PRIVATE SECTOR PARTICIPATION IN THE ZAMBIAN MAPPING INDUSTRY

By

BWALYA KAPANSA

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requirements for the degree of
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DECLARATION

I, **BWALYA KAPANSA,** do hereby declare that this thesis is entirely the outcome of my own work and that to the best of my knowledge, it has never been presented for a degree at this or any other University. All figures and tables, except for those whose sources have been acknowledged, are original.

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APPROVAL

This dissertation of Bwalya Kapansa is approved as fulfilling the partial requirements for the award of the degree of Master of Engineering in Project Management by the University of Zambia.

NAME	SIGNATURE	DATE
……..	…….....	.....
Internal Examiner		
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Internal Examiner		
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Internal Examiner		
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Dissertation Chairperson		

ABSTRACT

The Revised Sixth National Development Plan states that there will be an increase in urbanisation and infrastructure development. This process has an impact on the environment and economy therefore proper land use planning is critical to sustaining the economic developments. However, most of the cities in Zambia have remained unplanned and updated topographic maps are lacking. This study therefore investigated the participation of private sector in the mapping sector in Zambia. From the literature reviewed it was shown that updated maps play an important role in making informed decisions affecting urbanisation and sustainability. Therefore, in this stud data was collected using a self-administered questionnaire distributed to registered land surveyors and semi-structured interviews with officials from the Ministry of Lands, Natural Resources and Environmental Protection. Using descriptive statistics, it was established that the private sector's participation in Zambia was inadequate and did not contribute to all the areas of updating maps. This suggested that the mapping industry was not performing as expected and could not provide the needed updated topomaps. Using these results this study proposed that government should review how it had engaged the private sector in mapping. Lastly, this study raised awareness on the existing paradigm of the private sector that should help all the stakeholders enhance the performance of this part of the economy.

DEDICATION

To my family and Simuyuni Namangolezya

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Lastly, I thank God for giving me good health and all the blessings I have enjoyed which are really too numerous to mention. “He is good, all the time. And all the time, I can testify!”

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ABBREVIATIONS

ANOVA	Analysis of Variance
CBU	Copperbelt University
DEM	Digital Elevation Model
DESA	Department of Economic and Social Affairs
DMMU	Disaster Management and Mitigation Unit
DNLP	Draft National Land Policy (2015)
ECZ	Environmental Council of Zambia
ESRI	Environmental Systems Research Institute
GIS	Geographic Information Systems
GMAs	Game Management Areas
GRZ	Government of the Republic of Zambia
KCM	Konkola Copper Mine
MFNP	Ministry of Finance and National Planning
MLGH	Ministry of Local Government and Housing
MLNREP	Ministry of Lands, Natural Resources and Environmental Protection
NGO	Non-Governmental Organisation
NHA	National Housing Authority
NRFA	National Road Fund Agency
NRSC	National Remote Sensing Centre
PPP	Public-Private Partnership

PSP	Private Sector Participation
RDA	Road Development Agency
REA	Rural Electrification Authority
SADC	Southern Africa Development Community
SI	Statutory Instrument
SMS	Short Message Service
SNDP	Sixth National Development Plan
SPSS	Statistical Packages for Social Sciences
UN	United Nations
UNEP	United Nations Environment Programme
UNZA	University of Zambia
ZLA	Zambia Land Alliance
ZSD	Zambia Survey Department

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter introduces the reasons for conducting this research. It starts with outlining the current situation in Zambia and then discusses the problem being investigated. Furthermore, it summarises the methodology that was used to gather data.

1.2 Background to the study

The mapping industry contributes to a countries economic development. It provides information on how the land is being used. It also allows predictions on how the land use will change in future. Furthermore, the mapping industry provides a platform on which several stakeholders can operate as they use the land. Zambia is one of the countries with an established mapping industry.

1.2.1 The role of maps in economic development

It is reported by Minango (2015) that Zambia generates revenue from mining, tourism, timber, agriculture and other economic activities which required considerable areas of land. This suggests that a change in one land use will affect the others. For example, the United Nations (2004) observes that the increased level of urbanisation in all parts of the world is critical to sustainability in urban development. As such, one of the land uses that require to be planned properly is the land used for farming (Matuschke, 2009). This is because the majority of the population in urban areas do not engage in farming and yet they buy more food than they grow (ibid).

According to Minango (2015) the Zambian land use can be summarised as presented in Figure 1.1.

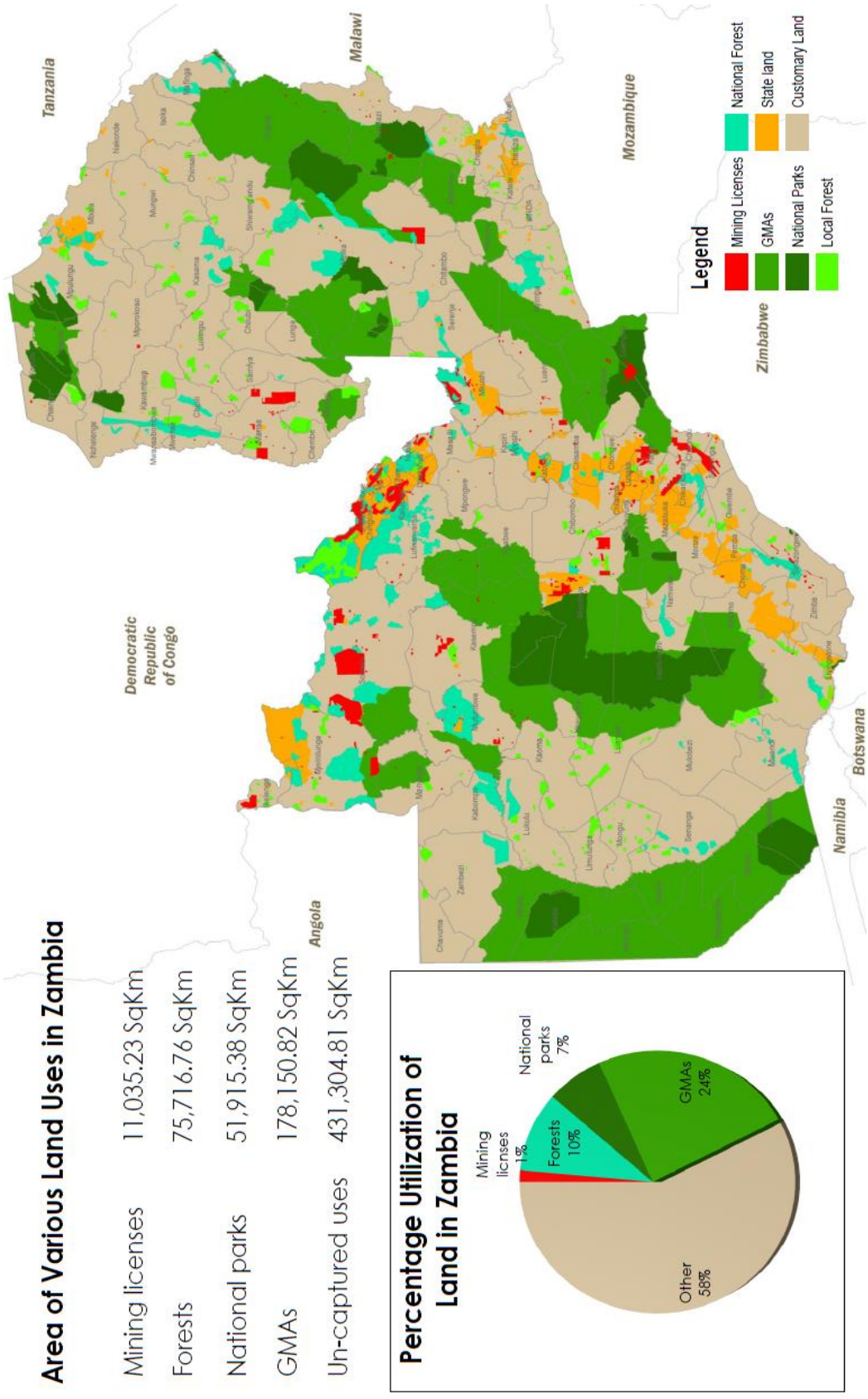

Figure 1.1: Typical land use in Zambia

(Source: Minango, 2015)

In order to understand, analyse, monitor, and plan how the land is being used and how one use is impacting the other uses, various tools are used worldwide. One of these tools is a topographic map (topomap). It is used to depict how features on the earth's surface are distributed and related to each other. It is useful because it represents a part of the surface of the earth drawn to a particular scale and when it is kept up to date, it depicts the status of the country's ever changing landscape (Geoscience Australia, 2016). Furthermore, a topomap provides a way to view and analyse the spatial distribution of features on the earth. These features can be manmade like roads, buildings, and dams or natural like rivers, valleys and forests (ibid). A topomap therefore combines these features and visually describes how the land is being used at a given point in time. It is important to have topomaps because Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) (2012: p.8) states that:

> *Land is a scarce resource increasingly affected by the competition of mutually exclusive uses. Fertile land in rural areas becomes scarcer due to population growth, pollution, erosion and desertification, effects of climate change, urbanization, etc. On the remaining land, local, national and international users with different socioeconomic status and power compete to achieve food security, economic growth, energy supply, nature conservation and other objectives. Land use planning can help to find a balance among these competing and sometimes contradictory uses.*

Therefore, during the planning and decision making process topographic data is required. Seeing the topomap is drawn to scale, a lot of information can be derived from it about the area mapped such as: location, shape and area of features, distance and direction (bearings) between features, using the coordinate system employed by the map; and the volume of particular features and phenomena, using the contour lines. Therefore, using topomaps for scientific studies is possible and this informs decision-makers on proper use of the land and its natural resources.

1.2.2 Updating topographic maps

In order to get accurate information the topomap must be updated constantly so that it is a true representation of the earth's surface over a given time. Because of this, the

government should update the topomaps and the accompanying information on a regular basis. Updating in Zambia is done by the Ministry of Lands, Natural Resources and Environmental Protection (MLNREP) and is done every five years according to Mooka (2016). However, the lack of updated topomaps has caused a lack of coordination among decision makers when planning settlements (Minango, 2015). In view of this, concerns from the public have been raised on the need for updated land use information.

Therefore, a Land Audit in Zambia was started in 2015 that would allow MLNREP to ascertain the actual amount of land: generate statistics on the number of land uses and how the various uses were competing (Minango, 2015). This Land Audit involves updating topomaps for 15 selected towns in Zambia using aerial photos taken at different spatial resolutions and subsequently creating a database system for that information. A foreign company has been contracted by the MLNREP for this project (ibid). Even though a foreign company is updating the topomaps in these areas, the participation of the Zambian private sector is still required.

1.3 The Private sector participation

In order to update land use data, the government of Zambia, through the Ministry of Lands, Natural Resources and Environmental Protection (MLNREP) has invited the private sector to participate in this process. This involves creating Public-Private Partnerships (PPPs) which allows the private sector to participate in the mapping industry in Zambia.

Despite the private sector being considered as a model for good budget and public financial management practice (Lienert, 2009) and that it is run for profit it is also known for avoiding defined protocols. In this regard, the private sector is limited to how much it can participate in the updating of maps in Zambia (Mooka, 2016). However, the limitations imposed on the private sector still provide for several opportunities for participation in the mapping industry.

1.4 Problem statement

Zambia is one of the most urbanised countries in Africa with 70 percent of the capital city's population leaving in unplanned settlements (UN-habitat, 2012). This has exerted pressure on the land because urbanisation has introduced changes in land use

that have not been planned for. To manage and plan an effective urbanisation process requires using updated topographic maps. Because of this, efforts have been made by the government to engage the private sector's participation in the mapping industry. However, the topomaps of Zambia still remain out of date.

1.5 Aim and objectives

This research aims at investigating how the private sector is assisting the government in Zambia to update topomaps. The focus is on the contribution made by the registered land surveyors to the mapping sector.

1.5.1 General objectives

The general objective is to establish how the private sector is participating in updating topographic maps in Zambia.

1.5.2 Specific objectives

- To outline the process of updating maps in Zambia.
- To determine the nature of the private sector in Zambian mapping industry.
- To determine the type of contribution the private sector is making.
- To propose key areas of focus for effective private sector involvement.

1.6 Research questions

This problem prompted to ask the following questions:

1. How was the updating of topographic maps done in Zambia?
2. Who constituted the private sector that is involved in updating maps in Zambia?
3. What type of contribution was made by the private sector in the mapping industry in Zambia?
4. What were the factors the private sector felt influenced their level of participation?

1.7 Research methodology

This was a Descriptive study that adopted a mixed methods research approach in data collection. It was a descriptive study because the variables affecting the private sector's participation were observed without any manipulation. Primary data collection involved conducting interviews with government officials at MLNREP and a survey using a self-administered questionnaire distributed to the respondents. Random sampling techniques were applied because the entire population of registered surveyors could not be issued a questionnaire. The data collected from the survey was sorted using MS Excel and then, using Descriptive statistics, analyses were performed on the data. The findings were presented in form of graphs, tables and charts. Secondary data was collected from literature collected from various sources such as the internet, journals, and textbooks.

1.8 Significance of the study

Zambia's economy is highly urbanised (Banda, 2004; GRZ, 2000) and the increase in population has caused changes in land use. However, the lack of up-to-date topographic information has caused a lack of coordination among decision makers when planning settlements (Minango, 2015). Because of this, concerns have been raised on the need for updated land use information so that developmental processes, undertaken by various Stakeholders, can be coordinated. Therefore, this study comes at a time when the private sector has been engaged to assist government update the existing topographic maps. Despite the Private sector being an important part of the economy that is known to be very efficient and helpful in economic development, knowledge on how it is contributing to this process in Zambia is lacking. Therefore, this study provides insights in to the mapping industry in Zambia and the contribution the private sector is making.

1.9 Chapter Synthesis

This report is organized into five (5) chapters. Each chapter begins with a short introduction for that chapter and ends with a summary of the major themes discussed in that chapter. Chapter 1 gives a background to the study and highlights the reasons for conducting the study. Furthermore, it defines the focus for the study by listing the questions that are addressed in this research. Chapter 2 is dedicated to reviewing the

literature that speaks to the themes of this study thereby validating this research. Chapter 3 provides the methodology and methods used in the research. Furthermore, it highlights the type of data that was collected, the type of mathematical methods that were used during analysis, and how the data was presented. Chapter 4 presents the analyses of the data collected and then produces models and graphs that summarise the findings of the research. Chapter 5 presents the discussion of the collected results and provides recommendations useful for future research.

1.10 Summary

This chapter summarised the economic activities taking place in Zambia based on the Vision 2030 themes of infrastructure development. It then introduced the main theme of the research which was the need for updated geographic information in form of topographic maps. Then the private sector's participation in the Zambian mapping industry was discussed. Furthermore, the chapter outlined the objectives and research questions that this research sought to answer. These themes are developed further in chapter two that presents literature related to this research that was reviewed.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Chapter 1 summarised how Zambia's land use patterns has been transformed by urbanisation and why topographic maps were required to manage this process. In addition, the chapter introduced the main theme of this study which was the participation of the private sector in updating Zambian topographic maps. This chapter reviews literature on the mapping industry and the participation of the private sector.

Taylor (2014) defined literature review to be an "outline of what researchers and accredited scholars have said about a given topic and it aims at analysing the strengths and weaknesses of the current level of knowledge on the topic". Therefore, this chapter gives an overview of the research that has been done on what constitutes the private sector's involvement in the mapping industry. It continues building on the major research themes such as urbanisation, the need of updated geographical information, and how the private sector participates in updating maps. Lastly, the chapter focuses on the nature of the Zambian mapping sector and how the private sector is involved.

2.1.1 Urbanisation

Urbanisation is the movement of the population into cities which has the benefit of promoting modernisation and transforming low-income rural societies into middle-income and high-income countries (Annez and Buckley, 2009). In the Zambian context, these urban areas were areas with not less than 5000 inhabitants where more than 50% are not engaged in agriculture (CSO, 2013). In this definition it was noted that the size of the area was not specified explicitly because the demarcation is based on administrative and municipal boundaries not on the extent of built up areas. The definition further states that the duration of stay should not be less than six (6) months (ibid).

Because the major economic activity is not agriculture-based in the urban areas, urban areas are centres for modern production and industry, financial services, internal commerce and foreign trade, education and government (ibid). The United

Nations' World Urbanisation Prospect report (2014) confirms stating that Cities are important drivers of development and poverty reduction in both urban and rural areas, as they concentrate much of the national economic activity, government, commerce and transportation, and provide crucial links with rural areas, between cities, and across international borders. Urban living is often associated with higher levels of literacy and education, better health, greater access to social services, and enhanced opportunities for cultural and political participation. This is applicable to Zambia where Lusaka, the capital city received the lion's share of social, economic and health services development. Furthermore, other urban cities such as Ndola and Kitwe had also seen an increase in the number of development projects.

2.1.1.1 History of Urbanisation

Most of the European countries urbanised relatively slowly, which allowed governments time to plan and provide facilities for the increasing populations (Haapala, 2002). However, the current trend was different in that the rate of urbanisation was now higher than the rate at which planning was taking place (ibid). Highlighted are some of the major issues surrounding current urbanisation as reported by the United Nations (2014):

- More people live in urban areas than in rural areas, with 54 per cent of the world's population residing in urban areas in 2014.
- The global rural population is now close to 3.4 billion and is expected to decline to 3.2 billion by 2050.
- Today, the most urbanised regions include Northern America where 82 percent were living in urban areas in 2014, Latin America and the Caribbean with 80 percent, and Europe at 73 percent.
- Continuing population growth and urbanisation will add 2.5 billion people by 2050 with nearly 90 per cent of the increase concentrated in Asia and Africa.
- Continued urbanisation will produce sustainable development challenges concentrated in cities, particularly in the lower-middle-income countries where the pace of urbanization is fastest. Integrated policies to improve the lives of both urban and rural dwellers are needed.

