource were adopted from the land administration domain model (description on section 2.3.2). Additional classes ZW_DocumentStatus and ZW_Archive were introduced in response to user requirements. The ZW_DocumentStatus was introduced to the tracking of administrative documents within the administration system and the ZW_Archive will be responsible for the management of archived documents in the land administration system. The external classes Ext_Valuation and Ext_Taxes were introduced to accomodate the valuations processes carried out by the local authorities and the taxation operations carried by the Zimbabwe Revenue Authority respectively.

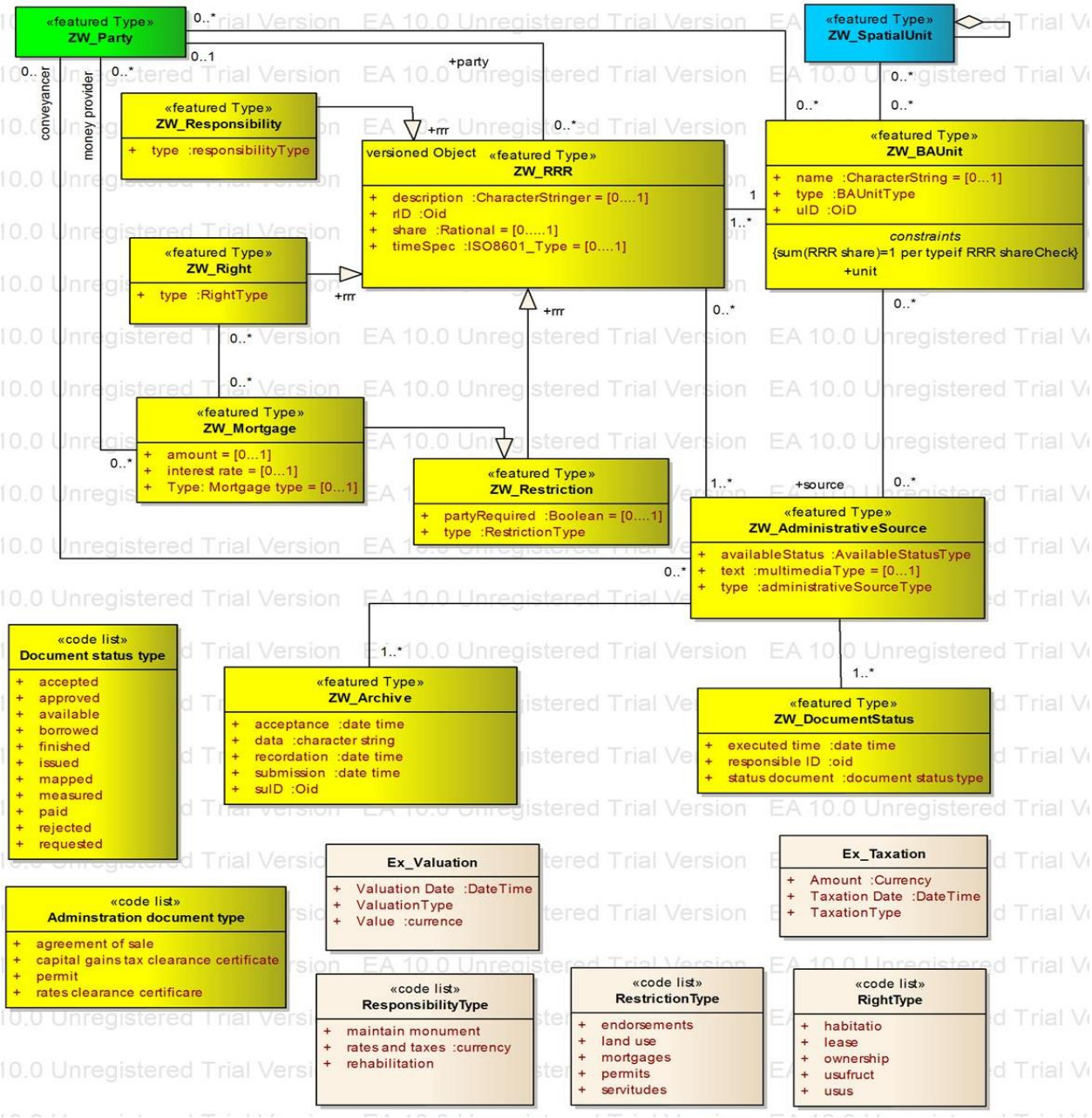


Figure 4.3 Proposed Zimbabwe administrative package based on the LADM.

