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GIS as a decision making tool for development projects in local government: A comparison of category B and C municipalities in Gauteng

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UNIVERSITY OF WITWATERSRAND FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT

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A research report submitted by Sabelo Mahlangu
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UNIVERSITY OF WITWATERSRAND
FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT
SCHOOL OF ARCHITECTURE & PLANNING

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GIS as a decision making tool for development projects in local government: A comparison of category B and C municipalities in Gauteng

A research report submitted to the school of architecture and planning, University of Witwatersrand in partial fulfillment of the Degree of Bachelor of Science in Urban and Regional Planning with Honours

Declaration

I declare that this research report is my own professional work. It is submitted for the Degree of Bachelor of Science in Urban and Regional Planning with Honours to the University of Witwatersrand. It has not been submitted to any other institution other than the University of Witwatersrand.

……..

(Signature of candidate)

……..day of ……. (year) ……..

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Dedications

I dedicate this work to my parents who have been my inspiration for my academic aspirations. It is through the sacrifices you have made, the pleasures you denied yourselves that I can aspire to be a producer of knowledge. Dad, in your trying health circumstances I dedicate this work to you for all the conversations we had about education. Mom, your constant prayers for me have been the lamp on my study table. I love you both.

Regards

Abstract

GIS has transformed the nature of business and decision making in various industries by providing insight, opportunities to change business outcomes. In planning GIS has provided opportunities for better decision making for spatial planning as well as other areas of planning. Even though the technology has evolved and grown into the decision making structures of local authorities in the developed world. In South Africa there is still a slower incorporation of GIS as a decision making tool within local government planning. The general performance of municipalities in South Africa has been poor as most municipalities failed to get clean audits. One of the leading results for poor municipal performance has been linked to 'unfruitful expenditure', poor management as well as wasteful spending, all which could relate to poor decision making. Most Gauteng municipalities have access to GIS but it is underused and mostly limited to mapping functions. The study investigated the use of GIS within two municipalities in Gauteng, South Africa. The study focuses on the strategic location and use of GIS in informing municipal planning decisions. The aim of the study was to highlight the role GIS can play in informing decision makers of best alternatives for planning projects while enhancing the performance of municipalities.

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CHAPTER 1

1.1 INTRODUCTION

Local government in South Africa is the cornerstone of service delivery, spatial and economic development. It acts as the vehicle for promoting democracy with its ability to connect communities and citizens with their government (Mguni, 2008). South Africa has experienced many challenges in governance and service delivery since 1994. Shaidi, 2015 argues that transitioning into the post-apartheid South Africa was lacking critical reflections and considerations on how local governance could be strategically placed and equipped to achieve the desired goals (Shaidi, 2015).

Since 2007, there has been an increase in public protests across South Africa highlighting dissatisfaction on local government performance (Koellde, 2016). Ncube, 2016 argues that these protests highlight the issue of planning and failure of municipalities to meet the needs of communities. Shaidi (2015) further iterates that municipalities often fail to plan and spend well on development and infrastructure projects. Various media reports as well as the reports from the Auditor General of South Africa highlight the severity of decimal municipal performance in South Africa. According to Koellde (2016) lack of planning support systems and leadership are some of the key areas where municipalities fail.

This notion brings the question of the ability of local government to strategically plan, measure and implement and manage development that is aligned to the needs of its citizens. Koellde 2016 and Mguni 2016 further argue that the challenges of local government often lay with decision making. Their argument is that capacity and the ability for municipalities to make informed decisions remains the lagging factor in local government (Koellde 2016 and Mnguni, 2016). This argument is proven by the audit results of local government across the country which reveals that municipalities generally struggle with wasteful and fruitless expenditure (AG, 2015). The Auditor General reports some improvements since 2013, however there is still significant

evidence of poor performance within local government (AG, 2015). The Auditor General of South Africa summarises the challenges with municipal performance into the following key categories: *financial management, corruption, poor planning, institutional elements, wasteful* and *fruitless expenditure* (AG, 2015). Development planning takes place within local government and fall within the fruitless expenditure category. Development planning projects become fruitless expenditure when municipalities fail to take good decisions relating to project location, magnitude of projects and needs analysis (Koellde, 2016). The failure of municipalities to plan for their projects affects the efficacy and success of their projects.

1.1.1 RESEARCH TOPIC

This study focuses on the use of GIS as a decision making tool for decision making for development planning projects within local government. GIS is a commonly used tool in local government planning. It is widely used for mapping exercises with very limited use of it for more strategic purposes. Therefore the research topic for this study is GIS as a decision making tool for development planning projects in local government, a comparison of category B and C municipalities in Gauteng.