2.1.1.2 Factors affecting urbanisation in Zambia

It was observed that urbanisation was a global phenomenon and that the rate at which it is taking place is higher than the rate of planning (UN, 2014). Some factors leading to urbanisation are common to all countries while others are specific. The following section discusses the factors that have led to an increase in the rate of urbanisation in Zambia.

2.1.1.2.1 Population Growth

There are three components of urban population growth: natural growth of urban population, rural-urban migration and the reclassification of areas previously defined as rural (Haapala, 2002). In Zambia the urban areas have been experiencing growth in their population. Between the years 2010 and 2015, the urban population was expected to grow from 5,611,909 to 6,176,921 (CSO, 2014) which represented a growth of 10%. Because of reduced mortality rates, improved healthcare, easy access to financial services, the urban population has been increasing in size (GRZ, 2010).

2.1.1.2.2 Migration

Notwithstanding natural growth, the growth in these urban areas was attributed to internal and international migrants mostly (CSO, 2013) with internal migration consisting of rural-rural, rural-urban, urban-urban and urban-rural migration. Migration was defined as "a form of geographical or spatial motion between one geographical unit and another" according to Haapala (2002). Furthermore, it is a continuous and repeated process rather than a single event which increases the numbers of people permanently living in relatively small areas (ibid).

Figure 2.1 shows the estimated net-migration of people into urban areas between 2000 and 2010.

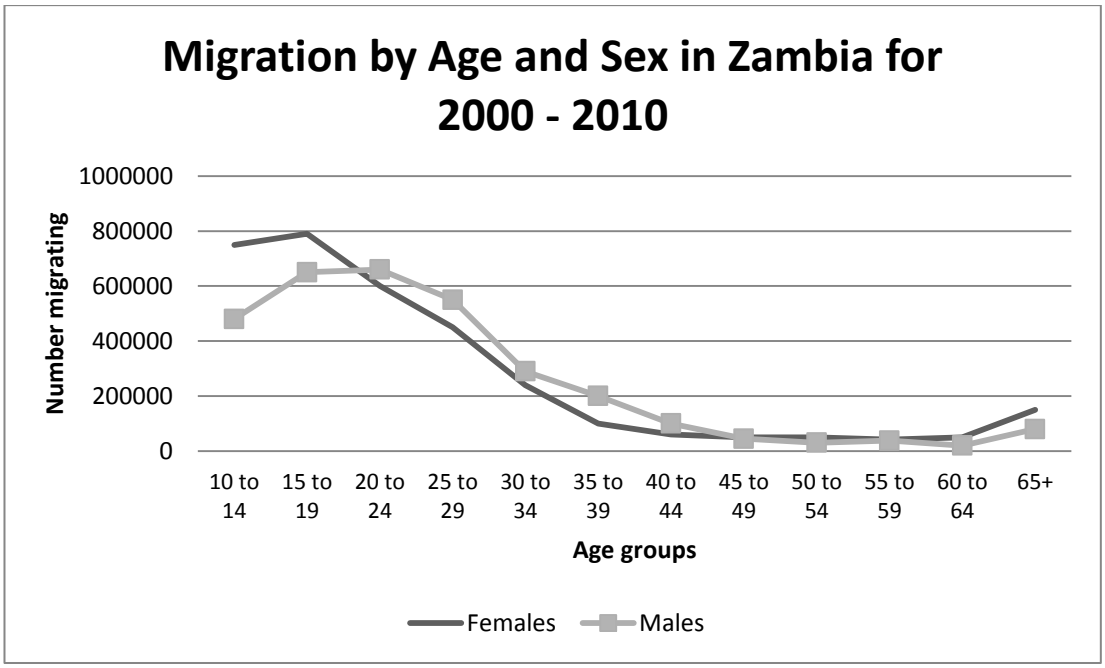

Figure 2.1: Estimated Urban Inter-censal Net-migration by Age and Sex, Zambia, 2000-2010

(Source: 2000 and 2010 Censuses of Population and Housing)

It is observed, from figure 2.1 that more males migrated than females during the 10 year period especially men between 20 to 44 years. This is because 20 to 44 years age group corresponded to the group which provided for the families and was engaged in tertiary education, formal and informal work. This is confirmed in Figure 2.2 where the percentage of in and out-migration was compared for each province.

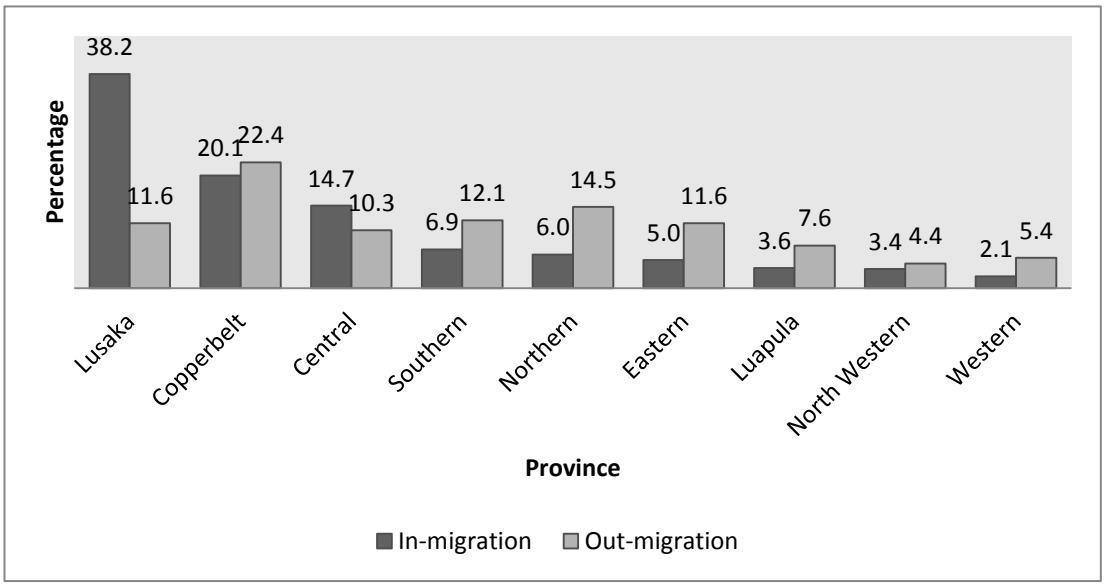

Figure 2.2: Percentage Distribution of In and Out-migrants by Province, Zambia, 2010

(Source: 2010 Census of Population and Housing)

Lusaka, Central and the Copperbelt provinces all have public Universities and major industries therefore in-migration was higher than the other provinces. Furthermore, banking, mining, and manufacturing are done largely in the three provinces. This increases demand for labour hence an increase in migration. In addition, it is observed that out-migration was higher than in-migration in most of the provinces listed in Figure 2.2. This is so because most of these provinces have fewer social services and hence look for greener pastures elsewhere. For example, Southern province has been experiencing droughts hence the people who were once engaged in agriculture have moved on to other forms of livelihood or migrated. Therefore, these immigrants are contributing to the rise in the population growth in the urban areas.

2.1.1.3 The nature of urban areas in Zambia

Urban areas lie along the line of rail that was built to allow easy transportation of materials and products from these industries (UN-habitat, 2012). It is observed that cities with massive populations are more efficient due to economies of scale, social division of labor and lower transaction costs (Wang et al, 2013). In Zambia these areas have received major investments in the retail shop industry. Lusaka city alone has several shopping malls such as Arcades shopping mall, East park mall, Manda hill, Levy Junction, Crossroads mall just to name a few. On the Copperbelt province, Ndola city has four malls: Kafubu mall, Rekays mall, Zmart mall, and Jacaranda mall, while Kitwe city has Mukuba mall.

2.1.1.3.1 High density areas

However, despite the comparative advantage of cities, urban areas are more unequal than rural areas and hundreds of millions of the world's urban poor live in sub-standard conditions and in poverty (ibid). According to Haapala (2002) poverty meant that human basic needs for everyday life cannot be met by the individual. The history behind the development of high density areas in Zambia was recorded by UN-habitat (2012) stating that:

> *For half a century, from the 1930s until the 1980s, the industrial and commercial employers provided housing for their workers in urban areas. Their dominance as housing suppliers gradually declined as informal settlement increased to fill the growing gap between supply of and demand*

for urban housing. By the 1980s, virtually all new housing was provided in informal and peri-urban settlements. The formal housing stock was sold off to sitting tenants during the liberalisation of the 1990s by which time it was in a generally poor state of maintenance.

As an example, Lusaka has unplanned settlements that have grown like Chibolya and Misisi settlements. These areas have been reported in Zambian media to support criminal activities and the use of illicit drugs and the abuse thereof.

2.1.1.3.2 Pollution in urban areas

The UN (2014) has observed that in some cities, unplanned or inadequately managed urban expansion led to rapid sprawl, pollution, and environmental degradation, together with unsustainable production and consumption patterns. For example, it was now common knowledge that Zambia was experiencing electric power deficiency due to new industries and more mines being opened. Furthermore, there was an increase in domestic consumption of electricity which had led to constant power cuts. To compensate for the shortage of power more households are now using charcoal and firewood for cooking and warming. The trees that were cut down for this purpose were seldom replaced which meant the Country risked losing some tree species to extinction.

2.1.1.3.3 Environmental degradation in urban areas

Furthermore, the high levels of industrialisation produced a high use of raw materials which in turn ended up in the production of waste. This waste, generated by households, industries and cities ultimately went on to pollute the environment. Haapala (2002) confirmed this stating that urban wastes have local impacts but are also a problem of global dimension in the case of global warming.

Figure 2.3 provides an illustration of how urbanisation leads to environmental pollution which leads to contamination of groundwater.

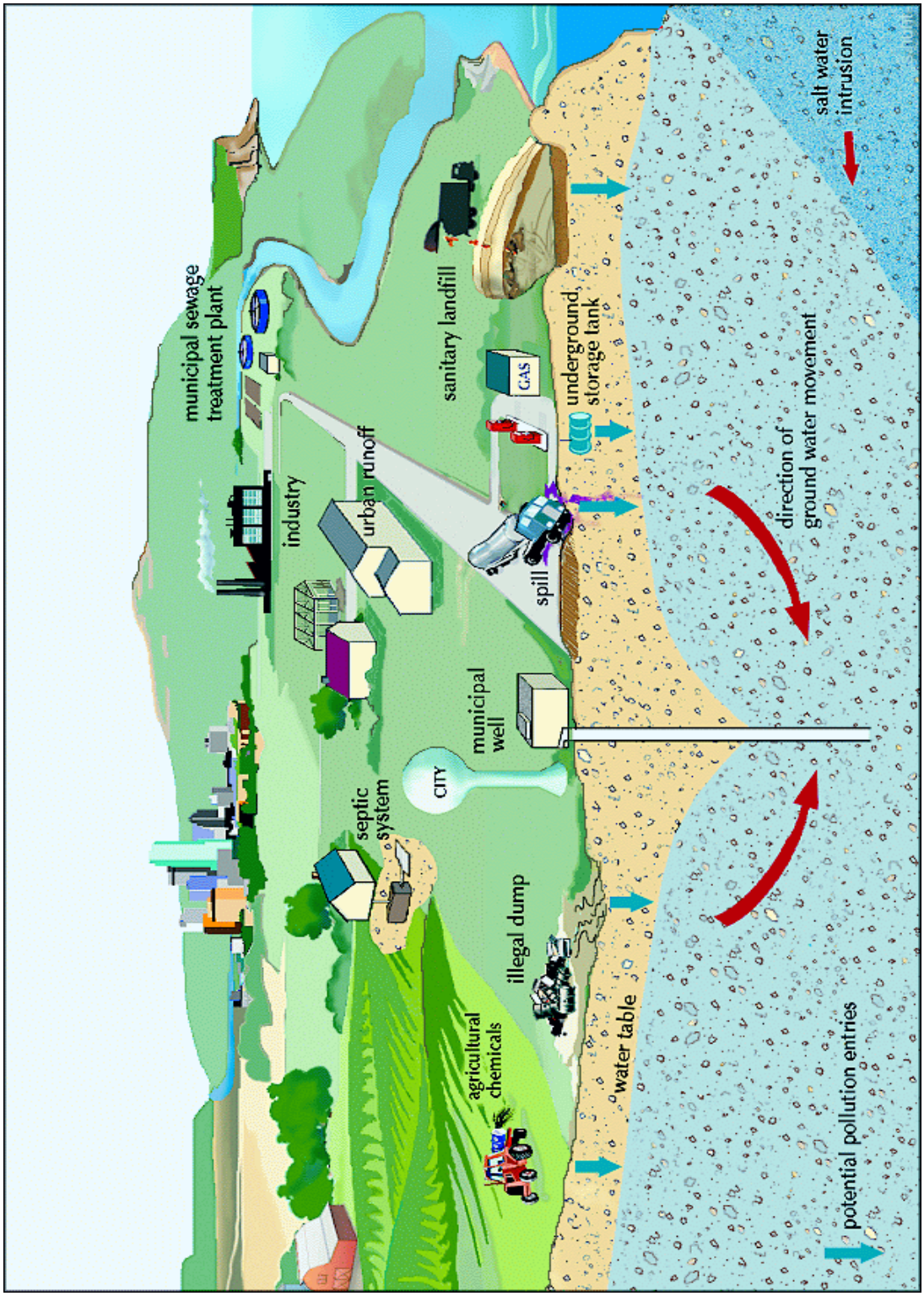

Figure 2.3: Groundwater pollution sources

(Source: Zaporozec et al., 2002)

Similarly, the construction of houses has seen a rise in the demand for construction workers in urban areas like Lusaka. Furthermore, this construction has contributed to the rampart deployment of containers which distributed building material such as cement, planks, rebar and roofing sheets. In the southern parts of Lusaka, in an area called Chalala, block making companies have turned residential plots into block making sites. Chalala is a residential area but pollution is being done in the form of dust particles, cement fumes, slurry, while water from the blocks is allowed to drain into the ground without being treated. This is not good for the inhabitants since most of the houses in this area use groundwater. Therefore, the location of such companies has to be planned for in order to protect the inhabitants and environment of the urban areas. If the lack of planning is allowed to continue the risk and impact of the adverse effects of environmental degradation would increase (GIZ, 2011). Figure 2.4 shows a typical example of the how the block-making company sites look like.

Figure 2.4: Typical block making site

To summarise the relationship between the environment and population growth in Zambia, GRZ (2010) stated that:

Modernisation of agriculture is key to achieving the national vision. Rapid population growth works against modernisation by contributing to deforestation, soil erosion, land degradation, and fragmentation of small holdings in many parts of the country. The high rate of population growth will also affect the ability of the country to achieve and sustain food security. Slower population growth would improve the country's ability to provide food security, would reduce pressures on the land, and would mean that more resources could be invested in agricultural modernisation.

Therefore, there is a need to depict how the land has been used already and then, using this information, allow all stakeholders to plan equitable solutions for the future. Some of the plans should include establishing urban areas that would have the necessary infrastructure and policies needed in order to have sustainable development that ensures the benefits of city life are equitably shared (UN, 2014).

2.1.2 The need for updated topographic maps

The topographic map remains "an indispensable tool for government, science, industry, and leisure" USGS (2015). This is because these maps are used to visualise spatial relationships and arrangements of features on the Earth's surface. The topographic map is defined by Geoscience Australia (2016) as:

a detailed, accurate graphic representations of features that appear on the Earth's surface which include: 1) ***Cultural****: roads, buildings, urban development, railways, airports, names of places and geographic features, administrative boundaries, state and international borders, reserves, 2)* ***Hydrography****: lakes, rivers, streams, swamps, coastal flats, 3)* ***Relief****: mountains, valleys, contours and cliffs, depressions, 4)* ***Vegetation****: wooded and cleared areas, vineyards and orchards.*

Because these types of maps portray both natural and manmade features, data on the locations and areas of the features can be determined accurately and used in scientific studies (ibid). As such the surface of Zambia had been divided into several sections which were depicted on topomaps (Mooka, 2016). These maps are referred to as a map index and are kept by MLNREP (ibid).

Figure 2.5 depicts how topographic maps for Zambia are distributed and the numbering system.