The ZW_DocumentStatus has the code list document status type which furnish information pertaining to the current status of a document, for example a document can be accepted, rejected, borrowed, rejected. Responsibility type, restriction type and right type were developed in accordance with the results of the comparison of the land administration system in Zimbabwe and the land administration domain model (section 4.2).

4.4.3 Spatial Unit Package

LA_Spatial unit can be described as an area of land or water where rights apply. Spatial units can be represented as sketch based units, text based units and line based units. In response to the user requirements a land use class was proposed. The land use class will be a subclass of the ZW_SpatialUnit. The land use type code list was also proposed (Figure 4.4.) and included all the land use types in Zimbabwe. The survey document type was modified in-order to relate to the land subdivision and consolidation requirements in Zimbabwe. The survey document type in the Zimbabwe model contains documents required when lodging a survey record. The ZW_BAUnit (basic administrative unit) allows the association of one right to a combination of spatial units. This class facilitates the administration of spatial units within a designated land zone. The spatial unit group has an aggregated relationship to itself; this facilitates the further subdivision of spatial units. The ZW_Level allows the integration of information from the organizations involved in the Zimbabwe land administration system. The class allows the representation of information in layers based on the principle of legal dependence, for example formal rights pertaining to a parcel of land can be in one layer and information pertaining to restrictions and responsibilities imposed by the local authorities can be represented in another layer. Layers for taxation and valuation can be included in the ZW_Level.