1.1.2 PROBLEM STATEMENT

GIS technology in local government is one of the increasingly researched areas of study, with most of the existing literature focusing on the global north context. Little literature focuses on GIS within the African context and specifically the South African. There is a substantial body of literature in South Africa focusing on GIS as a science, a technology as well as a tool for various study areas in government, mining and the private sector (Odendaal, 2013 and Van Nie Kerk, 2008). However, there is very limited research on the use of GIS on decision making within local government especially for development planning decisions. Whilst most municipalities have some form of GIS in Gauteng, GIS use is still largely limited to map production than more strategic functions for decision making for development planning projects (GPD, 2015).

1.1.3 RATIONALE OF THE STUDY

The purpose of this study is to investigate the role of GIS as a decision making tool within local government. Evidence from international literature suggest that the use of GIS in local government as a decision making tool has had positive results on municipal performance (Budic, 1994). The observations of various scholars suggest that GIS can offer planners key insights on development trends and options through analysis (Goodchild et al 1991 and Worall 2007).

The use of GIS within the South African local government context is still largely abstract with most municipalities using GIS for mapping purposes alone. Development planning projects bring about socio-economic change and transformation as they allow spatial reforms within municipal jurisdiction and opportunities for the private sector. However, decision making has been noted as one of the greatest failures in ensuring that development projects achieve these unforeseen impacts (AG, 2015). Good decision making is therefore one the most important part of plan making (Goodchild et al 1991 and AG, 2015). It is therefore crucial that planners, politicians as well as other decision makers within local government make the best decisions on development projects.

Decision making has an influential role on the success and progress of major projects as well as their budgetary constraints in municipalities (Mnguni, 2016). Good decisions produce better results, while bad decisions lead many municipalities towards qualified audits (AG, 2015). Qualified audits continue to represent bad decision making within local government. Fruitless expenditure through unproductive, unsustainable as well as spatial misplaced projects is among some of the leading contributing factors to municipal performance (Mnguni, 2016).

GIS technology has been widely used in various professional platforms such as maritime, aviation, weather, defence as well as educational (Waggin and French, 1990). As a result, GIS has become one of the best comprehensive tools for decision making across various industries (Esri, 2016). It has brought about diversity in the manner in which choices are viewed for planning and development. Through GIS, many

institutions are able to plan and align their plans accordingly through capturing, visualization as well as manipulation of spatial data (Campbell, 1992).

The poor performance of local municipalities in decision making indicates the need for comprehensive decision making tools that will allow municipalities to plan, measure, review and implement their projects. This allows municipalities to have a better understanding of the impacts of their plans. GIS provides access to tools and analysis that can lead to informed decisions to limit fruitless expenditure and project failure. In addition, GIS could ensure that decisions within local government are backed by data modelled in various ways to facilitate buy in from different stakeholders through better communication (Budic, 1993).

This study therefore considered GIS's role in local government and its ability to affect decision making for development planning projects. The study further filled in the gap between planning activities and decision making tools used. It provided a discussion on the role of technology such as GIS in ensuring that spatial developments have minor negative social, economic as well as developmental impacts. Lastly, the study presents GIS as a strategic tool for improving planning decisions within local government for better outputs as well as overall organization performance.

1.1.4 THE AIM OF THE STUDY

The aim of this study is to research on the potential of GIS as a decision making tool for development planning projects in local government by comparing municipalities in category B and C in Gauteng, who both have access to GIS.

1.1.5 RESEARCH QUESTIONS

This study will be answering the following questions (a) *what is the role of GIS in decision making for planning in local government?* (b) Secondly, *can the implementation of GIS as decision making tool improve effectiveness of local government planning?*

(c) *Can GIS be adopted as a decision making tool for local government institutions?* In order to address these questions, the study adopted the following key objectives that seek to address the research questions.

1.1.6 THE OBJECTIVES OF THE STUDY WERE AS FOLLOWS:

1. To investigate the role of GIS in decision making for development planning projects in local government.
2. To determine the effectiveness of GIS as a strategic tool for improving;
   (i) Operational effectiveness (ii) decision making effectiveness in local government.
3. To investigate the impact of the location of GIS within municipalities on its use and influence on decision making.
4. To contribute to existing knowledge on the use of GIS within local government planning.

1.1.7 SIGNIFICANCE OF THE STUDY

In 2015, the Gauteng Planning Division within the office of the Premier commissioned a survey to determine the use of GIS in all Gauteng municipalities (GPD, 2015). The survey intended to gather information on whether municipalities had access to a GIS and functions GIS played in planning and service delivery. The survey also sought to determine the types of GIS data existing and needed by these municipalities in order to carry their tasks (GPD, 2015).