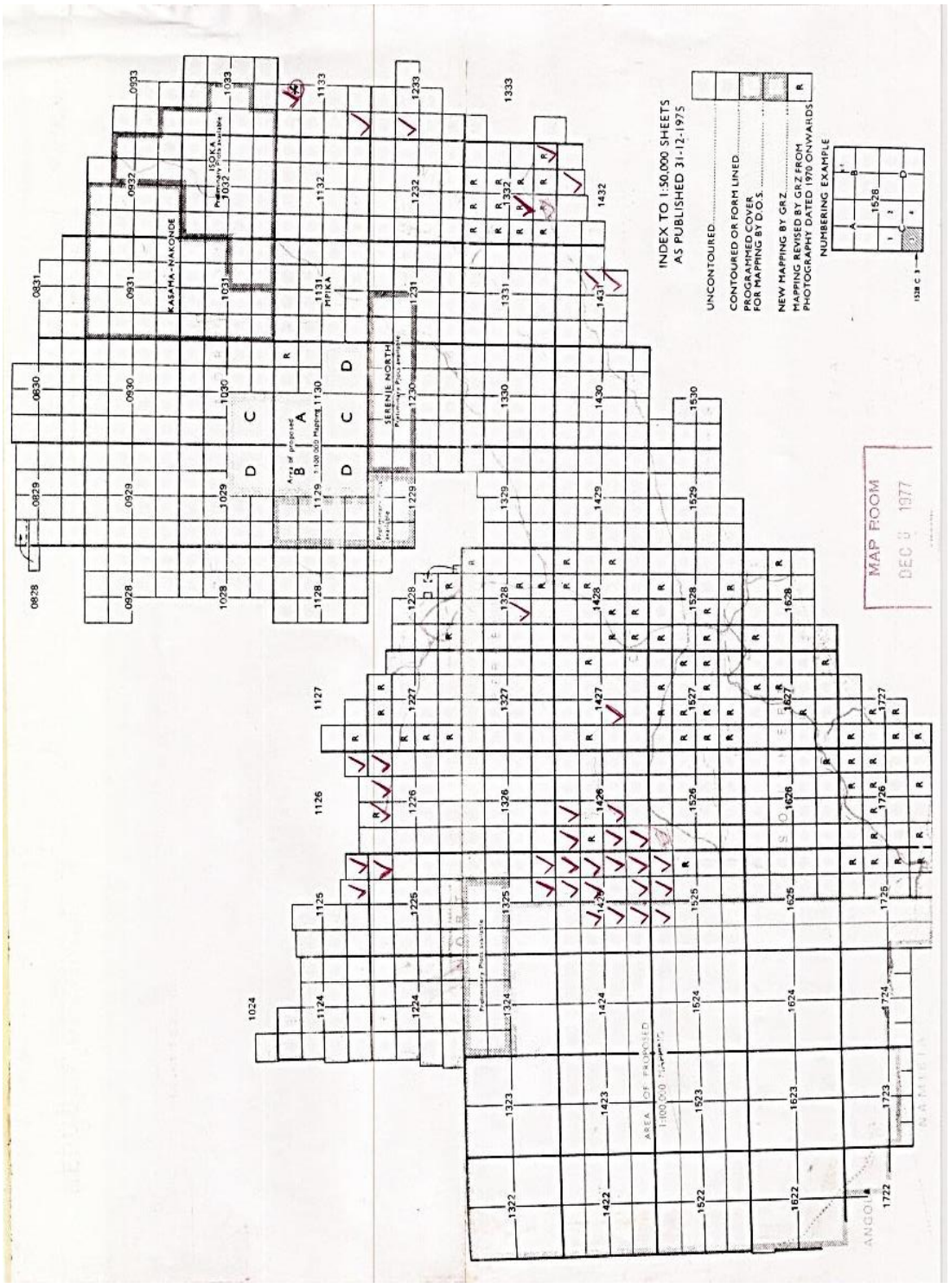

Figure 2.5: Topographic map index of Zambia

(Source: Survey department, 2016)

In figure 2.5 the smallest square is a single topomap sheet drawn at a scale of 1; 50, 000. Furthermore, it was observed that most of Zambia was covered by these topomaps sheets that are drawn at a scale of 1: 50, 000. However, figure 2.5 also showed that the Western part of Zambia has smaller scale maps drawn at 1: 100, 000 and 1: 250, 000. Because the scale of a map affects how much detail or information can be derived from the map, the western part of Zambia had relatively less detail depicted on its topomaps than the rest of the parts of the Country. Therefore, some of the information on how the land is being utilised in these areas would be lacking if these maps are used in planning. CSO (2014) observed that Mongu, an urban area in Western province would experience a 12 percent growth in population from 2010 to 2015. However, information is lacking that would be critical to influencing the decisions made on the process of urbanisation which would lead to constant change in land use due to high demand of natural resources (Mohan et al., 2011).

Since the Zambian economy is being transformed into a middle-income status (GRZ, 2010) and economic growth and modernisation were being led by urbanisation (CSO, 2013), proper decisions on land use had to be made. In order for these decisions to meet the call for sustainable development that resounds globally (UN, 2004) knowledge on the mapping sector's operations would help Zambia sustain the following areas:

2.1.2.1 Tourism

Tourism is a source of income for Zambia and is among the sectors of the economy that was expected to increase during the Vision 2030 (GRZ, 2011). Because most of the tourists travelled from outside the Country, the main existing tourism infrastructure such as roads, airports require upgrading to modern standards. Therefore, updated topomaps, aere required to assist tourists navigate through the country to their destinations efficiently. Another important use for the street maps was the new numbering system for houses that have been introduced in the Country.

Tourists came to experience the exotic wildlife of Zambia but farmers had encroached onto Game Reserves which had increased the human-wild animal interactions leading to injury and death in certain cases. The expanding urban areas had led to certain Indigenous species of trees being endangered due to uncontrolled

felling of trees where houses had been built. Similarly, the demand for charcoal was a major motivator for cutting down trees. Figure 2.6 is an example of the impact these economic activities have had on the environment.

Figure 2.6: Effect of poor economic activities on the environment

(Source: GRZ, 2010; Plougmann, 2005)

Animals have also been affected by the loss or their breeding and hunting sites, or being killed. Therefore, if the natural resources are not conserved Zambia would have problems maintaining the interests of the tourists who came to appreciate its natural resources.

2.1.2.2 Equal access to land and services

It has been recorded by GIZ (2011) that "Land use went hand in hand with *land ownership*. Different functions and uses of land could imply different owners and users. A change in land use can, therefore, result in the displacement of current users. This is the case when a huge area is zoned as commercial farm land. Previously used and often owned by the local population, the land is now leased to strangers either national or foreign investors." This happened when 925ha of farm land was converted into a limestone mine and cement manufacturing plant in the Masaiti district of Ndola. Over 300 inhabitants were displaced and relocated to another smaller area.

Research suggests that the lack of maps disadvantages the poor in society (Max Lock Centre Projects, 2003). Furthermore, UN-habitat (2012) observes that land is amongst the most expensive commodities in Zambia. Because the poor people could not afford to buy land a lot of informal settlements in urban areas have developed that have poor access to properly planned services. In these areas the use of pit latrines is dominant which reduces the quality of water and sanitation (ibid). The Department of Economic and Social Affairs (DESA) (2013) reports that:

> *Sustainable development will need to be inclusive and take special care of the needs of the poorest and most vulnerable. Strategies need to be ambitious, action-oriented and collaborative, and to adapt to different levels of development. They will be need to systematically change consumption and production patterns, and might entail, inter alia, significant price corrections; encourage the preservation of natural endowments; reduce inequality; and strengthen economic governance.*

For this reason several Non-governmental organisations (NGOs) had come up to help improve the situation. For example, the Zambia Land Alliance (ZLA) was formed to respond to land law reforms (Zambia land alliance, 2015). ZLA has written several letters to the Republican President lobbing for equal access to land for the poor as the Country develops. This was because ZLA advocated for equitable access and secure access and secured ownership of land by the rural and urban poor (Ibid).

2.1.2.3 Quick access to data in mixed formats

Concerted effort from all the stakeholders would be required in order to plan the new settlements. Among the major stakeholders are Ministry of Lands, Natural Resources and Environmental Protection (MLNREP), Road Development Agency (RDA), Ministry of Home Affairs, Ministry of Mines, Minerals and Natural Resources Development (MNRD), Ministry of Local Government and Housing (MLGH), Disaster Management and Mitigation Unit (DMMU), and Environmental Council of Zambia (ECZ). An example of projects that involve data from several stakeholders and formats is construction of infrastructure. Ibraheem et al (2012) observed that:

> *Civil engineering projects involve the management, analysis and integration of large amounts of geographic information to ensure success. This can include a wide range of information such as detailed design drawings*

originating from CAD solutions, detailed mapping, air photography, geological investigations, population information, traffic flows and environmental models.

The stakeholders mentioned above all have interest in the land and require geographic data for their operations. For example, ECZ generated a lot of geo-data from all the Environmental Impact Assessments (EIA) it conducted. The Environmental and Social Impact Statement (ESIS) report for Konkola Copper Mines (KCM) is an example. It outlined the proposed new dumping site for the mine and the reasons for choosing this site (URS Scott Wilson Zambia, 2014). Since Zambia's economy is largely dependent on the mining sector expanding the capacity of the mines would have a positive impact on the economy. However, any increase should not harm the environment and the people living in that community. Therefore, EIAs contain the type of data useful to the other stakeholders as they planned for new urban areas.

Fortunately, data sharing across every field of knowledge is possible through the use of Remote Sensing and GIS (ESRI, 2010). This is possible because the technology has advanced rapidly that generates quick and accurate results (International cartography Association, 2012). Szukalski (2014) observed that GIS had become deeply woven into an organization's fabric and extended to a very public and connected audience. This was seen in the move towards the use of web apps and devices such as phones and tablets (Ibid). Figure 2.7 gives an example of how GIS is used to share data of different types. It shows maps for various land use being combined.

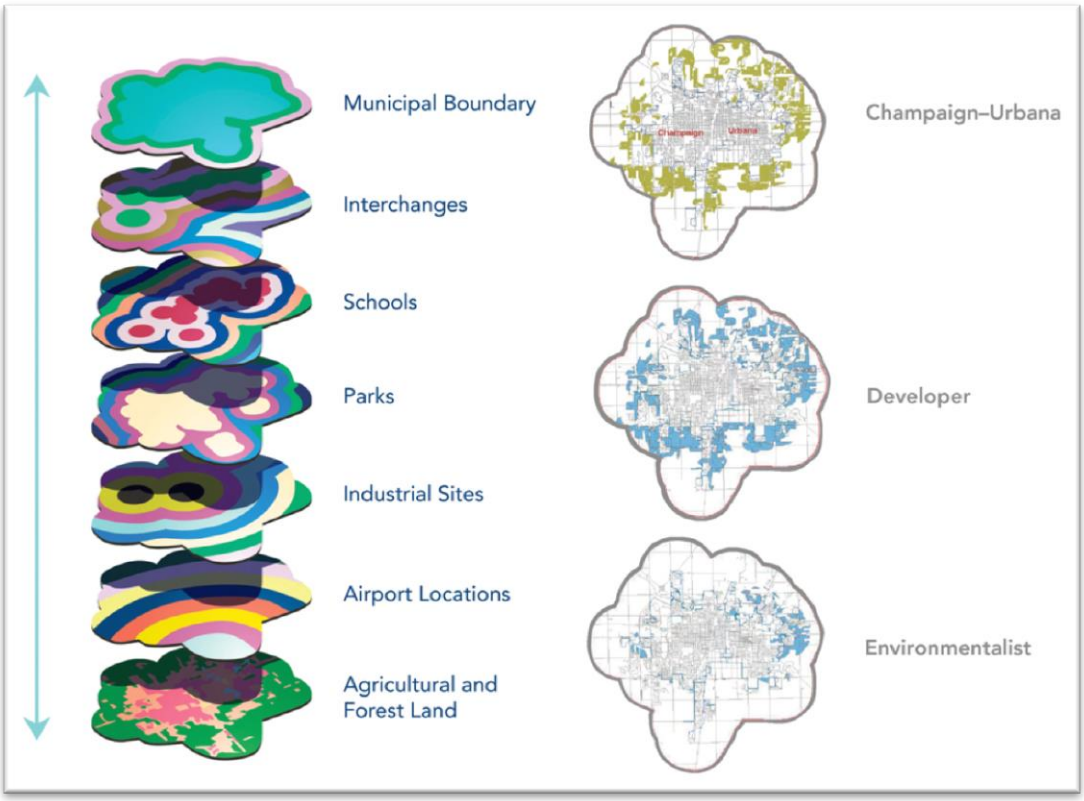

Figure 2.7: The raster layers used in raster analysis

(Source: Abukhater, 2011)

2.1.2.4 Research and decision making

There is need for topographic data to be generated periodically so that researchers can gain knowledge about the ever changing land cover/use (Rajan and Shibasaki, 2000). This is necessary because the changes happening have a huge impact on the people, the economy, and resources (Auch et al., 2004). However, the impact is usually felt in the future in most cases. For example, in America, the U. S Geological Survey (USGS) seeks to illustrate and explain the spatial history of urban growth and corresponding land use change in order to help understand the impact of anticipated changes in the future (Ibid).

2.2 The use of Topographic maps

Because of this, updated topomaps would help increase cooperation amongst various stakeholders thereby preventing or reducing land use disputes because all the Stakeholders have the same accurate datasets on which to make decisions (GIZ, 2012). Furthermore, the topomaps would be used by different types of people for recreation, military, academic and business (USGS, 2015). However, this section

focuses on the use of topomaps as tools used to plan the land use change due to urbanization.

2.2.1 Waste management

Solid waste is a byproduct of creating goods from raw materials and the consumption of the goods thereof. In every society the issue of solid waste management helps protect the population from diseases and the environment from pollution. However, managing it is a problem being faced by city planner's worldwide (Gorsevski et al, 2012).

Gorsevski et al. (2012) discussed the selection of landfill sites using GIS evaluation techniques in Macedonia. Their method used several factors related to the land to determine landfill suitability. For example, the slope, elevation, distance between selected features and land use were determined for the proposed landfill site. These were classified as environmental considerations. Another class was called economic considerations. This involved using the proximity of the landfill site to the roads, building material and dense population. All these considerations became inputs into their model. Their model then produced several decision alternatives for landfill suitability (ibid). This study therefore showed how topographic data would be combined in order to provide the best landfill sites. The choice of a location for landfills was important but, Zaporozec et al. (2002: p.31) observed that "in many cases, these disposal sites may just be pieces of open land that have been fenced off, excavations and old mining areas, or isolated ravines and valleys." These dumpsites are rarely planned for and this has led to contamination of the groundwater in the surrounding areas.

In a study conducted in Sweden, Travar et al. (2015) analysed the quality of drainage water coming from built landfills. The study showed that the water from these landfill sites was contaminated with chemical elements. Furthermore, the concentration of these elements was affected by the amount of vegetative cover which reduced the mobility of these elements. This research suggested, firstly, that water from these sites always drained into other places and, therefore, the size of the vegetative cover around these areas either reduced or increased the concentration of these pollutants. This knowledge is important for Zambia because land that was once covered with trees is now bare due to human settlement and charcoal burning.

In study on landfills Zaporozec et al, (2002) explained that in order to reduce the amount of solid waste, landfills were being burned. This increased the amount of smoke produced from the burning landfill sites. This added to the amount of contamination. However, with proper topomaps these areas would be located away from residential areas. This study demonstrates the need for updated topographic map information in planning the urban areas. This is because all the planning considerations i.e. environmental and economic, are based on geographic data. If these parameters were derived from inaccurate data then the decision alternatives would all give wrong results.

2.2.2 River basins conservation

In his study Banda (2013) reviewed several agreements made by the Southern Africa Development Community (SADC) that specified the rights the countries that share the Zambezi river basin would have. The study recorded that the SADC region had 15 major river basins that were shared by at least two countries. These basins covered 70 percent of the total surface area of the SADC region. Of these basins, the Zambezi river basin was shared by 8 countries with 42 percent of it covering Zambia.

One of these agreements defined the nature and limits of the rights each country in the SADC region would enjoy (Banda, 2013). Traditionally, each riparian state monitored, assessed, planned, developed, conserved and protected water resources of that part of the Zambezi river basin within its territory (ibid). Therefore, updated information about Zambezi River was required for this purpose. For example, a study in India proposed the use of topomaps when conducting studies of the Gandheshwari sub watershed. In that study an enhanced technique for constructing a digital elevation model (DEM) of the Gandheshwari sub watershed was performed (Jana et al., 2007). It was noted that some of the parameters that a DEM produces are basin-wide information about overland flow direction, flow accumulation and area contributing flow to any point (ibid). In generating this model, raster contour data was used. Figure 2.8 shows the nature of this river basin with the Zambezi River highlighted.

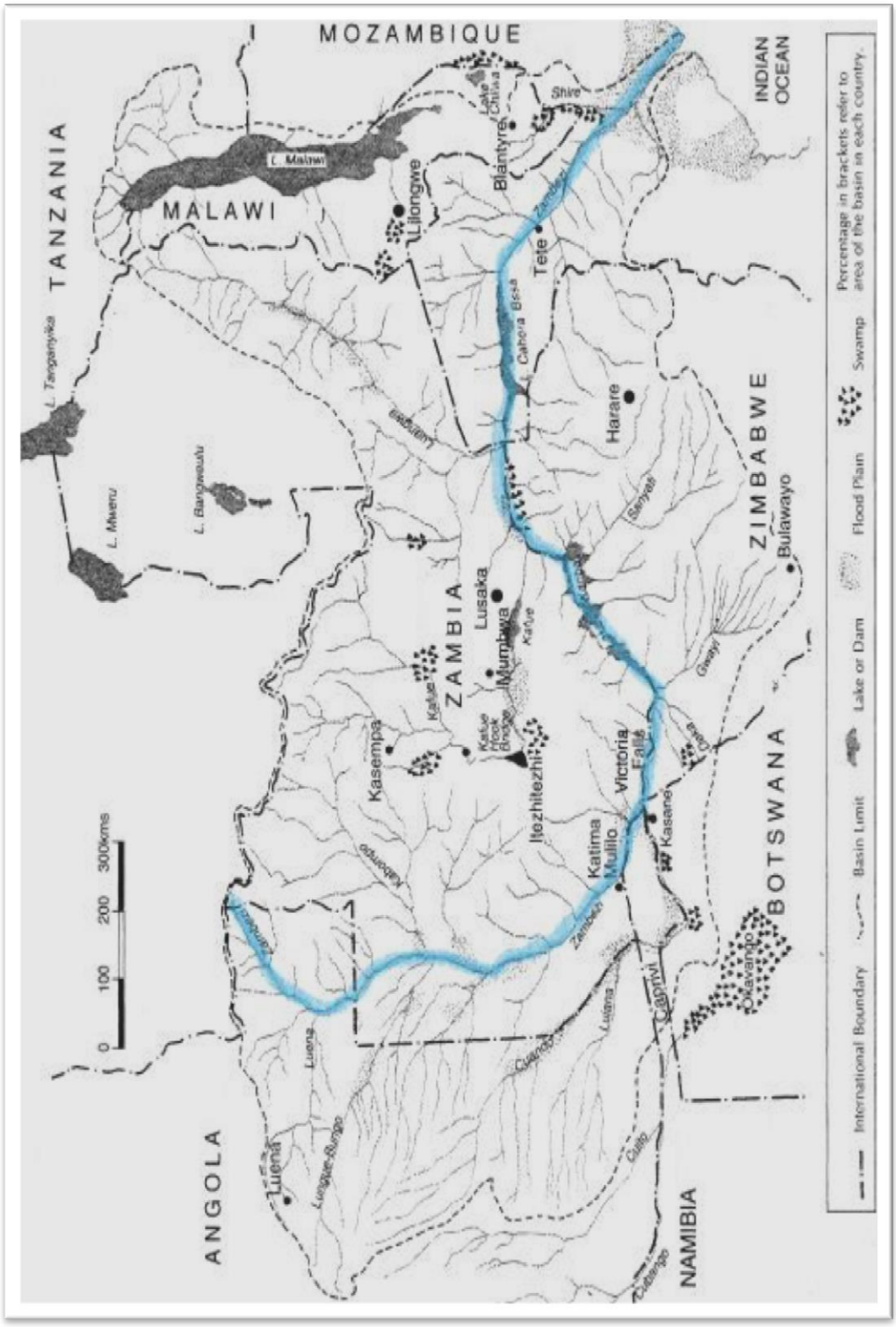

Figure 2.8: Geography of the Zambezi River Basin

(Source: Banda, 2013)

Figure 2.8 indicated that the Zambezi river basin was shared by Zambia, Tanzania, Malawi, Mozambique, Zimbabwe, Botswana, Namibia and Angola with most of the basin being in Zambia. Furthermore, Banda (2013) stated that about 70 percent of Zambia was part of the Zambezi river basin. Therefore, it was important to plan carefully how the land would be developed in Zambia because the effects, positive or negative, would impact the Country as a whole and the surrounding countries too. For example, the study conducted in some of the townships in Zambia showed that the usage of pit latrines had contributed to contamination of the groundwater according to United Nations Environment Programme (UNEP) (2004).