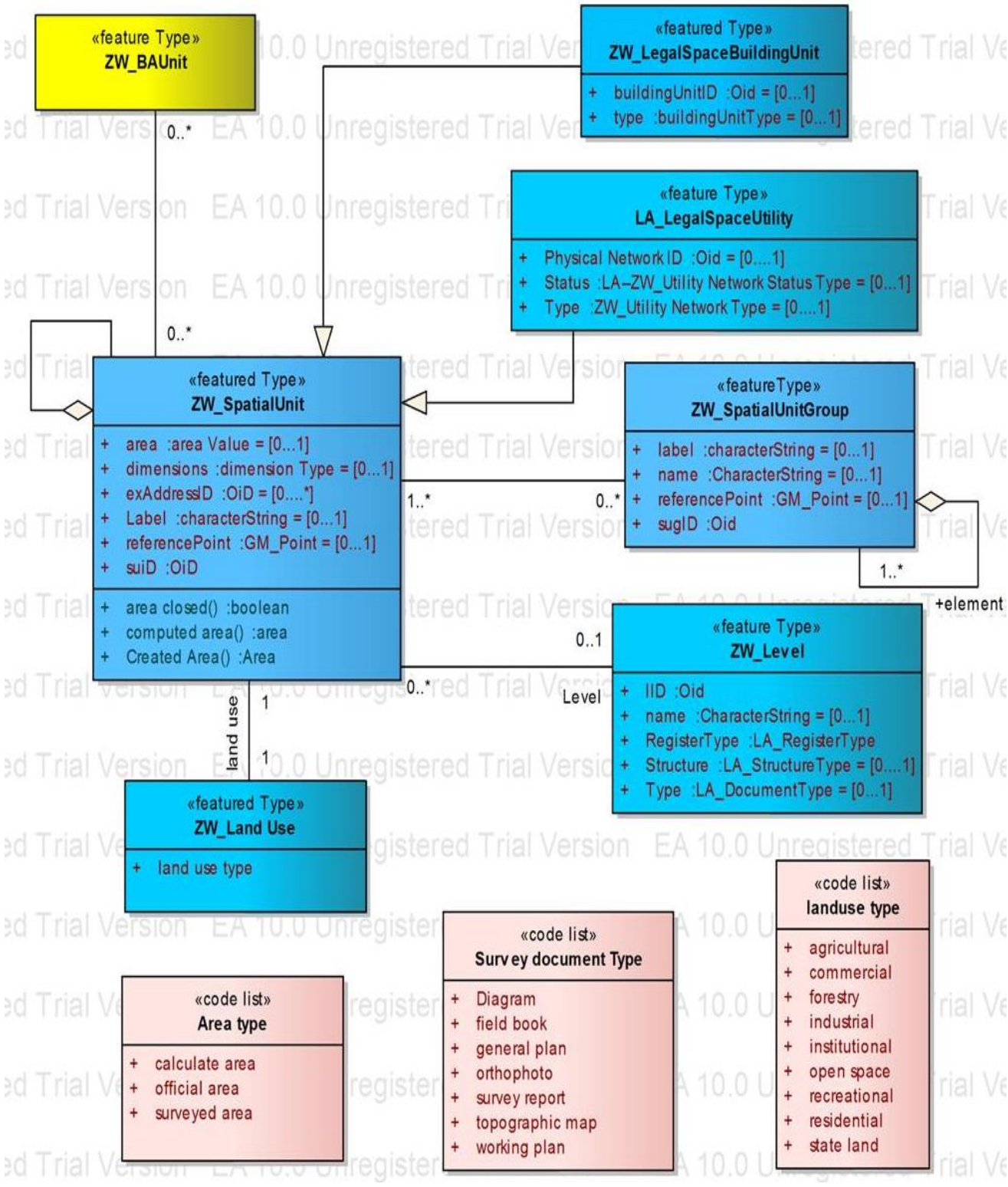


Figure 4.4 Proposed Zimbabwe spatial unit package based on the LADM.

Surveying and spatial representation

The surveying and spatial unit package is a subpackage of the spatial unit package. The surveying and representation subpackage shows the data related to technical features about land use. The classes ZW_Point, ZW_SpatialSource and ZW_BounadryFace were mostly inherited from the land administration model ISO19152 standard. The monument type and spatial source type were modified to relate to the Zimbabwe land administration system. Figure 4.4 below shows the proposed Zimbabwe surveying and spatial representation subpackage.

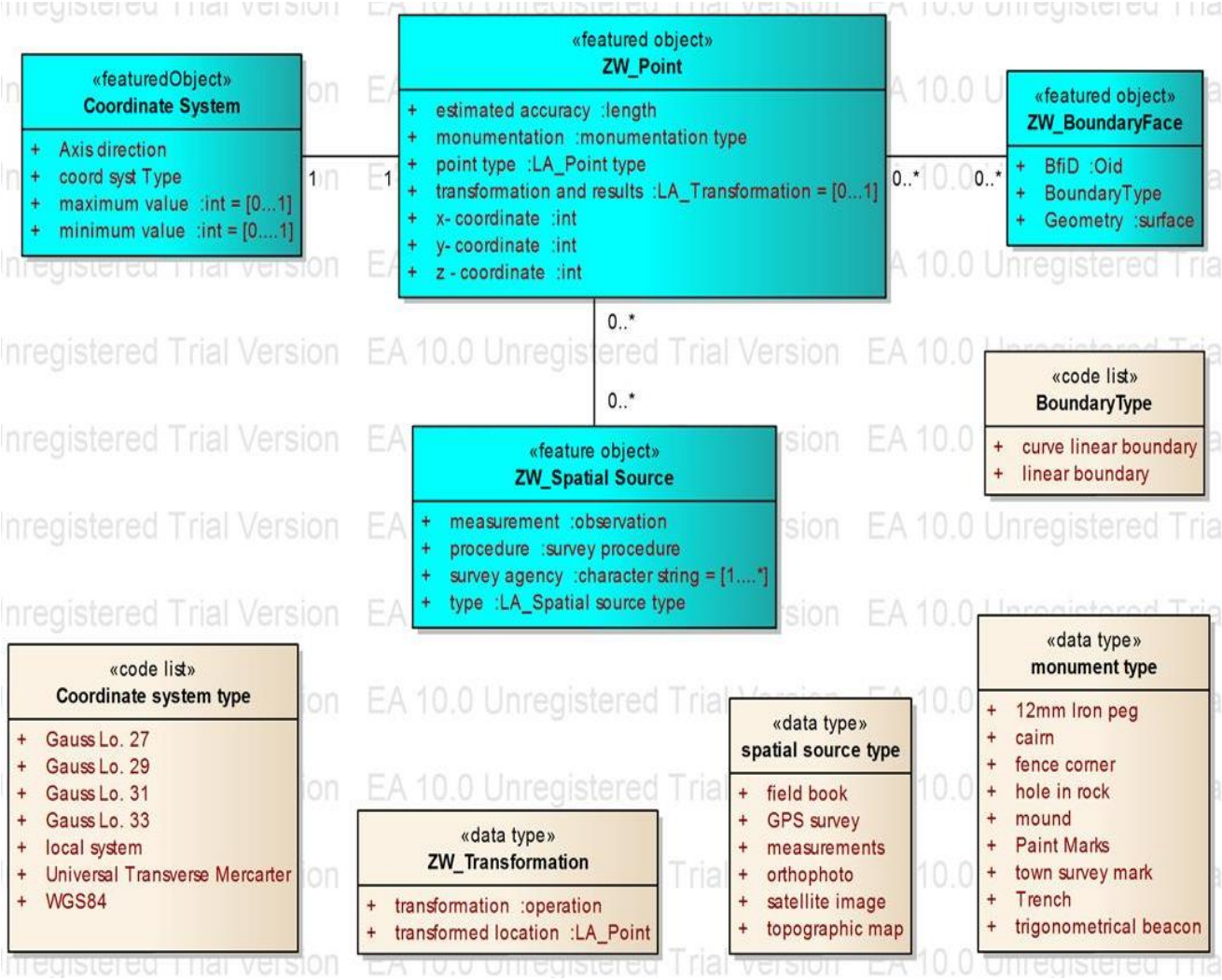


Figure 4.5 Proposed survey and spatial representation package based on the LADM.