The general results of the survey indicated that most municipalities in Gauteng have access to some form of GIS system, however in most municipalities the GIS was not fully functional. In other cases GIS was not located within the development planning directorate or departments that took strategic decisions on development. There is a legitimate debate on which departments should the GIS be located within municipalities. Secondly, what scope should the GIS cover in the context of local government institutions. This challenge is similar to findings of GIS implementation at local

government in American local government institutions in the late 1990s as recorded by Budic (1994) research on the introduction of GIS in local governments in the United States.

This study therefore explored the role of GIS as a decision making tool for development planning projects in the local government sector in Gauteng. The study sought to assess, compare and critique the current planning support systems employed in Gauteng municipalities or lack thereof. The study compared category B and C municipalities to ascertain the efficacy of their planning support tools as well as their use of GIS in planning. Key interest was put on the municipal planning process and decision making structures.

GIS and spatial information systems are becoming increasingly used across many municipalities in South Africa. However, the application of these tools as decision making tools is still lagging behind as most municipalities still view GIS as a mapping tool and nothing more is expected from it. There is a disjuncture in the understanding of the use of GIS and its application in other areas of local government planning functions. All planning functions have been bestowed to local government making it a good study area for the application of technology in planning and development of this nature.

In terms of section 42 of the South African Constitution local municipalities are responsible for all municipal planning functions which include Development Planning, local economic development as well as corporate investment projects within municipalities. There are various mechanisms and tools that municipalities use to drive economic and physical growth as municipalities continue to seek competitiveness both in the local context and internationally. Spatial Development Frameworks, Integrated Development Plans as well as Economic Development Plans continue to be used by municipalities to drive development. However, there is an existing gap in the planning process for more spatial analysis that can improve scenario building for better choices of projects, location and magnitude of projects through spatial analytics.

GIS as a technology, as a science, and as a tool presents opportunities for municipalities to create a multiplicity approach to development planning project which will lead to better decision making. This study will contribute to the conceptions of GIS by highlighting the inherent benefits of using GIS as a decision making tool for development planning and also various other municipal planning functions. The study also highlighted similar aspects between the local South African context as well as those of overseas local government authorities on GIS implementation.

1.1.8 STUDY AREAS

1.1.8.1 CATEGORY B: MIDVAAL LOCAL MUNICIPALITY

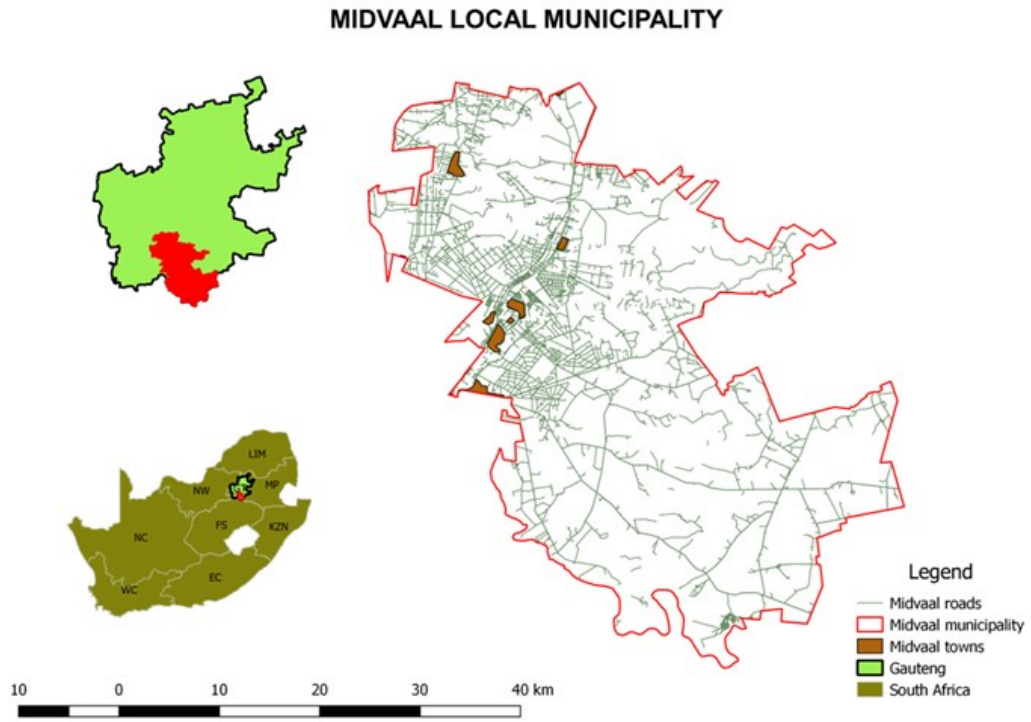


Figure 1: Locality map of Midvaal Local Municipality (Source: Mahlangu, 2016)