2.2.3 Transportation systems

It was observed that migration led to growth in urban areas and this growth had an impact on the transport sector and the economy as a whole (Padam and Singh, 2004). This was because the urban areas were centres of trade and industry and therefore goods and services were supposed to move in to and out of the cities (ibid).Their study outlined the following:

- Movement was reduced in urban areas because vehicle speeds were slow. This caused congestion and traffic jams.
- Poor road infrastructure introduced poor performances of the economy within the urban cities because goods and services were not distributed effectively due to poor roads.

Because of this, the transportation system has to be well designed so that the economy can be allowed to grow. In Zambia, the RDA and National Road Fund Agency (NRFA) have implemented projects like the Link Zambia 8000 and Toll Gates, respectively. These projects would ensure a proper road network is available in Zambia. This would promote trade and allow the economy to grow. These projects require updated topomaps for planning and also documenting.

2.3 Map updating methods and tools

Several methods of updating maps were used in the world. These could be classified broadly as terrestrial and extra-terrestrial methods. Terrestrial methods involved making measurements of the earth using surveying equipment placed on the earth. Extra-terrestrial methods involved the use of surveying equipment that is not in

contact with the earth's surface, such as satellites. The following section discusses the major methods and tools used to update maps in Zambia.

2.3.1 Methods used for updating maps

Maps easily become out of date once they are made because the information depicted becomes static hence there is need for the map to be updated (Abbas et al., 2010; Keates, 1973). The following are the methods that are used in updating maps.

Remote sensing and satellite images were methods used in GIS to create maps which are then used for scientific research such as Mirlas (2012) and Wang et al (2015). Furthermore, studies had indicated that satellite imagery combined with GIS are good for analysing urban areas (Rahman et al., 2010; Mohan et al., 2011). Web-maps were also being updated using satellite images and this was available to users.

Photogrammetry gathers information by measuring and interpreting photographs (USGS, 2015). These aerial photographs were captured in such a way as to create a stereo model of the area to be mapped. Different types of maps were produced using this process such as Thematic, Planimetric and Topographic maps (Schenk, 2005). However, Photogrammetry is an expensive and complex method of updating maps and requires a team of professionals and well-coordinated plan of execution (USGS, 2015).

Land surveying is done so as to provide ground control points that can be used as the framework for the map details. This involves the establishment of and densifying geodetic networks and national control. In Zambia this is the prerogative of the Ministry of Lands through the office of the Surveyor-General.

Digital mapping was summarised by USGS (2015) as:

> *Map digitization resembles the original map scribing process in that it requires that each feature on each map separate be located, classified, and traced. A map can have 10 or more different layers roads, contours, boundaries, surface cover and manmade features, for example that require digitization. Maps can be digitized by hand, tracing each map's lines with a cursor, or automatically with scanners. After digitizing, several editing operations remain. For example, attribute codes must be added to identify*

what each digitized line or symbol represents. A variety of other tasks must be performed to ensure that information is complete and correct, including matching features with adjoining files, matching features relative to each other within the file, and controlling the accuracy of attribute coding and positions.

In Zambia, the process of updating maps starts with acquiring aerial photos and high resolution satellite images of an area which is being mapped. These photos are then subjected to photogrammetric processing which involved georeferencing and applying corrections that ensured an accurate orthophoto is produced. The next stage involves extracting the features of interest from the created orthophoto using a process called digitizing the photo. After the features have been extracted, cartographic enhancements are applied to the data and this is presented as the final updated map. In certain cases, depending of the user requirements, cadastral data is added to the map before final publishing is done. The source of the cadastral data is the cadastre index found in the Survey department at MLNREP. Once the maps are finalized, they are made available for access to the public and all Stakeholders in various formats at MLNREP. The process, outlined above, is summarized in figure 2.9.

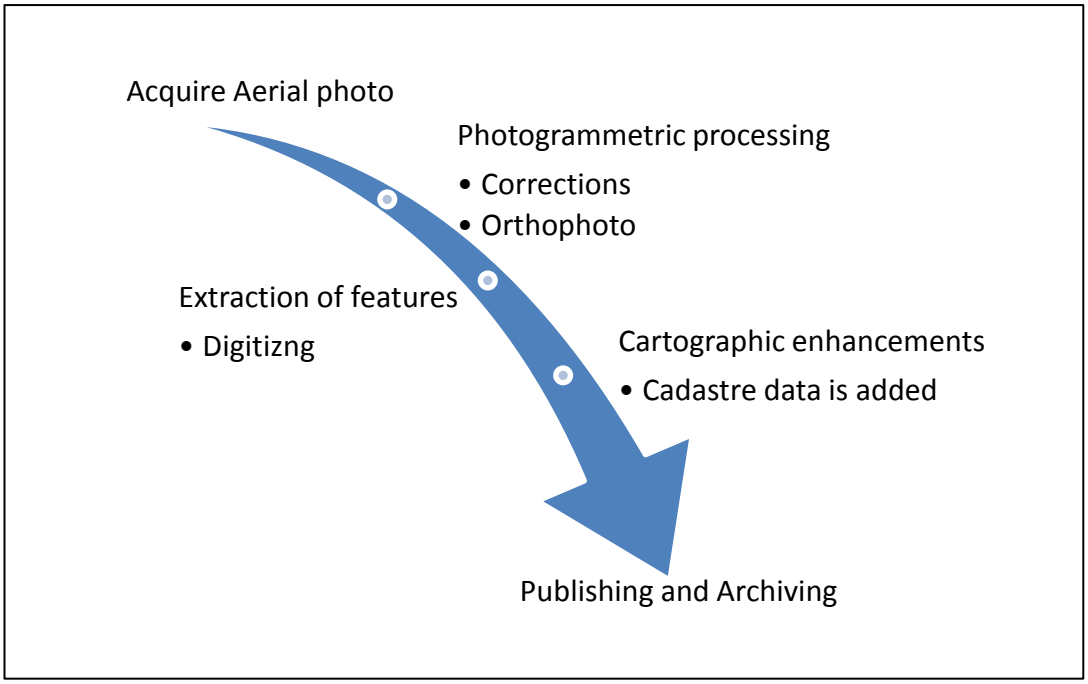

Figure 2.9: Flow chart for updating topomaps in Zambia

(Source: Mooka, 2016)

2.3.2 Tools used in updating maps

A lot of tools have been developed and are being used for updating maps. These came in different forms such as software, surveying equipment, aerial cameras, satellites, and mobile devices. Several of the companies that create the tools used in mapping were owned by the private sector and had contributed to the mapping industry in their countries of origin and beyond. Examples of these companies are Leica, Sokkia, Trimble, AutoDesk and ESRI.

2.3.2.1 Software

Al-Kodmany (2012) stated that:

> *GIS helps to store, analyse, and present data, and assists in turning complex datasets into relatively easy-to-understand visuals including maps and charts. Furthermore, GIS enables creating powerful visuals that inform programs and planning decisions and advocacy. It enables analysing data across multiple geographic scales, highlighting spatial distribution and patterns. Geographic units can range from a single address, block, census tract, or zip code to a municipality, county, region, state, or the entire country.*

In Zambia the GIS software that is mostly used is QGIS and ArcGIS (and its related packages). ArcGIS software is commercial software and its use demands that users regularly update their license in order to use the software. However, there is a growing demand for open source software in Zambia (Mooka, 2016; Pole, 2016). The need has arisen from the Map Awareness Program initiated by MLNREP that seeks to promote the use of digital maps in secondary schools in Zambia (Pole, 2016).

2.3.2.1.1 ArcGIS software

As a tool, GIS helps decision-makers view geography using new trends in technology and make informed decisions (Esri, 2010). ArcGIS is a product created by Environmental Systems Research Institute (ESRI) and is a leading global producer and supplier of GIS software, web GIS and geodatabase management applications (ibid). Its nature and ability can be summarized as: (1) it can combine geographic data from a variety of sources, (2) GIS maps are interactive and help

users explore the world scientifically, (3) effective tool for planners when making informed decisions based on actionable intelligence, and (4) Promotes economic development and environmental protection (ibid). For example, GIS is used to generate new maps in assessing soil salinity levels in Israel (Mirlas, 2012). In Ethiopia, GIS is being used to create a medical referral system (Bailey et al., 2011). Similarly, in China, was used to simulate water quality after pollution caused by accidents (Zhang et al, 2011). Lastly, Khan et al. (2011) used GIS in geophysical applications software as a project manager in seismic refraction software.

2.3.2.1.2 AutoCAD software

AutoCAD is computer-aided design (CAD) software that is developed by Autodesk, Inc according Autodesk (2016). It is mostly used for drawing land parcels and survey diagrams in Zambia. However, the software itself offers far more capabilities than just line work. For example, in China, Southern CASS software, based on AutoCAD, was used for collecting cadastral data that was used in MAPGIS according to Liu and Cai (2010). Similarly, Mamat et al. (2013) conducted a research in which it was shown that the rate of updating forestry maps was enhanced by interfacing AutoCAD with MS Excel. Furthermore, AutoCAD's functionality can be extended using the inbuilt Visual Lisp Integrated Development Environment (VLIDE) according to Sanders (2013).

2.3.2.1.3 Software from equipment manufacturers

Surveying equipment comes with software that allows the equipment to interface with computers. This software is used for sharing, storage, analysis and manipulation of data.

2.3.2.2 Equipment and tools

Several international companies owned by the private sector have been created that manufacture surveying equipment. This equipment can be classified under the following: GPS differential sets, Total stations, Dumpy levels and handheld data collectors. Although these manufacturers were all located outside Zambia, they have provided local distributorship partnerships to any company that submits a proposal.

2.4 The need for participation of the private sector in Zambia

The private sector is allowed to work within Zambia following the provision that all the intellectual property rights for survey related work are held by the office of the Surveyor-General (Mooka, 2016). This implies that the private sector assumed the role of an assistant to the MLNREP and all the work it conducted had to be approved by the Surveyor-General (Mooka, 2016). Such types of limitations/definitions were commonly found in the partnerships between the private sector and public sector (government). Lienert (2009) observed that:

> *The extent to which the private or public sector supplies services in these areas varies considerably across countries, depending on political and cultural factors, and consensus on the role of government in society. There are, however, a few exceptions where the public sector has exclusive or near-exclusive functional responsibility, notably for national defence and foreign affairs. However, even for the provision of national defence, some countries may rely on partner countries, multilateral organizations or even the private sector.*

In a study on the private sector participation in the water industry Banda (2004) reported that the private sector is expected to:

- Bring technical and managerial expertise and new technology into the sector
- Improve economic efficiency in the sector in both operating performance and the use of capital investment
- Inject large-scale investment capital into the sector or gain access to private capital markets
- Reduce public subsidies to the sector or redirect them from sections of the populaces currently served to the poor and those without access to services
- Insulate the sector from short-term political intervention in utility operations and limit opportunities for intervention by powerful interest groups
- Make the sector more responsive to the consumers' needs and preferences

These points were summarised as Consultancy, job creation, knowledge, innovation and improved sector's performance. Therefore, for this research the private sector was expected to contribute to the Zambian mapping industry in the following ways.

2.4.1 Job creation

Dangelmaier (2012) stated that "Jobs create income and provide people with new opportunities for a better life, beyond poverty… Jobs contribute to social recognition and integration and can play a key role in overcoming conflicts". The Zambian economy is expected to grow and this includes creating better opportunities for the citizens. Therefore the private sector is expected to help alleviate the shortage of employment opportunities. It is observed by Di Bella et al. (2013) that:

> *It is widely recognized that micro firms and SMEs play crucial roles in furthering growth, innovation, and prosperity in developing countries. SMEs typically account for more than 95 per cent of all firms outside the primary agriculture sector and generate significant domestic and export earnings (OECD 2004). They also provide a major source of employment.*

2.4.2 Knowledge enhancement through research

Research is defined as the systematic collection, analysis and interpretation of data to answer a certain question or solve a problem according to Salama (2008). It can be described further as a process of enquiry and discovery according to Kitchin and Tate (2013). At its core, research investigates hypotheses, suggests new interpretations of data or texts, and poses new questions for future research to explore (UC San Diego, 2014). Usually conducting research is one of the defining attributes that is common to all learning institutions. However, research suggested that 25% of businesses fail in the first year, 36% in the second year, 44% in the third year and 50% in the fourth year (Conner, 2013). Therefore, companies also cconduct research thereby improving the chance that their company will be in the percentage that succeeds (ibid). The key to research is solving a problem or providing answers to questions that are not known. In doing so the researcher tries to describe the phenomena and how they are related and then using this information a prediction about future outcomes is made. The mapping industry is one of such areas with phenomena on which research can be based. The following section highlights some of the research

that has been done by private companies and educational institutions that increases knowledge in the mapping sector.

2.4.2.1 Research done in mapping industry

This study noted that a lot of research was done in mapping. Nonetheless, the following section summarises a few examples that outlined research that was done in places around the world that relates to Zambia.

Al-Kodmany (2012) examined the use of GIS in non-profit organisations in the city of Chicago. This study suggested that non-profit organisations provided knowledge to decision and policy makers in the following broad areas 1) planning for the location of infrastructure for transport, housing and new branches for banks, 2) planning economic development for business owners and retailers, 3) provide educational information to the public and 4) provide advocacy for the communities in housing preservation and bicycling programs. This information came from practical urban planning applications.

Similarly, a more accurate method for georeferencing aerial images was proposed by Shen et al. (2015). In their study, aerial photographs were projected on to the Cartesian plane using a new map projection correction method used to georeference aerial images. Prior to this study, the methods that existed required the use of several other corrections. This study was done by faculty members of named Chinese universities.

Furthermore, the advances in technology had given birth to a need for research and development. We now had a lot of applications that are capable of getting data from the earth to use for cartographic purposes. Coupled with these applications was a growing use of software development to help handle this data. This scenario, according to ICA (2012) raised new challenges for research and development as well as innovations for several application areas to ensure that map production flow lines must be able to handle spatial data varying in source, format, scale, quality, reliability and area of coverage.

2.4.2.2 Research that should be done in Zambian mapping

Chileshe and Shamaoma (2014) observed that Zambia was still using outdated surveying techniques. Because of this new mapping techniques were required that would increase productivity and yield accurate results.

2.4.3 Software and equipment supply

Several companies have been producing software related to mapping (indicated in section 2.3.2) and as shareware and freeware. This free software is being developed by privately owned companies and communities all over the world. Notwithstanding, the main software used in Zambia are MS Access, AutoCAD and ArcGIS. These are commercial software that are used with a license or product key. Although equipment and software is produced outside Zambia, dealership ventures are possible. Therefore, the Zambian industry requires suppliers of both software and equipment to provide these in the sector. Mooka (2016) observes that the procurement process allows Zambians to provide services and equipment to the mapping industry.

2.5 Mapping sector institutional framework in Zambia.

2.5.1 Policy Review

The Draft National Land Policy (DNLP) of 2015 has been written in order to improve the administration of land and enhance development in Zambia (DNLP, 2015). The policy seeks to combine the provisions of the Constitution of the Republic of Zambia and the National Vision 2030 document (ibid).

2.5.2 Land surveys and mapping in Zambia

Land is held by the President on behalf of the people of Zambia as stated in the Lands Act, cap 184 Section 3, subsection 1 but the Commissioner of Lands presides over the administration of land Land Survey Act, cap 188. Furthermore, it is the mandate of the Ministry of Lands, Natural Resources and Environmental Protection (MLNREP) to administer all land related issues in Zambia. Figure 2.10 depicts the simplified structure of the Ministry Lands with regards to land administration.