In Zimbabwe there are three main coordinate systems in use and these are: the Gauss conformal system, Universal Transverse Mercator (UTM) and WGS 84. The Gauss system is

used for cadastral surveys, the UTM is used for mapping and the WGS 84 is mainly applied in engineering works. The local system is no longer in use, but survey records complied and stored at the Department of the Surveyor General prior to the passing of the land survey regulation are still based on local systems. These will be captured by the coordinate system class. Coordinate system information will facilitate coordinate transformations. Monument types were derived from the land survey regulations statutory instrument 727 of 1979.

CHAPTER 5: CONCLUSIONS AND RECONMENDATIONS

5.1 Introduction

The chapter seeks to unveil the findings of the investigation, which will provide a basis for concluding and making recommendations on future studies. Results from the previous chapter will be the basic point of reference for this chapter.

5.2 conclusions

In-order to determine the conformity of the Zimbabwe land administration system to the land administration domain model five specific research objectives and four research questions were formulated. Conclusions for this investigation will be drawn from the research question and the specific objectives.

The first research question was aimed at determining the similarities and difference between the Zimbabwe land administration system and the land administration domain model. The basic similarity between the Zimbabwe land administration system and the land administration domain model was identified in the representation of the relations between people and land thus through rights, restrictions and responsibilities. The basic packages and classes of the land administration model where identified in the Zimbabwe land administration system.

Differences were noted on the attribute and the code lists of the LADM class. This difference was mainly attributed to difference in land administration system and the uniqueness of the land administration in Zimbabwe.

The determined similarities and differences gave a basis for determining the LADM classes that could be directly applied into the Zimbabwe model and the classes that will not be required in the Zimbabwe model. LADM parties that were similar in concept to land administration system in Zimbabwe were directly applied to the Zimbabwe land administration model. The classes (discussed in section 4.2) included the LA_Party, LA_GroupParty, LA_PartyMember, LA_Right, LA_Restictions, LA_Responsibilities, LA_Mortgage, LA_LegalDocument, LA_Point, LA_SpatialUnitGroup LA_SpatialUnit, LA_LegalSpaceNetwork and LA_FaceString.

LADM classes that were not compatible with the Zimbabwe land administration model were excluded from the Zimbabwe land administration model. These classes include LegalNetwork, LA_Face, MovableClass, OtherRegisterObject and NonGeoRealEstate.

There were no extensions required on the LA_Party package, but there was need to modify code list for the PartyRoleType, PartyGroupType and PartyRoleType. The administrative package was extended to include LA_Archive and LA_DocumentStatus. Attributes for the LA_Mortgage and LA_Restriction were modified. The LA_LandUse class was added to the LA_SpatialUnit package so as to carter for the land use types in Zimbabwe and the conditions imposed thereafter.

The results obtained from the research provide a basis to conclude that the Zimbabwe land administration system is conformant with the land administration domain model. However there was need to modify and extend the model so that it is applicable to the Zimbabwe situation.

5.4 Recommendation

The researcher recommends the review of the current legislation pertaining to land administration in Zimbabwe with the aim reducing the land administration procedures and simplifying the land registration procedures.

It is also recommended that there be established a land administration department under the Ministry of Lands, Agriculture and Rural resettlement that will administer a land information system for Zimbabwe.

Increased involvement of the private sector in the land administration was advocated for, as the private sector is viewed to be more efficiency and quickly respond to the user requirements.

It can also be recommended that the government invests in the development of Zimbabwe land administration system based on the LADM as the system can be cost recovering if properly administer

Recommendations for future works

The major objective of this research was to determine the conformity between the Zimbabwe land administration system and the land administration domain model. The specific objectives included the developing of the Zimbabwe conceptual models based on the land administration domain model. It is recommended that the model be advanced into a full functioning system based on the proposed Zimbabwe land administration model.