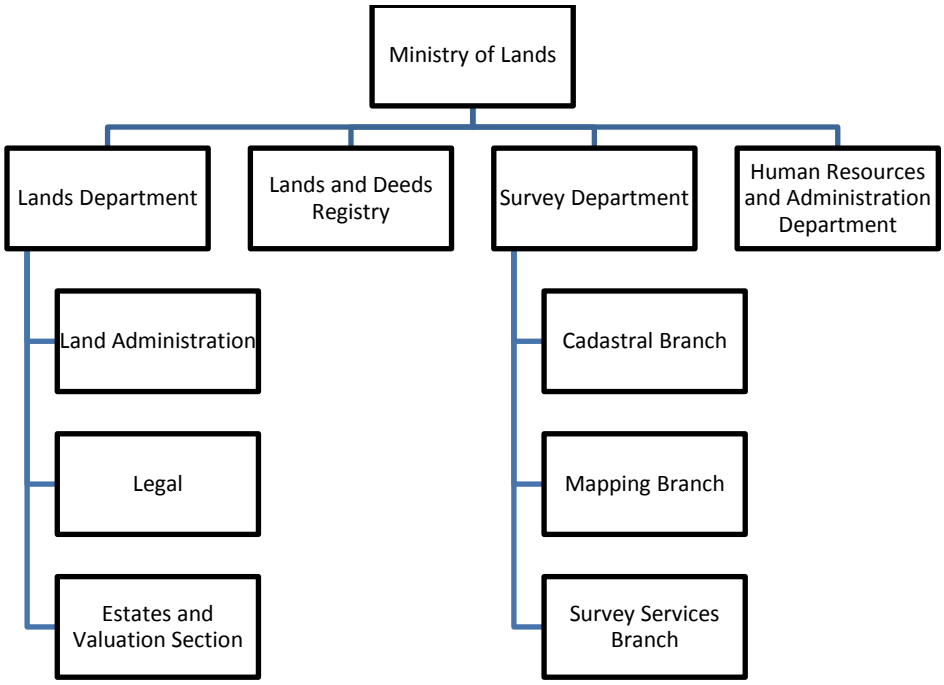

Figure 2.10: Ministry of Lands department Structure

(Source: UN-habitat, 2012)

With regard to mapping, the Land Survey Act Cap 188 provides that Surveyor-General shall be appointed by the Minister for MLNREP to supervise the preparation of such maps as the Minister may direct from the data derived from any surveys, and the amendment of such maps. Two issues are implied by this law. Firstly, the Surveyor-General superintends all surveys that are done. Secondly, all mapping and updating is done by his office. However, subsection 1 of section 10 of the Land Survey Act, allows licensed lands surveyors to perform land surveys on behalf of the Surveyor-General. Therefore, one area the private sector can contribute to the public sector is by providing a service to the government through cadastral surveys.

Furthermore, the Survey Control Board has a membership composed of the Surveyor-General, one legal practitioner, a land surveyor from the public service, and not more than two licensed surveyors from the private sector. This is found in subsection 1 of section 6 of the Act. The duties of this Board are outline in section 7 as:

a) To conduct examinations of and trial surveys by persons who desire to become land surveyors;
b) To keep a register of land surveyors;

c) To hear complaints and to take such disciplinary action as may be necessary against land surveyors in accordance with the provisions of this Act;
d) To make recommendations to the Minister relating to the making of regulations under section *forty*;
e) Generally to control and regulate the practice of the survey profession.

What this means therefore, is that the private sector contributes to the discipline and professional conduct of the sector.

2.5.3 National Spatial Data Infrastructure

Since getting independence in 1964, Zambia had not undertaken a land audit that would ascertain how the land is being used. Using data collected before 1964, it was believed the Country can be divided into 6 percent State land and 94 percent Customary land (Minango, 2015). However, a land audit was started in 2015 that would provide updated data on how land was held (ibid). Figure 2.11 shows the distribution of State land and customary land.

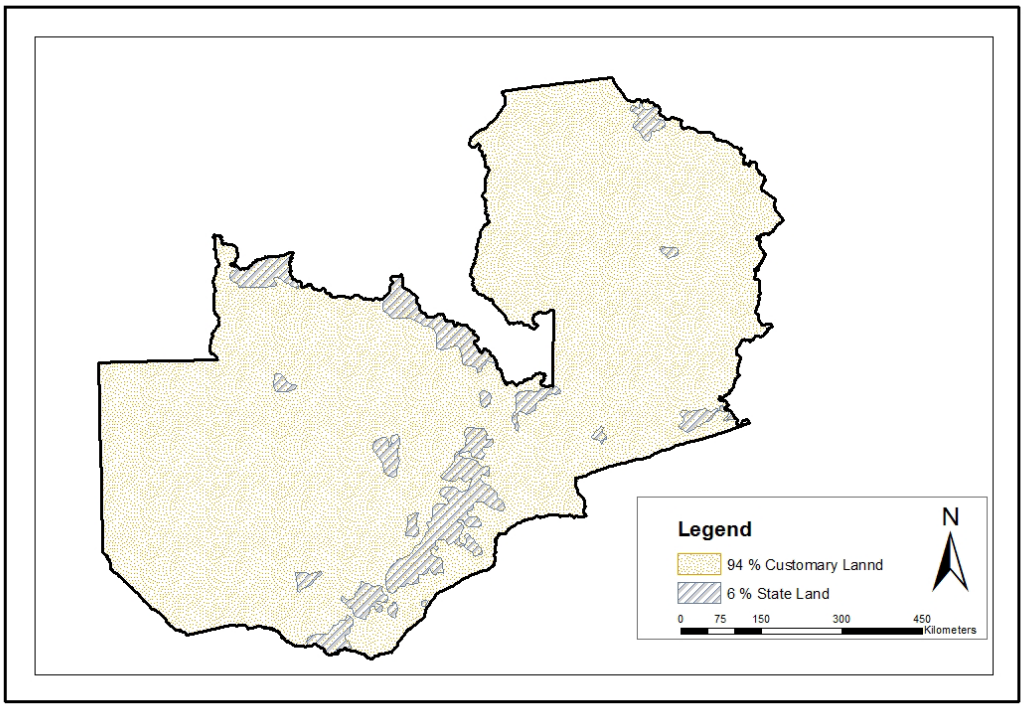

Figure 2.11: Land tenure in Zambia

(Source: Chileshe and Shamaoma, 2014)

Minango (2015) stated that one of the outcomes of this land audit would be the creation of a National Spatial Data Infrastructure (NSDI). An NSDI had been defined as "the technology, policies, standards, and human resources necessary to acquire,

process, store, distribute, and improve utilisation of geospatial data" (Richardson, 2014; Executive Order 12906, 1994). The NSDI facilitates the availability of and access of spatial data according to Minango (2015). Figure 2.12 is an example of what type of data will be stored in the Zambian NSDI.

Figure 2.12: National Spatial Data Infrastructure (NSDI) Layers

(Source: Minango, 2015)

The NSDI would allow all the Stakeholders to access the same information from a single source that is reliable. Rajabifard et al., (2008: p.1) confirmed this role by stating that:

> *A Spatial Data Infrastructure (SDI) is an enabling platform for data sharing. It is based on a dynamic, hierarchic and multi-disciplinary concept that includes, people, data, access networks, institutional policy, technical standards and human resources dimensions which aims to facilitate and coordinate the exchange and sharing of spatial data between stakeholders in the spatial data community. An SDI is developed for the purpose of supporting ready access to spatial information to support decision making at different scales for multiple purposes, and is based on partnerships at*

corporate, local, state/provincial, national, regional (multi-national) and global levels. This enables users to save resources, time and effort when trying to acquire new datasets by avoiding duplication of expenses associated with the generation and maintenance of data and their integration with other datasets.

In Zambia, the NSDI would be controlled by the Ministry of Lands, Natural Resources and Environmental Protection (MLNREP) and a technical committee had been created to superintend the whole process (Minango, 2015). The Land audit would be implemented in phases as shown in Table 2.2.

Table 2.1: Implementation strategy for land audit

(Source: Minango, 2015)

Phase 1		**Phase 2**					**Phase3**
Level 0	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**
Zambia		Heritage sites					
	Customary	Forests	Urban		Male	Statutory Areas	Recreation
		Mining		Titled	Female	Improvement Areas	Industrial
					Foreign		Residential
		Settlement		Untitled	Company		Commercial
	State land			Illegal	Institution		Institution
		Wetlands	Rural		Association		Open spaces
		Way leaves			Others		Services
		Fisheries					
		Agriculture					

2.6 Findings from literature

Literature was reviewed from different sources in this research and the following was observed:

- Urbanisation was good for a country's development but it had to be planned for in order for it to be sustainable.

- Studies, conducted around the world, had shown that maps play a critical role in the planning process.
- The type of maps that were used for monitoring, planning, and implementing land use change are topographic maps because they depict the surface of the earth with all its features at a given time.
- Some areas of Zambia did not have large scale maps hence very little spatial information could be retrieved from these maps.
- A land audit started in 2015 would ensure that all the land and how it was being used was accounted for in Zambia.
- The creation of an NSDI would enhance collaboration among Stakeholders who planned for Zambia's development
- The government had the mandate to update the maps and the private sector was engaged to assist the Surveyor-General in updating maps.
- The private sector helped the government in the following ways:
    1. Job creation,
    2. Conducting research,
    3. Supply of software and hardware used for mapping
    4. Policy review, registering and licensing land surveyors, and implementation disciplinary action through the Survey control board.

2.7 Summary

This chapter discussed the factors giving rise to the need for updated topographic maps in Zambia such as the impact of population growth and urbanisation. Since urbanisation is a global phenomenon, literature from other Countries was reviewed and this helped understand how these countries have managed their urbanisation process. The literature showed that one of the tools being used for planning the land use is a topographic map. Because of this, how a topographic map is produced and why it is useful was discussed in line with the role the private sector can perform. The next chapter discusses how data about the Private sector's participation in Zambia was collected.

CHAPTER THREE:RESEARCH METHODOLOGY

3.1 Introduction

The main focus of the study was to establish the contribution the private sector was making in the process of updating Zambian topographic maps. Chapter 2 reviewed literature on the private sector's participation in the Zambian mapping industry. The chapter revealed that Zambia started a process of updating the map index in 2015 and the private sector was engaged to perform this process. This chapter discusses the methodology used to achieve the research objectives and how data about the participation of the private sector was collected.

3.2 Research paradigms

Kothari (2004: p.1) noted that "research comprises of defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organising and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis". Furthermore, research involves the manipulation of things, concepts or symbols for the purpose of generalising to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art (ibid).

Positivism and Post-positivism are the two popular paradigms used by researchers according to Bhattacherjee (2012). These paradigms can be summarised as follows:

a) *Positivism* is the gaining of knowledge through empirical evidence (Collins, 2010). It is popular amongst natural sciences and employs instruments such as surveys and experiments and produces quantities or statistics (Mwiya, 2009). It is highly accurate but has the disadvantage of requiring large samples to validate the results (ibid).
b) *Post-positivism* involves the use of theories to influence all observations made thereby gaining knowledge that is biased towards an observer (Trochim, 2006). It is popular amongst social sciences and produces qualitative data generated from an inductive process (Mwiya, 2009). The observers influence makes this type of research less reliable (ibid).

3.2.1 Descriptive Research

This was a descriptive research and adopted the positivist approach which involved measuring quantities and statistics of data which ensured removing the researcher's presence, behaviour or attitude that would affect the results. It was descriptive research because it involved measuring how the variables were relating to each other without explaining why (Mwiya, 2009).

The major purpose of this descriptive research was "to outline the state of affairs as it exists at present where the researcher has no control over the variables; he can only report what has happened or what is happening" (Kothari, 2004). Because a researcher cannot control nor manipulate the variables, this type of research was appropriate for gaining insights in to the participation of the private sector. However, this provided a weakness of descriptive research because the cause of the phenomenon being investigated could not be determined.

3.2.2 The scientific method

Schickore (2014) suggested that scientific discovery was the process or product of successful scientific inquiry. Being a process or method, Flom (2014) defined the scientific method as the system used by scientists to explore data, generate and test hypotheses, develop new theories and confirm or reject earlier results. It was noted that the process was based only on logic and evidence, or theory and observations respectively (Bhattacherjee, 2012). In addition, when discussing scientific knowledge, Bhattacherjee (2012) stated that:

> *The purpose of science is to create scientific knowledge. Scientific knowledge refers to a generalised body of laws and theories to explain a phenomenon or behaviour of interest that are acquired using the scientific method*

Therefore, the basis of the scientific method is the experiment, which involves understanding natural laws through direct manipulation and observation (Trochim, 2006). However, it is important that the method allows researchers independently and impartially test theories and prior findings (Bhattacherjee, 2012).

3.2.3 Type of methodology

A research methodology was defined by Mwanaumo (2013) as "an appropriate operational framework within which facts are placed in such a way that their meaning may be seen more clearly". The methodology adopted for this research was a mixed methods or triangulation approach which combined quantitative and qualitative research approaches. These methods are explained as follows:

3.2.3.1 Quantitative approach

Alzheimer Europe (2009) stated that quantitative research usually involved collecting and converting data into numerical form so that statistical calculations could be made and conclusions drawn. This was done through the use of mathematical models used in Statistics. Furthermore, a quantitative approach was good for reporting research findings in numerical terms with a given degree of confidence (Abeyasekera, 2003). Lastly, this approach helps a researcher to make credible findings and conclusions according to Mwanaumo (2013).

For this research the quantitative approach involved the use of a self-administered questionnaire that was distributed to the respondents. Furthermore, the respondents that were out Lusaka were sent an online questionnaire so that all the respondents would be covered. Two weeks after the questionnaires were distributed a reminder was sent to those who had not yet responded using Short Message Service (SMS). A final reminder was sent after two weeks to those who had not yet responded.

3.2.3.2 Qualitative approach

This is the type of research that involves recording, analysing and attempting to uncover the deeper meaning and significance of human behaviour and experience, including contradictory beliefs, behaviours and emotions (Alzheimer Europe, 2009). It involves collecting data on a phenomenon by analyzing the behavior of people. It is much more subjective and uses very different methods of collecting information, mainly individual, in-depth interviews and focus groups (ibid). This approach was adopted because data about the areas where the government required private sector participation was given through interviewing MLNREP senior staff members.

3.3 Study Population

The population used for this study included all the licensed land surveyors in Zambia, registered with the Zambia Survey Department (ZSD). This was because only licensed land surveyors in the private sector can contribute to the mapping industry in Zambia (Land Survey Act, Cap 188).

From the 29 licensed land surveyors, a sample of 23 land surveyors was adopted. This was equivalent to 79% of the population. This sample size was accepted because only 23 respondents were reachable using the details that appeared on the register at ZSD.

3.4 Research variables

Research variables were the relationships that existed in phenomena that the research observed in order to gain knowledge about the research topic. The phenomenon that was investigated in this study was how the private sector participated in mapping. This was because the private sector had been called upon to assist the government in many areas and at various levels. Therefore, performance of the private sector had an impact on the mapping industry.

3.4.1 Independent variable

Independent variables can be thought of as categories that are populated with answers (Skehan, 2003). Therefore, the independent variables selected were: employment creation, development of software and supply of equipment used in mapping, conducting research and development (R&D) that enhances mapping in Zambia, ability to do work and offer consultancy services, and policy or institutional framework.

3.4.2 Dependent variable

The dependent variables were the answers that were given for each question on the questionnaire (Skehan, 2003). These were used to analyse the performance of the private sector in meeting the demand for updated topographic data.

3.4.3 Unit of Analysis

The unit of analysis defines what was going to be measured and was restricted to indigenous Zambian registered licensed surveyors. This was for the purpose of determining how Zambian companies were participating in this sector.

3.5 Data collection procedure

3.5.1 Primary data

Primary data is the data that was collected by the researcher during this research from the sample. It was collected using a survey and interviews as outlined in the following sections.

3.5.1.1 Questionnaire survey

Primary data was the data that was collected by the researcher during the research. Descriptive research involves the use of surveys and fact-finding enquiries of different kinds (Kothari, 2004). In order to achieve a high response rate, a survey method involving questionnaires was used. This was because this method yields a good response rate (Mwanaumo, 2013; Ibeh and Brock, 2004). In particular, the questionnaires were hand-delivered to each respondent and collected after some time. This type of questionnaires is called self-administered questionnaires. On the other hand, respondents that could not be reached physically were sent an online survey so that data would be collected from them. Data about the participation of the private sector was collected using the following type of questions:

3.5.1.2 Categorical questions

These were questions that involve dichotomous variables. Examples of such questions are:

- Yes or No?
- Male or Female?
- Old or Young?

3.5.1.3 Ordinal questions

Using a Likert scale, ordinal data was collected. Ordinal data has a particular order and can be rated. It allows researchers to make comparisons of greater than or less than within a set of data (Kothari, 2004). The appropriate measure of central tendency is the median and the best percentiles are used to measure the dispersion (ibid).

3.5.1.4 Interval questions

Concerning Interval questions, Kothari (2004) stated that "Interval scales provide a more powerful measurement than ordinal scales because an interval scale also incorporates the concept of equality of interval". Interval scales therefore allow statistical measures such as the Mean and Standard Deviation to be employed (ibid). Table 3.1 gives a summary of the type of data that is used in research and outlines the scale of measurement that is used on each data type and how results are presented.

Table 3.1: Summary of data type and Scale of Measurement

(Source: Strydom, 2012)

	Nominal	**Ordinal**	**Interval**	**Ratio**
Type of data	Qualitative	Qualitative	Quantitative	Quantitative
Attribute	Names the attributes	Ranks the attributes	Ranks the attributes	Ranks the attributes
Absolute zero	meaningless	meaningless	meaningless	meaningful
Multiples	-	-	meaningless	meaningful
Frequency	Yes of categories	Yes of categories	Yes of intervals /bins / class intervals	Yes of intervals / bins / class intervals
Percentage	Categories	Categories	Classes or intervals	Classes or intervals
Mode	Yes	Yes	Yes	Yes

	Nominal	Ordinal	Interval	Ratio
Median	No	No	Yes	Yes
Mean	No	No	Yes	Yes
Graphical displays	Pie chart Bar chart	Pie charts Bar charts	Stem-and-leaf Cross tabulation	Histograms Scatter plots
Examples	Brands of toothpaste (Aquafresh, Colgate, Close up, Mcleans, Mentadent P, Sensodyne)	Size (XS, S, M, L, XL, XXL)	Temperature (Celsius, Fahrenheit) 0 C 0 F	Distance or weight – usually have some sort of measurement scale

3.5.1.5 Interviews

Interviews were conducted with several personnel at the MLNREP. These interviews were semi-structured. The advantage of using this method was that it allowed collection of specific information about the study and acquired extra information beyond what the researcher had initially intended. This was important because the research drew upon the expertise of the respondents on how the private sector would participate in the mapping industry. Five MLNREP senior staff members were interviewed and one retired MLNREP member of staff was interviewed. These interviewees came from the Zambia Survey Department of MLNREP because mapping was handled by this department.

3.5.2 Secondary data

Secondary data was used to form the basis for this study. It has been stated that "research is not a solitary activity and an end in itself but an act of community building on the knowledge that others have acquired before and providing a road map for those to come after" (UC San Diego, 2014). As such, secondary data was collected from several journals and internet articles. Furthermore, reports from government agencies were consulted as well. These were collected from the internet because these data were in the public domain.

3.6 Statistical analysis

Descriptive and inferential statistics were used because both could be performed on the same data. Collectively, these were defined as the measures of central tendency and dispersion (Bird, 2007).

3.6.1 Descriptive statistics

Descriptive statistics were used for this research. This is because descriptive statistics involve determining the relationships between variables so that the data is shown in a simpler and meaningful way (Lund and Lund, 2016). In other words, descriptive statistics help understand the extent of an issue within a population (ibid).

3.6.1.1 The arithmetic mean

This is usually referred to as Mean or an average. It is the sum of all the scores divided by the number of scores (Spiwak, 2009). The formula used for the arithmetic mean is given as:

$$\overline{\boldsymbol{x}} = \frac{\sum_{i=1}^{n} \boldsymbol{x_i}}{\boldsymbol{n}} \qquad \ldots\ldots\ldots \text{ formula 1}$$

where $\boldsymbol{x_i}$ is the individual observed values and $\boldsymbol{n}$ is the number of observations.

Devore and Berk (2009) stated that the Mean suffers from one deficiency that makes it an inappropriate measure of centre under some circumstances: Its value can be greatly affected by the presence of even a single outlier (unusually large or small observation). The Mean in this research was used to determine the average of the given responses from the questionnaire.

3.6.1.2 The median

The formula for the Median was found by arranging the data from lowest to highest number and then getting the value in the middle (Mwanaumo, 2013; Manikandan, 2011). It was used for data measured in a nominal and ordinal scale (Mwanaumo, 2013; Sundaram et al., 2010). The advantage it has is that it is less inclined to be affected by outliers (Lund and Lund, 2016).

3.6.1.3 The mode

This was the number with the highest value. An example of the Mode is given by Lund and Lund (2016) in Figure 3.1. It shows that the mode corresponds to the highest bar on a histogram (ibid).

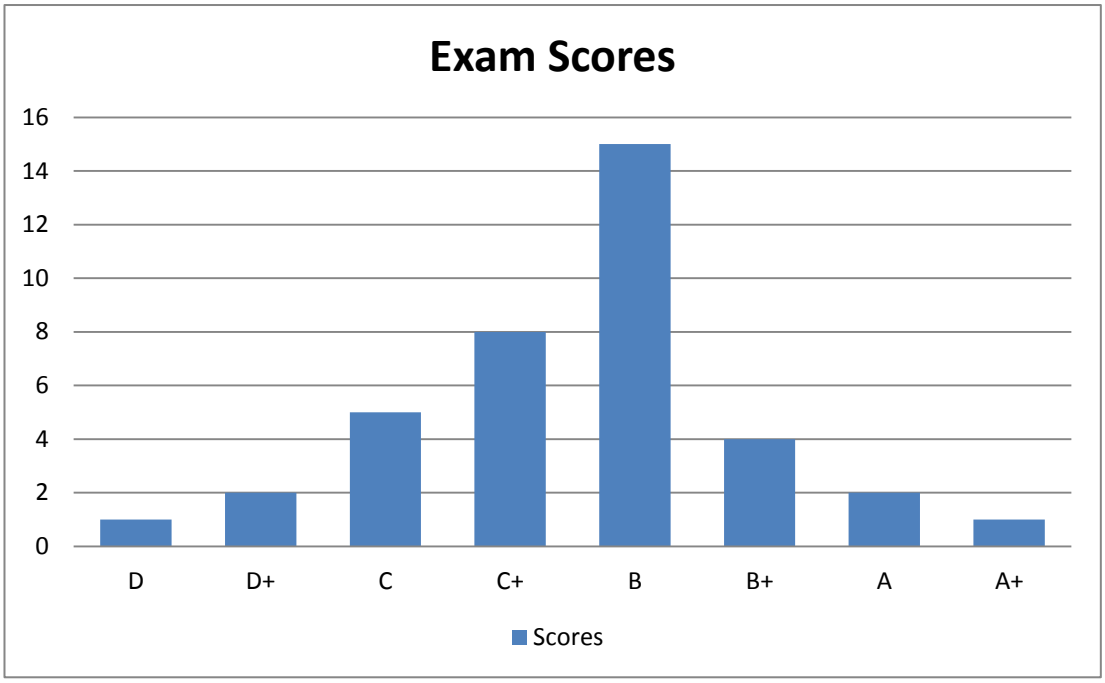

Figure 3.1: Example of the Mode on a histogram

3.6.2 Inferential statistics

Because data from the entire population could not be retrieved which produced a response rate below 100 percent, inferential statistics were used to make generalisations over the entire population. Inferential statistics are techniques that allow researchers to use samples in order to make generalizations about the populations from which the samples were drawn. It was, therefore, important that the sample accurately represents the population.

3.6.2.1 Standard deviation

This is referred to as the variance and it measures how spread out a given distribution of scores is (Spiwak, 2009). The standard deviation depicted how values are distributed from the mean value. The formula that is used for calculating the standard deviation is given as:

$$\boldsymbol{\sigma} = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \qquad \text{…… formula 2}$$

Where ***(n-1)*** is the total number of observations in a sample of the population minus one, $\sum_{i=1}^{n}(x_i - \bar{x})^2$ is the sum of the squares of the individual value minus the arithmetic mean

3.6.2.2 Distribution of data

Inferential statistics also help researchers understand how the variables, usually continuous variables, are distributed through the values for Skewness and Kurtosis (Pallant, 2005). Skewness depicts the symmetry of the distribution while Kurtosis depicts the peak of the distribution (ibid).

3.6.3 Coding the questionnaire for analyses

The data collected from the questionnaires was fed in to SPSS for analysis to be performed. Prior to this the questionnaires had to be coded so that data could be understood by the software (Pallant, 2005). The process of coding and analysing the questionnaires was adopted from a tutorial written by Skehan (2003). The following sections are just an adaptation and summary of that tutorial.

3.6.3.1 Questionnaire identification

Each questionnaire was given a unique letter to identify it. Since the sample was less than 26, letters from the alphabet were used because this would suffice since no two questionnaires would have the same identifier.

3.6.3.2 Response identification

Each response was given a positive integer value that would compose the dataset analysed with SPSS. Furthermore, this helped observe trends in the data even before the statistical analysis was done (Skehan, 2003). Lastly, a unique value was chosen outside all the possible numbers given to the responses that could occur. This number represented a question that was not answered. The final output from this exercise was a table that was a matrix showing the questionnaire id and responses to the questions with a code attached.

3.6.4 Testing

Parametric tests are conducted on data that is assumed to be normally distributed. Therefore, these were conducted on interval data because many statistical analysis techniques could be used on it while ordinal data is non-parametric therefore only a limited number of statistical techniques could be performed on it (Kothari, 2004). Mwiya (2009) summarised the most used statistical tests as shown in Table 3.2.

Table 3.2: Most used statistical tests in research

(Source: Mwiya, 2009)

S/ No.	Normal theory based test	Corresponding non-parametric test	Purpose of test
1	t-test for independent samples	Mann-Whitney U test Wilcoxon rank-sum test	Compares two independent samples
2	Paired t-test	Wilcoxon matched pairs signed-rank test	Examines a set of differences
3	Pearson r correlation coefficient	Spearman rank correlation coefficient	Assesses the linear association between two variables
4	One-way analysis of variance (F-test)	Kruskal-Wallis analysis of variance by ranks	Compares three or more groups
5	Two-way analysis of variance	Friedman two-way analysis of variance	Compares groups classified by two different factors

3.6.5 Data presentation

Lund and Lund (2016) observed that when descriptive statistics are used it was necessary to summarize the group of data using a combination of tabulated description such as tables, graphical description like graphs and charts, and statistical commentary likened to a discussion of the results. These graphs allow researchers to analyse and present the distributions of the findings visually.

3.7 Summary

This chapter outlined the steps that were taken to conduct this research. A mixed methods approach was selected because the nature of the study was descriptive research. It involved measuring variables without manipulating them. Furthermore, the tools used for collecting data such as questionnaires and interviews were discussed. A self-administered questionnaire was selected and categorical, ordinal, and interval data types were included. The following chapter discusses the findings of the research.

CHAPTER FOUR: RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

Chapter 3 outlined how the data was collected that was used to achieve the objectives of this research. Because the participation of the private sector was being established, descriptive statistics were used to summarise and analyse the data. This analysis involved using the standard measures of central tendency to describe the data. The tools that were used were a Microsoft Excel spreadsheet, for sorting and coding the data, and SPSS for analysis. The tables, graphs and charts that were created during the analysis are included into chapter 4 of this report. This chapter is dedicated to compiling the analyses performed on the data collected from the survey.

4.2 Response rate of questionnaires

Registered licensed land surveyors composed the private sector that was engaged in mapping in Zambia. A record of all these surveyors is kept by the SG's office and the total registered in the private sector was found to be 29. The number of questionnaires that were distributed for the survey was 23. The reason why 23 questionnaires were distributed was that the remaining 6 licensed land surveyors could not be contacted because their phone numbers were not reachable and their physical address could not be determined. Therefore, the 23 provided a randomly selected sample equivalent to 79% of the entire population. However, from the 23 questionnaires distributed, 18 were completed successfully. The response rate for this research was therefore 78%. The response rate of the private sector is presented in Table 4.1.

Table 4.1: Response rate of the distributed questionnaire survey

Questionnaires	Online survey	Hardcopy survey	Grand Total
Distributed questionnaires	6	17	23
Usable questionnaires	4	14	18
Response rate	0.67	0.82	0.78
Response rate (%)	66.67%	82.35%	78.26%

This research recorded such a response rate because some of the respondents stated that they did not have time to answer questionnaires when reminded to participate in the survey. In a similarly manner, some of the members of the private sector do not have personal email accounts therefore the opted to provide email accounts for their employees.

4.3 Nature of the Private Sector

Using the register kept at MLNREP, it was established that 19 licensed land surveyors operated under registered companies and 10 did not operate registered companies. Although the study noted that two licensed land surveyors had formed a single company, they were treated as individuals. This allowed the total number of licensed land surveyors in the private sector to remain constant, at 29. This finding is depicted in Figure 4.1.

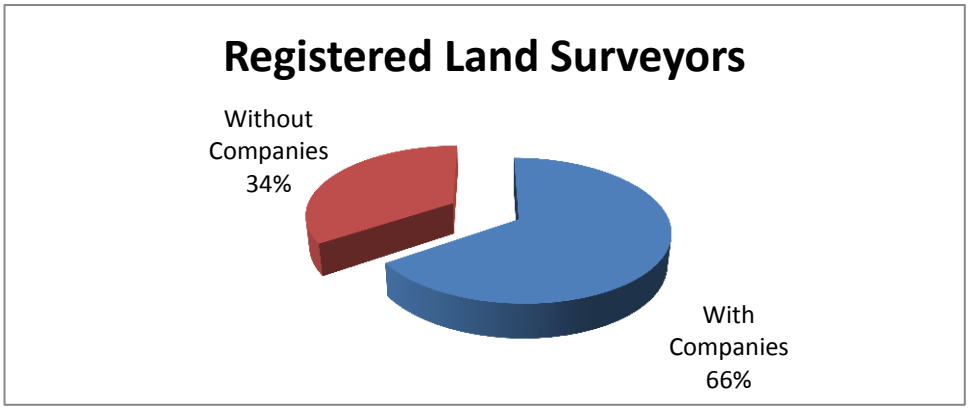

Figure 4.1: Total population of Registered Land surveyors

Furthermore, it was observed that the private sector was composed of land surveyors with a background in Engineering owning the registered companies. However, according to the provisions of the Land Survey Act under article 3 of subsection 2 section 8, any person with background qualifications in Geography, Mathematics, Physics or Engineering from an approved University is eligible to register as a land surveyor.

It was also discovered that all the registered land surveyors had been performing survey works for more than 10 years. This suggested that the youngest participant in the private sector had at least more than 10 years of experience in the industry. This implied that the private sector had not been growing for the past 10 years. This data collected is provided in Figure 4.2.

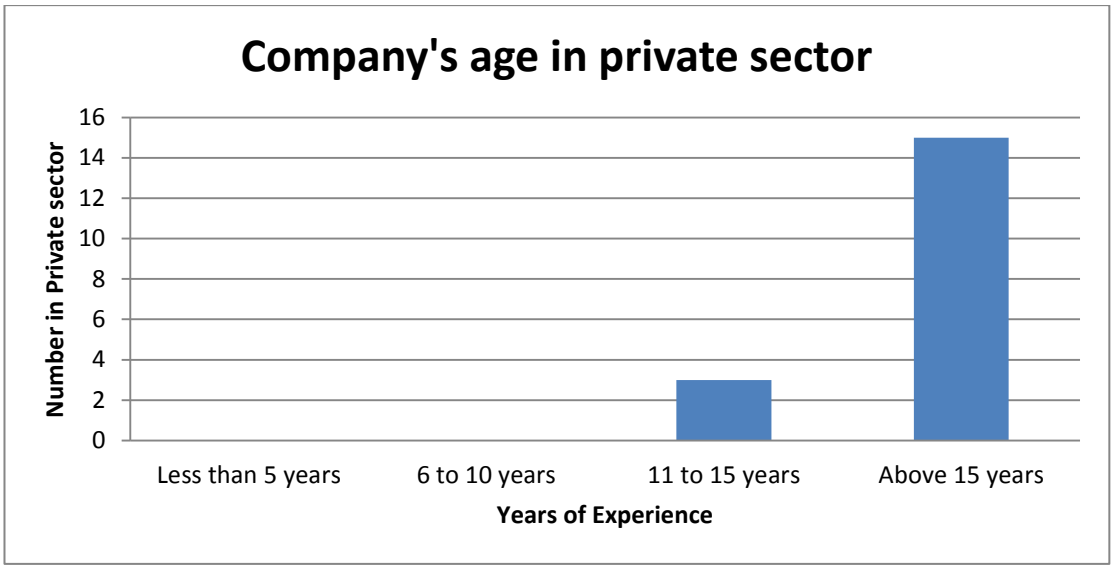

Figure 4.2: Company years of experience in offering surveying services

The findings further revealed that 67% of the companies owned the equipment they used for performing work. This research did not endeavour to categorise the equipment in to Total stations, GPS sets and the other types of equipment but generalised these into equipment used by the Company. This data is presented in Figure 4.3.

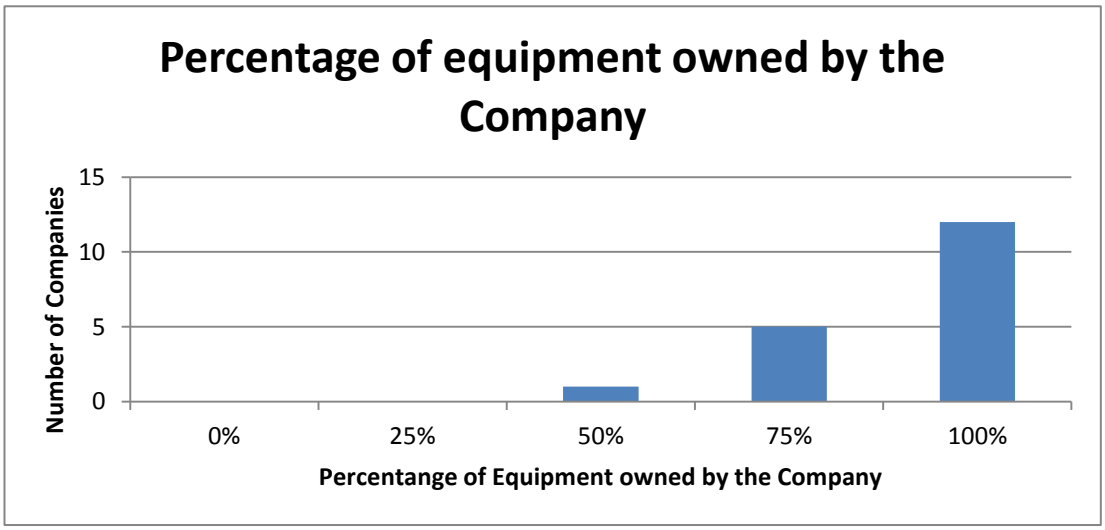

Figure 4.3: Equipment sorely owned by the company that is used in Surveying

This research went on to establish that the academic qualifications found in the private sector ranged from PhD down to Certificate level with "other qualifications" being reported as well. Although this study did not endeavour to determine the exact field in which the participants possessed qualifications, it was observed that the registered land surveyor possessed the highest qualifications while the employees had lower qualifications. Furthermore, the pattern was such that no company had

personnel from all the academic qualifications levels. Notwithstanding, one respondent reported that they had employed personnel from Masters degree down to Certificate level. Apart from the registered land surveyor, who had a minimum of a Bachelors degree, it was noted that only three licensed land surveyors had offered employment to graduates with technical knowledge in surveying between 2010 and 2015. Figure 4.4 summarises the finding on the educational profile of the private sector.

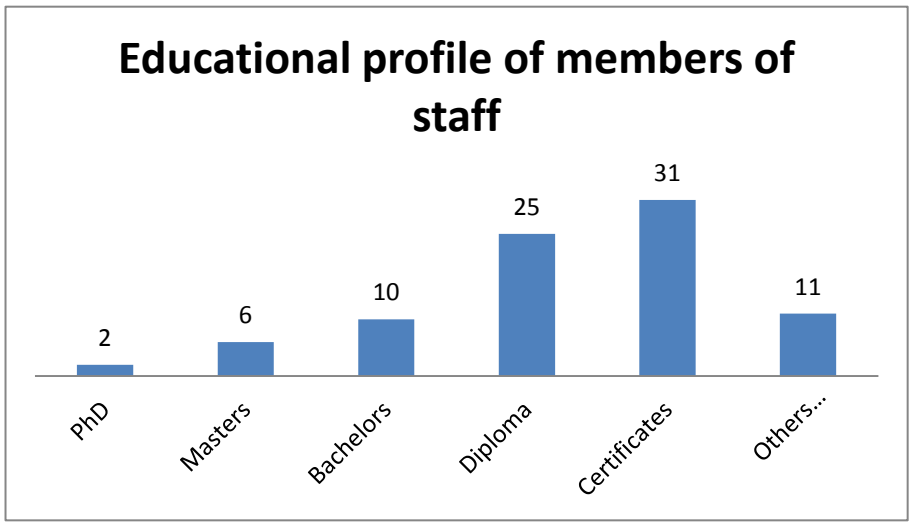

Figure 4.4: Academic qualifications of members of staff

The findings of the research further showed that the employees were not engaged for more than five (5) years by their employers. The data showed that four companies did not keep the same employee for more than 5 years, three kept 25% of the employees, seven kept 50% of their employees, none kept 75% of their employees while four kept 100% of their employees as shown in Figure 4.5.