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APPENDICES

Appendix i: Interview Question Guide

LAND ADMINISTRATION SYSTEM IN ZIMBABWE

Research Questions Guide

Department of the Surveyor General (DSG)

1. What are the land administrative functions of your organization
2. Which individuals or organizations play a part in land administrative processes at your organization

3. What are the controlling legislation.
4. What information is usually required by your clients
5. How do you identify land disputes and how to you resolve them
6. What are the types of cadastral plans that you produce and at which scales
7. Which documents are required for survey approvals
8. What are the sources of the information
9. What information is recorded in the land cadastre
10. Which legal documents do you produce after the approval of a survey

Deeds Registry Office

1 What are the land administrative functions of your organization

2 Which individuals or organizations play a part in land administrative processes at your organization

3 What are the controlling legislation.

4 What information is usually required by your clients

5 Which information is recorded in the land registry

6 What is the procedure for mortgaging a land property and what information is recorded when a registering a mortgage

7 What are the type of rights, restriction and responsibilities recorded in the land registry

8 What are the sources of the information

9 Which legal documents are produced after the registration of a land parcel.

Local Authorities

1 What are the land administrative functions of your organization

2 Which individuals or organizations play a part in land administrative processes at your organization

3 What are the controlling legislation.

4 What information is usually required by your clients

5 What are the processes and importance of land use planning

6 What is the condition of public utility mapping

7 What are the land valuation procedures

8 What is the information recorded on building plans and what is the information used for

9 What are the sources of information used at your organization

10 What land use restrictions and responsibilities recorded at your organization

APPENDEX ii : Research Questionnaire

Land Administration System in Zimbabwe

The purpose of this study is to gather expert opinion on issues relating to the land administration system in Zimbabwe and factors affecting the process. Only **Tinashe Mtariswa** of **Midlands State University** shall use this information for his final year project.

LAND ADMINISTRATION OFFICE QUESTIONNAIRE

"Land Administration system in Zimbabwe"

All responses shall be treated with confidence. Please fill in the available spaces and tick where applicable.

Section A: Personal Information

Name: ……..……..……. (optional).

Position:……...……

Organisation:……

Section B: Questions

1. Does your organization have standards for defining land administration processes?
   ☐ Yes ☐ No
2. Have the current land administration processes or procedures at your organization been compliant with the standard procedures.
   ☐ Yes, they have all been compliant. ☐ Only some of them have been.
   ☐ No, they have not been compliant.
3. According to your opinion are the current land administration procedures appropriate for effective land management.
   ☐ Procedures are appropriate.
   ☐ Some of procedures need to be simplified.

   Please explain:

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4 What spatial information does your organization maintain.

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5 What are the sources of the spatial information.

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6 a) Does your organization share spatial information with other organizations ?

☐ Yes ☐ No

b) Which organizations do you share information with.

……

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……

c) What information do the organizations require?

……
……
……

7 a) Does your organization share spatial information with other countries ?

☐ Yes ☐ No

b) Which countries do you share spatial information with.

……
……
……

c) What information do the countries require?

……
……..……
……..

8. Does your organization have good coordination /relations with other organizations involved in the land administration system in Zimbabwe?

☐ Yes, there is good coordination.

☐ Yes, but the coordination is not so good.

☐ No, there is poor coordination.

9. According to your assessment, how is the quality of information (both spatial and non spatial) disseminated at your office?

☐ High quality

☐ Moderate quality

☐ Low Quality

10. According to your assessment is the current legislation adequate for proper land administration

☐ Yes, but there is too much legislation.

☐ Yes, it is adequate.

☐ No, it is not adequate.

Please explain:

……
……

11. At your organization is there a standard and efficient system for document archiving (for example maps, cadastral plans, land certificates)

☐ Yes, all documents are well archived.
☐ Yes, most documents are well archived.
☐ Yes, but only a few documents are well archived.
☐ no, the documents are not well archived.

Please Explain

……
……

12. According to your own assessment is the current land administration system effective and efficient and is it meeting the customer requirements?

☐ Yes, the system is efficient and meeting requirements.
☐ Yes, the system is efficient but is not meeting the user needs.
☐ No, the system is not efficient.

13. If the system is inefficient and ineffective, what do you attribute the ineffectiveness to?

☐ Shortage of financial resources.
☐ Poor coordination between the organizations involved in the land administration process.
☐ Too many complicated procedures.
☐ Unavailability of the required information and information technology.

Other(s) please specify:

……
……

14. What do you recommend should be done to overcome the land administration challenges in Zimbabwe.

1……
…..
2……
…..
3……
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4……
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5……
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