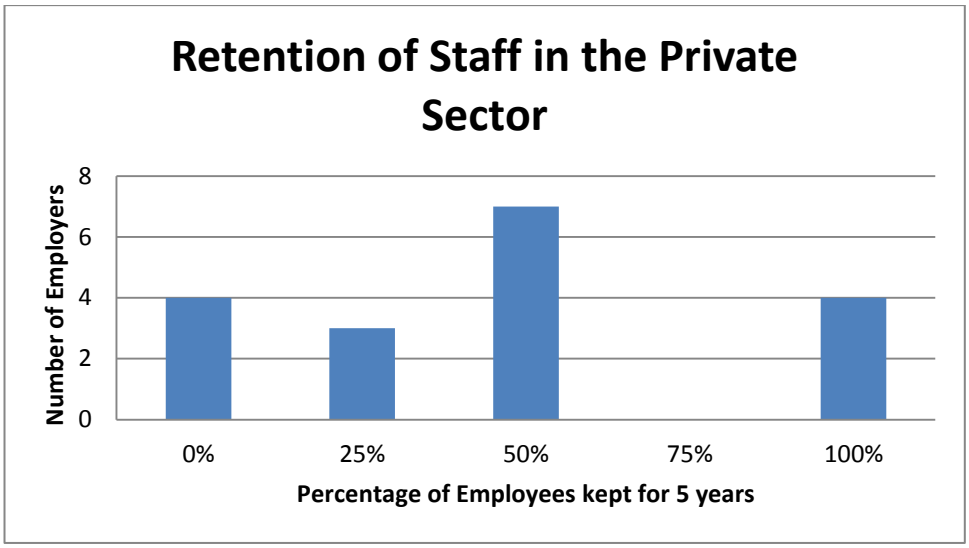

Figure 4.5: Retention of Staff in the Private Sector

Furthermore, it was observed that the Private Sector depended largely on software that was not fully licensed. The study categorised the license types as free, demo and full licence. The findings showed that all the companies had used software in the three categories but that their bias was towards free software as shown in Figure 4.6.

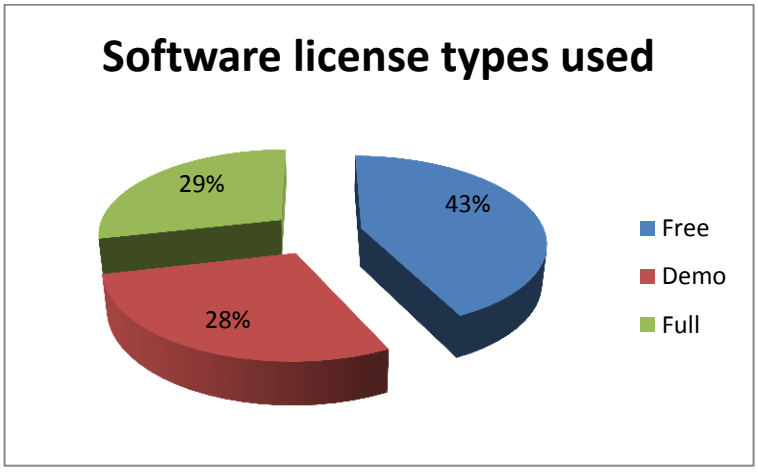

Figure 4.6: Software license types that were used

From this research objective, the nature of the private sector was summarised as follows:

- Companies are owned by licensed land surveyors,
- All the licensed land surveyors have a background in engineering,
- The highest qualification was possessed by the owner of the company,
- Technically skilled persons had been employed by a few of the companies,
- The majority of employees did not work for more than five years,

- The type of software used for works was usually free software.

4.4 The type of contribution the private sector is making

The private sector was found to have provided services for land used for Residential, farming, mining, transport and tourism purposes. The nature of the surveys offered was cadastral surveying and 60% of the respondents reported to have performed subdivisions 75% of the time while 40% reported to have done new surveys 75% of the time. Furthermore, the respondents employed plane surveying techniques in their works as a first priority, Remote Sensing and GIS was a second technique while Photogrammetry was the last technique used. The data collected on the number of companies offering services for specific land use is presented in Figure 4.7.

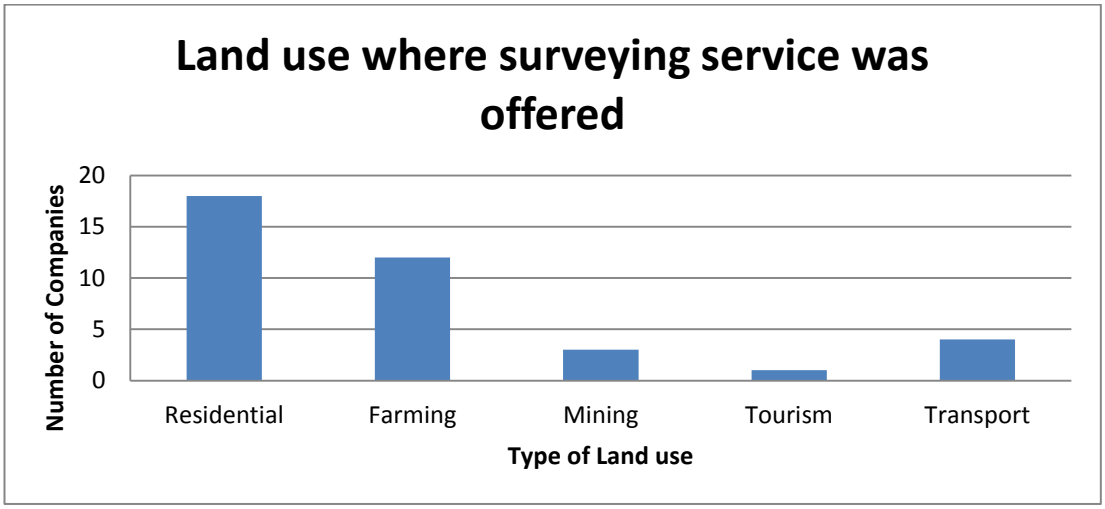

Figure 4.7: Number of Companies offering services for specific land use

The study also observed that all the respondents had been engaged in providing services for private companies and organisations during 2010 to 2015. The type of companies that had the surveyors were Utility Companies (Water, Electricity and Communication), Engineering (Road construction and Mining), International organisations (UN, Southern Africa Development Community (SADC)), and Ministry of Local Government and Housing (MLGH).

The participation was distributed as shown in Figure 4.8.

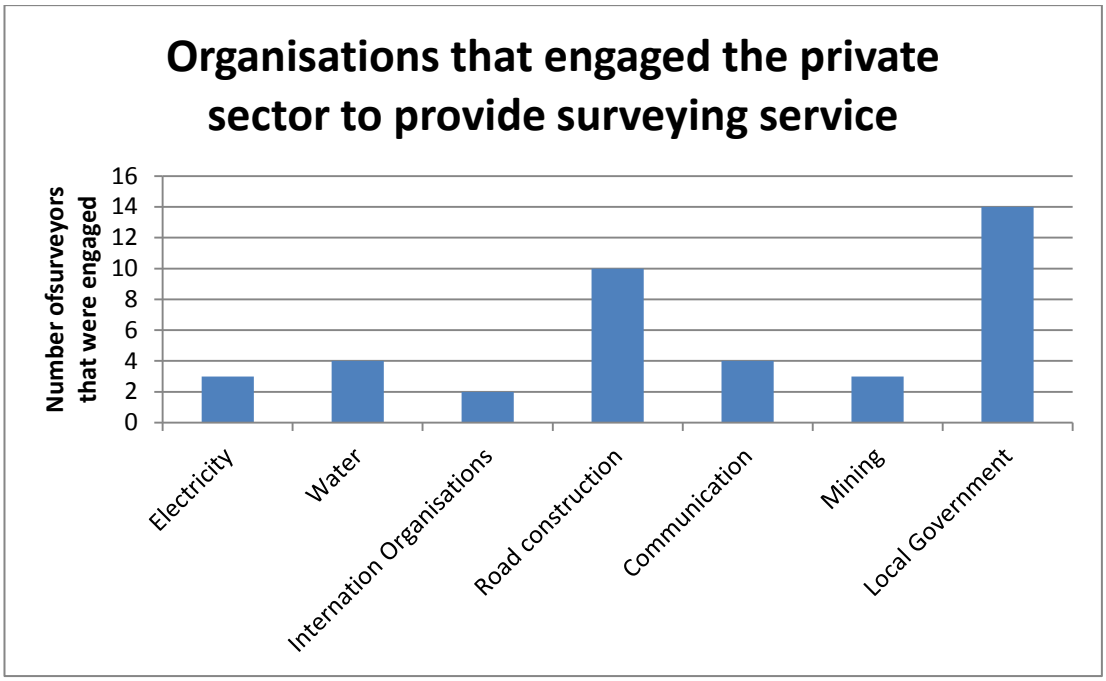

Figure 4.8: Organisations that engaged the private sector to provide surveying services

Furthermore, the study established that fifteen of the respondents had been engaged through a bidding process and two had been engaged through single sourcing while one had been engaged using both methods. The number of jobs that the surveyors were engaged in were not emphasised for this variable. Only the method used for engaging the surveyor was considered.

The members of the private sector were observed to have specialised in providing specific work. This specialisation was recorded to have been influenced by a demand for particular services in the industry. Apart from the demand, the other factors that contributed to specialisation were lack of man power and equipment.

Existing laws were also reported to be a factor by one of the respondents as given in Figure 4.9

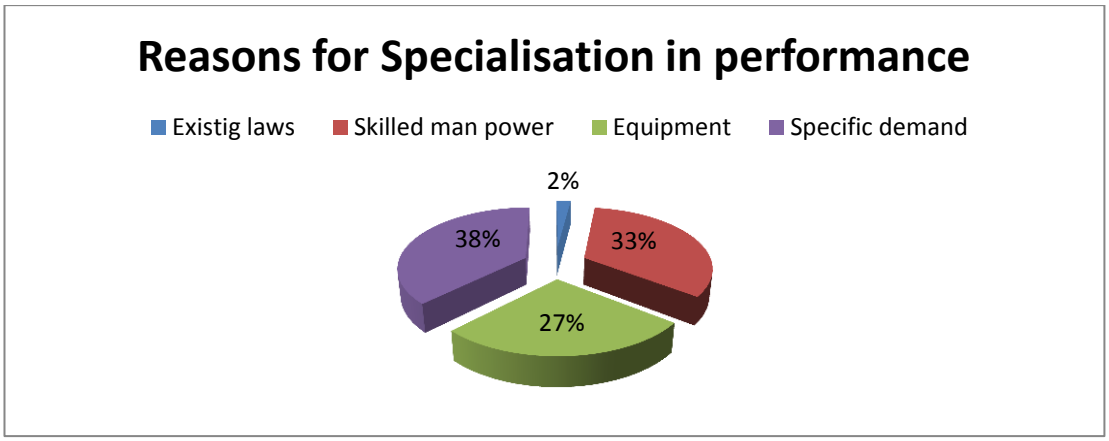

Figure 4.9: Reasons for specialisation in private sector

The other findings of this research revealed that one (6%) respondent had been engaged as a Contractor by the Ministry of Lands. On the other hand, three respondents had been engaged as Consultants by the Ministry of Lands. This translated into 17% being engaged as Consultants while 83% had not been engaged by the Ministry of Lands. These findings are presented in Figure 4.10

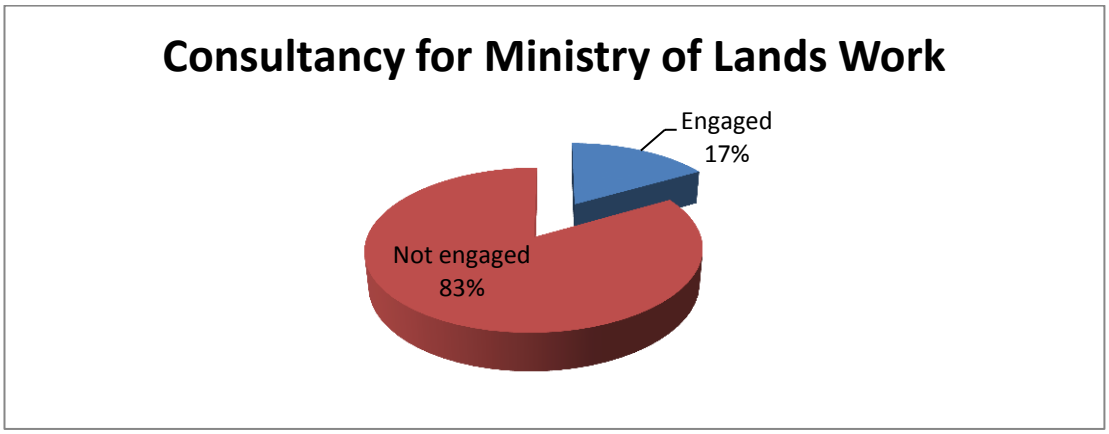

Figure 4.10: Respondents engaged as consultants by Ministry of Lands

The interactions within the private sector were found to have been in the following ways as given in Table 4.2.

Table 4.2: Private sector interrelationships

Question	Yes	No
Collaboration/ creation of a consortium	17%	83%
Subcontracting another company	17%	83%
Company attending Stakeholder meeting	67%	33%
Any members of staff sitting on Statutory bodies apart from Owner	0%	100%

Table 4.2 offered insights that showed that the private sector members had performed works independent of the others mostly. The reason was that the main Clients the sector provided services to were individuals who needed cadastral surveys which did not need to be performed by one company.

Furthermore, apart from performing fieldwork, the private sector had contributed to the mapping sector through other ways. From the responses it was determined that only two respondents were supplying surveying equipment and the accompanying services such as setting up, training and troubleshooting, to the Zambian industry. In addition, six respondents stated that they had conducted research into new surveying techniques and had presented these findings in the form of a research paper. However, it was determined that this research was undertaken in conjunction with learning institutions because these respondents were members of staff at the Institutions. In addition, it was established that the private sector had not created any software that could be used in the industry.

On the other hand, it was noted that the private sector had contributed to the policy and decision making processes. The findings suggested that five respondents had participated in this process as decision makers while the thirteen reported being general observers. 82% of the respondents reported to have been invited to Stakeholder meeting convened by MLNREP while 18% reported not to have been invited. All the respondents reported that none of their employees had represented their company at these Stakeholder meetings.

These finding were summarised and presented in Figure 4.11.

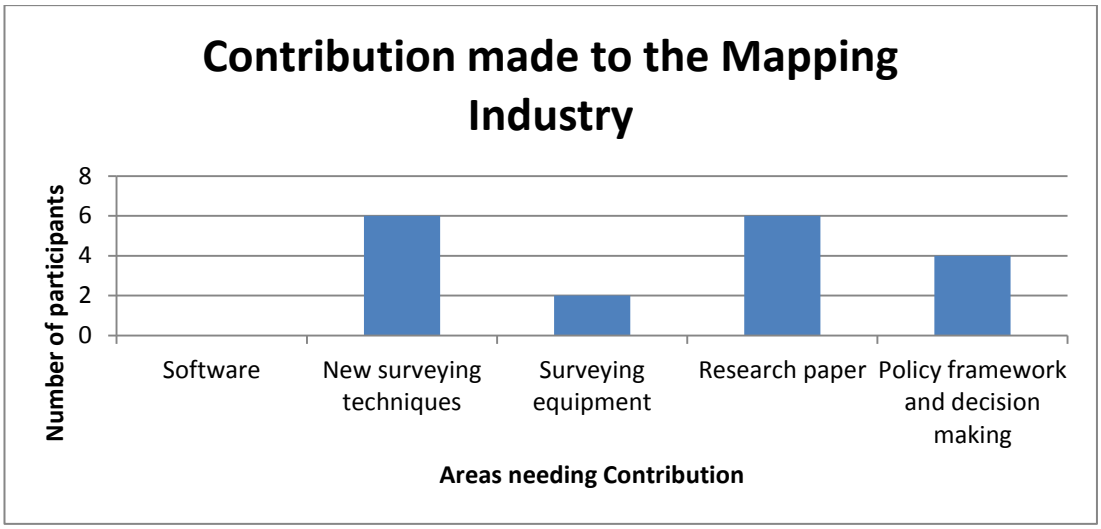

Figure 4.11: Contribution to the mapping industry

The findings on the type of contribution made by the private sector were summarised as follows:

- Performance was biased towards cadastral surveying with subdivisions being foremost,
- No software was developed by the private sector that could be used in the mapping industry,
- Only two were supplying surveying equipment and accompanying services,
- Only the company owners attended Stakeholder meeting organised by MLNREP,
- Research was conducted that contributed to the industry but this was done in conjunction with institutions of learning,
- Consultancy work was provided to MLNREP and one of the private sector companies was engaged as a Contractor by MLNREP.

4.5 The private sector's perception of the mapping industry.

The private sector expressed its perception of the mapping sector using a likert scale. Five options were given that ranged from *Strongly disagree, Disagree, Neutral, Agree* and *Strongly agree*. From the responses it was established that the private sector perceived the mapping industry to have corrupt practices within it structure. 25% confirmed that corruption does not exist while 75% confirmed its existence in the industry. Apart from this 75% of the respondents recorded that they needed to advertise their companies while 25% recorded they do not need to advertise because

their company was well known. In the same vein 6% were not sure if MLNREP preferred to use public service land surveyors to conduct mapping activities while 17% agreed that MLNREP preferred engaging public service land surveyors and 77% strongly agree to the statement that government prefers using public service land surveyors. Furthermore, the private sector felt that including foreign companies in the mapping industry would not boost the performance of the sector. However, 2 respondents felt the sector would be boosted if the foreign companies participated.

Regarding access to information, the private sector perceived MLNREP as not good at distributing information surrounding the mapping sector. The findings were such that 62% disagreed to information being shared about the areas needing services, 22% took a neutral stance while 16% felt MLNREP shared information. Lastly, 18% took a neutral stance on government implementing policies that allowed companies to grow while 82% disagreed that the government had implemented policies that allowed growth in the sector. These findings were presented in Table 4.3.

Table 4.3: Private sector perceptions of the mapping industry

Perceptions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Advertising is not necessary	0	75%	0	25%	0
Information is shared by Government	0	62%	22%	16%	0
Corruption exists in the industry	0	25%	0	75%	0
Public servant are preferred over private sector	0	0	6%	17%	77%
Foreign companies will boost sector	22%	72%	0	6%	0
Government policies encourage growth of sector	0	82%	18%	0	0

4.6 Discussion of Research Findings

From the data collected it was evident that a background in engineering for all the licensed land surveyors predisposed them to specialise in plane surveying techniques. This specialisation brought about competence within the private sector. However, the disadvantage of this specialisation was that the other areas of mapping remained unexplored. For example, MLNREP had introduced a procedure called Integrated Mapping in which high resolution aerial photos were being joined together with line maps so that detailed information about the current land use would be provided. Because the private sector was not engaged in acquiring and/or providing aerial photos, MLNREP resorted to engaging foreign companies. Pole (2016) explained that the reason the private sector was not providing aerial photos to MLNREP was because monetary value had not been attached to aerial photos in Zambia. This made quoting the price for aerial photos difficult. Because of this the area of photogrammetry was not considered good for business. In contrast to this, the value for line maps or cadastral maps was known already. Therefore, the private sector preferred to produce line maps because of the profit they would make. Also, Mooka (2016) reported that "printed maps had less value than softcopy maps therefore more money was generated from the sale of the softcopy maps".

Furthermore, the emphasis of plane surveying implied that other field's, related to surveying, such as Computer Science, Mathematics and Geography were not well represented in the mapping sector. Although, all the licensed land surveyors had some knowledge from these fields, Specialists from these Areas were required in order to assure quality performance. In the same vein, because the highest qualification was possessed by the licensed surveyor, this limited the participation of the private sector to areas where the licensed land surveyor was competent.

Notwithstanding, the major contribution the private sector made was conducting cadastral surveys. This provided MLNREP cadastral surveying data that was added to the Cadastre index. However, the lack of research into new surveying techniques meant that the mapping industry was using methods that are not up to date. This research suggested that the lack of research grew from the fact that only the owner of the Company was skilled in surveying techniques in most of the companies. This was further confirmed by the lack of skilled man power with technical knowledge in surveying being employed.

Furthermore, the low employment rates meant that the private sector was not investing in its knowledge database. The study observed that the sector would not return most of its employees for at least 5 years. This meant that the sector did not have employees with a lot of experience to assist the licensed land surveyor perform his work. On the other hand, this meant the private sector was creating short term employment for a lot of people. However, the rate at which the human resource was being turned over could have implied the employees found the sector not favourable for personal growth and so they left for better forms of employment. This could be in-line with the widespread notion that the government offers more secure jobs than the private sector. Furthermore, this meant the private sector was not growing in size but that the new employees were merely replacing those that left. Another indicator for the poor growth of the private sector could be seen from the fact that the youngest participant was more than ten years old.

Also, the use of free software compromised the level of security in the sector because most of the free source software was developed in communities and thereby increasing the risks of hacking into the systems. Notwithstanding, the need for free software in Zambia was confirmed by Pole (2016). It was reported that MLNREP was implementing a Map Awareness Program which would promote the use of digital maps in Zambian Secondary schools. Despite free software being on demand, emphasis was placed on national security (Mooka, 2016).

This study also confirmed that the private sector did not perceive the all the areas of the mapping industry to be profitable thereby prompting them to invest in these areas. Because of this the private sector was engaged in areas only were profits would be realised. This meant the private sector in Zambia was driven only by profit and not providing a service, even for free. This was proposed to be the reason for the sectors limited performance in research because it had been observed that applied research was expensive and there was no obvious commercial value to the discoveries that result from basic research (Wikibooks, 2014).

Although participation on the Statutory Bodies regulating the mapping industry was defined by law, the study showed that only a few were participating at such a level. It was reported by Chilesh and Shamaoma (2014) that the term of office on these bodies was not specified therefore the Office bearers would be in office for

unspecified durations. Furthermore, the findings pointed towards the idea that the private sector was not valued highly by the public sector. Instead of having a mutually inclusive industry and creating PPPs, the government preferred using the public sector. This meant the private sector was not motivated to improve on its performance because all the information was not availed to them outlining where they could participate. In addition, the existence of corruption meant that the members of the private sector were not engaged fairly and on merit. Although corruption was reported to exist, all the respondents reported not received any disciplinary action.

Lastly, the impact all these variables had on the mapping industry was that the private sector was forced to participate in a restricted way. Because of these restrictions, the mapping industry was not performing as expected because the participants were missing. This was because the sector does not have equipment, personnel, knowledge and the will to perform actively in the updating of maps. Therefore, the sector required the participation of foreign companies. This was reported that "topographic mapping was a very expensive endeavour that required a lot of skills and resources" by Membere (2016). Furthermore, the security of the Country will be put at risk because sensitive information about the land use might fall into wrong hands due to high reliance on free software.

4.7 Summary

From the findings of this research it was discovered that the private sector was contributing to the mapping industry. However, it was shown that all the companies had specialised in offering specific surveying services. For example, out of eighteen respondents only two were supplying equipment. Similarly, none from the private sector was producing software that could be used in mapping. Having presented all the data collected the chapter concluded with stating that the private sector cannot be relied upon to update the topomaps because it does not have the capacity not the will to perform such works.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Chapter 4 presented the data that was collected for this research using a survey questionnaire and interviews that were conducted. It further presented the analyses that were performed on the data and then discussed the results based on the literature reviewed. This chapter provides a summary of the conclusions that were drawn from this study. Furthermore, the chapter offers recommendations for future research that would add more knowledge on the participation of the private sector in Zambian mapping.

5.2 Evaluation of Research Objectives

The aim of this research was to establish the participation of the private sector in updating topomaps. However, the study limited its focus on the private sector composed of Zambian registered land surveyors only. In order to achieve this, the following research objectives were considered: 1) the process of updating topomaps in Zambia, 2) the nature of the private sector, 3) the areas in which the private sector is expected to participate and 4) the areas that would promote effective participation.

5.2.1. To outline the process of updating maps in Zambia

The first objective was to analyse the institutional framework of the Zambian mapping industry so that the areas where private sector participation was required could be identified. Therefore, the findings from this study showed that the process of updating Zambia's topomaps involved the private sector being granted approval from the office of the Surveyor-General to perform any updates to the existing topomaps. This involved signing a Contract that would allow the private sector to use the base map provided by MLNREP. Afterwards, the process involved the use of various techniques namely: Photogrammetry, Cartography, Land surveying, Remote Sensing and GIS. Depending on the specific requirements of the assignment, a combination of these techniques would be required in order to update the maps. Lastly, the final map products are stored with the Surveyor-General's office because all the intellectual property rights of the topomaps of Zambia are vested in his office.

Furthermore, the private sector was granted permission to sell the maps within a specified time and submit part of the royalties to MLNREP.

5.2.2. To determine the nature of the private sector in Zambian mapping

This study outlined the nature of the private sector involved in the Zambian mapping industry as composed of registered land surveyors. The summary of the findings established for the period 2010 to 2015 were presented in Table 5.1 to be as follows:

Table 5.1: Summary of the nature of the Private sector involved in Zambian mapping between 2010 and 2015

Code	Item	Remarks
1	Composition of private sector	66% operated as registered companies, 34% operated as individuals
2	Experience in the private sector	• Above 10 years • All performed plane surveying primarily • Only the registered land surveyors were owners of the companies
3	Employed technically skilled personnel	Only 3 companies had employed
4	Any disciplinary action received	None
5	Capacity to do work (Equipment, manpower, software)	Limited due to lack of equipment, software, qualified personnel
6	Major client	Individuals (cadastral surveys)
7	Major type of Cadastral surveys	Subdivisions
8	Major type of land use	Residential, Agriculture

Furthermore, the private sector's perceptions of the Zambian mapping industry between 2010 and 2015 were summarised in Table 5.2.

Table 5.2: The perceptions of the private sector on the mapping industry between 2010 and 2015

Code	Item	Perception
1	Information regarding mapping	Not properly shared or distributed by MLNREP
2	Government policies	Do not encourage growth in this sector
3	Involving foreign companies in private sector	Would not promote competition and growth in the sector
4	Existence of corruption	Restricted access to job opportunities
5	Job opportunities	MLNREP preferred using public service surveyors than the private sector

5.2.3. To describe the type of contribution the private sector is making

This study established that the participation of the private sector in updating topomaps is done through providing data generated from:

- **Cadastral surveys**. It was shown that 60% of the Cadastral surveys were of the subdivision nature while 40 % were new surveys. Thereafter, MLNREP would add this data to the Cadastre index and would combine it with aerial photos in order to produce updated topomaps.
- **Research and development**. It was established that the private sector, on its own, was not performing research that would improve the industries performance. However, some of the members of this sector that were attached to institutions of learning were conducting research as part of the academic requirements of those institutions.
- **Institutional framework**. It was established that the private sector was contributing to the wellbeing of the industry as provided for by the law. This involved creating industry standards, monitoring and implementing discipline and registration of members.
- **Supply of equipment and accompanying services**. It was established that only two respondents, from the registered land surveyors, were supplying surveying equipment in Zambia. Most of the equipment used in Zambian mapping would be purchased from outside the Country.

5.2.4. To propose key areas of focus for effective private sector involvement

The following interventions were identified as having potential to increase the private sector's involvement in the mapping industry:

- The private sector should employ technically qualified personnel and invest in upgrading and updating the skills of its personnel.
- Private sector should focus on using full license software that is affordable and offers all the tools required in mapping.
- The private sector should engage in more GIS and Remote Sensing techniques that allow mapping to be done faster and more economically than plane surveying.

5.3 Scope and limitations

The updating of maps in Zambia was also performed by foreign based agencies and/or organisations that have partnered with the Zambian government to improve the performance of this sector. Together with locally owned agencies, these formed the private sector. However, this study sought to establish the contribution to the mapping industry by only registered land surveyors who have Zambian nationality.

Further, although the private sector produced other types of maps, this study was limited to topomaps because these provided information about how the land was being used. In the wake of constant land use changes due to urbanisation, topomaps provided information that was useful for planning proper land use change. Apart from this, the participation of the private sector was limited to the years 2010 to 2015 because this was the period when the SNDP was implemented.

Furthermore, the primary focus was to establish how the private sector had collaborated with the Ministry of Lands, Natural Resources and Environmental Protection (MLNREP). This was because the mandate for updating of topomaps is vested in MLNREP.

5.4 Recommendations

The following recommendations are aimed at increasing the participation of the private sector in mapping in Zambia:

- The private sector should use fully license software that has enhanced security features. This will prevent unauthorized access to data of a topographic nature that might undermine National security.
- The private sector should transform from just supplying cadastral survey reports to a level of being partner with Government through the creation of PPPs in the mapping industry.
- Courses on software development should occupy an integral part in Institutions of learning so that/graduates are capable of creating software and customizing or extending the capabilities of the commercial software used in mapping like AutoCAD, QGIS and ArcGIS.
- Policies should be implemented that require the private sector to deliberately employ technically skilled personnel.
- Emphasis should be placed on policies that provide for the registration of qualified personnel/companies, that do not have an engineering background alone but on all who understand the principles governing land administration, to engage in the updating of topomaps.
- The private sector should be required to engage in research and development and should publish their findings in approved publications.

5.5 Areas for future research

The following areas of study are recommended for future research:

- Analyse the mapping industries private sectors growth patterns since its creation in Zambia.
- Perform a cost-benefit analysis on the impact of registering people without a background in engineering.
- Design a model that promotes effective performance of the private sector in the mapping industry.
- Review the provisions of the Land Survey Act, SIZ Act and EIZ Act that promote Health and Safety practices in the mapping industry.

5.6 Research conclusion

This research has provided useful information on the structure of the mapping industry and why the private sector has been engaged by Government of Zambia to participate. Furthermore, it has described the nature of the private sector and how it is contributing to updating Zambian topographic maps. From this research it is concluded that the topomaps are not updated because the private sector does not have the capacity to update topographic maps.

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APPENDICES

Appendix A: Questionnaire

Page 1

THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
MASTER OF ENGINEERING IN PROJECT MANAGEMENT

Dear Respondent,
My name is Bwalya Kapansa. I am a postgraduate student at the University of Zambia in the School of Engineering. You have been randomly sampled to take part in this research on the Private sector's participation in the Zambian mapping industry.

Your participation will be greatly appreciated as it will help me understand your views about the Private sector's contribution to Zambian mapping. I want to assure you that the informat on you provide will be strictly confidential and w ll not be linked to you personally. As such, you are not supposed to write your name or any personal identif cation information on this questionnaire.

Bwalya Kapansa, 260-979-356182
M Eng Student - UNZA
email: kapansabwalya@gmail.com

Thank you for your participation.

1 For how long have you been offering surveying services?

- [ ] Less than 5 years
- [ ] 6 to 10 years
- [ ] 11 to 15 years
- [ ] More than 15 years

2 What percentage of the surveying equipment you use is owned by your company?

- [ ] 0%
- [ ] 25%
- [ ] 50%
- [ ] 75%
- [ ] 100%

3 What percentage of your employees have worked for your company for at least 5 years continuously during 2010 to 2015?

- [ ] 0%
- [ ] 25%
- [ ] 50%
- [ ] 75%
- [ ] 100%

4 Apart from unskilled workers, have you provided employment to graduates with technical knowledge of surveying during 2010 to2015 years?

- [ ] Yes
- [ ] No

5 How many employees in your organisation have the following academic qualifications/ degrees? *(Provide a number e.g 0, 1, 2...)*

PhD

Masters

Bachelors

Diploma

Certificate

Other (Specify)

6 What type of software license do you use for your surveying work?

- [ ] Free version
- [ ] Demo version
- [ ] Full license version

Other (Please Specify)

7 What type of land use did you provide services for during 2010 to 2015? *(Select all that apply to you)*

- [ ] Residential
- [ ] Farming
- [ ] M ning
- [ ] Transport

Other (Please Specify)

8 What was the nature of 75% of the cadastral surveys you did during 2010 to 2015?

- [ ] New surveys
- [ ] Sub divisions
- [ ] Other (Please Specify)

9 Rankthe following methods used in mapping according to how you used them when providing services. *(Use 1 for first..., 4 for last)*

	1	2	3	4	Not used
Remote sensing/ GIS	☐	☐	☐	☐	☐
Plane surveying	☐	☐	☐	☐	☐
Photogrammetry	☐	☐	☐	☐	☐

10 Were you contracted to perform surveys for organisations and companies between 2010 to 2015?

- ☐ Yes
- ☐ No

11 Which type of organisations/ companies had engaged you to perfom the service?

- ☐ Power utility
- ☐ Water utility
- ☐ International organisations i.e SADC, UN, USAID...
- ☐ Road construct on
- ☐ Communication utility
- ☐ M ning

Other (Please Specify)

12 What type of tendering process was used when your company was engaged by these organisations?

- ☐ Bidding process
- ☐ Single sourcing
- ☐ Request for proposals
- ☐ Other (Please Specify)

13 What factors have led you to offer specific surveying services?

- ☐ Skilled man power
- ☐ Available equipment
- ☐ Existing laws
- ☐ Demand for specific services
- ☐ Access to funds is limited

Other (Please Specify)

14 Did your company perform any specific work as a Contractor for the Ministry of Lands?

- ☐ Yes
- ☐ No

15 Did your company perform any specific work as a Consultant for the Ministry of Lands?

- [ ] Yes
- [ ] No

16 Did you form a consortium *(collaborate)* with another company in your sector to perform any works during 2010 to 2015?

- [ ] Yes
- [ ] No

17 Did your company subcontract another company in order to perform surveying work?

- [ ] Yes
- [ ] No

18 Were you invited to any Stakeholder meetings organised by the Ministry of Lands during 2010 t0 2015?

- [ ] Yes
- [ ] No

19 What was the nature of your contribution to those meetings?

- [ ] Policy framework
- [ ] Research paper presentation
- [ ] Decision making
- [ ] General observer

Other (Please Specify)

20 Apart from you, did any of your members of staff sit on any of the statutory bodies concerned with land administration such as ZEMA, Lands tribunal and Survey Control Board?

- [ ] Yes
- [ ] No

21 Which of the following did you produce that helped the Zambian mapping sector during 2010 to 2015?

- [ ] Software
- [ ] New surveying techniques
- [ ] Surveying equipment (Supply, training ma ntenance...)
- [ ] Literature or research paper

Other (Please Specify)

22 Which factors affected the level of participation of your company during 010 to 2015?

- [ ] Number of emp oyees
- [ ] Lack of equipment
- [ ] Lack of specific experience needed to do work
- [ ] Disciplinary action against your company

Other (Please Specify)

23 Wereyou up to date with all the information on the Zambian mapping sector bythe Ministr of Lands?

- [ ] Yes
- [ ] No

24 Below are several statements describing the mapping sector in Zambia. Select the answer that best describes your perception on the this sector

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The M nistry of Lands shares information about all the areas needing your services					
Advertising your company and its services is not necessary because your company is well known already					
The government has implimented policies that allow your company to grow					
Includ ng foreign companies in updating maps would boost the perofmance of your sector					
There s coruption that negatively affects performance in your sector					
The M nistry of Lands prefers to used govemment surveys to private surveyors					