Midvaal Local Municipality is located in the Sedibeng District Municipality in the Vaal (South-East of Johannesburg). The municipality covers a total area of 1 722km² with numerous townships including Meyerton, Evaton and Walkerville. It is one of a few DA led municipalities in Gauteng. Midvaal Local Municipality has also been subject to

controversy with media reports of protest action (News24, 2015). The municipality has a population of 95301 people (Statistics SA, 2011). Midvaal Local municipality has been named as one of the best local municipalities in Gauteng with regards to the highest quality of life (GCRO, 2014). The Midvaal local municipality is one of the fastest growing economies in Gauteng ranking 23rd in the list of 231 municipalities in South Africa.

1.1.8.2 CATEGORY C: WEST RAND DISTRICT MUNICIPALITY

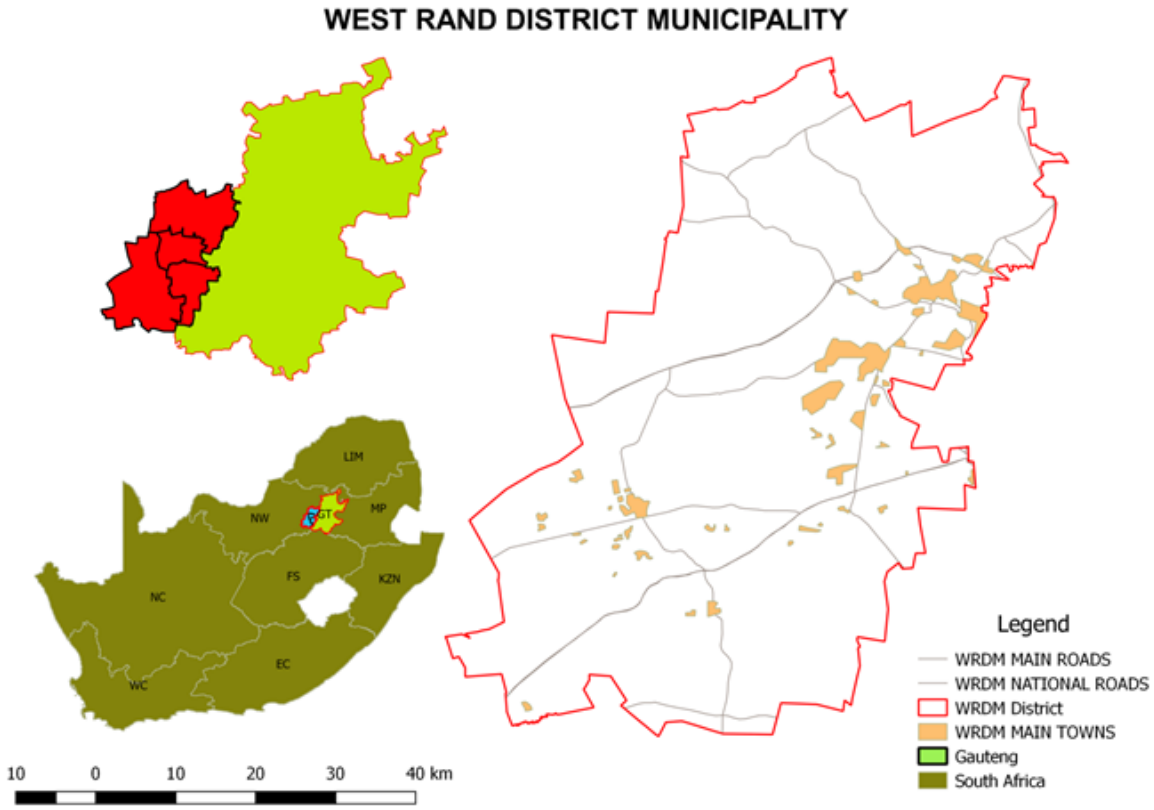


Figure 2: Locality map of the WRDM (Source: Mahlangu, 2016)

The West Rand District Municipality (WRDM) is a category C municipality that combines all the local municipalities of the West Rand which include Mogale City, Merafong and the newly formed Rand-West local municipality (amalgamation of Randfontein local Municipality and Westonaria local Municipality)(MDB, 2015). The municipality covers a total area of 4095km². The municipality is considered as one of the worst performing municipalities in Gauteng (AG, 2016). Numerous public protests have been recorded in its surrounding townships stating poor service delivery as well as corruption (Randfontein Herald, 2016).

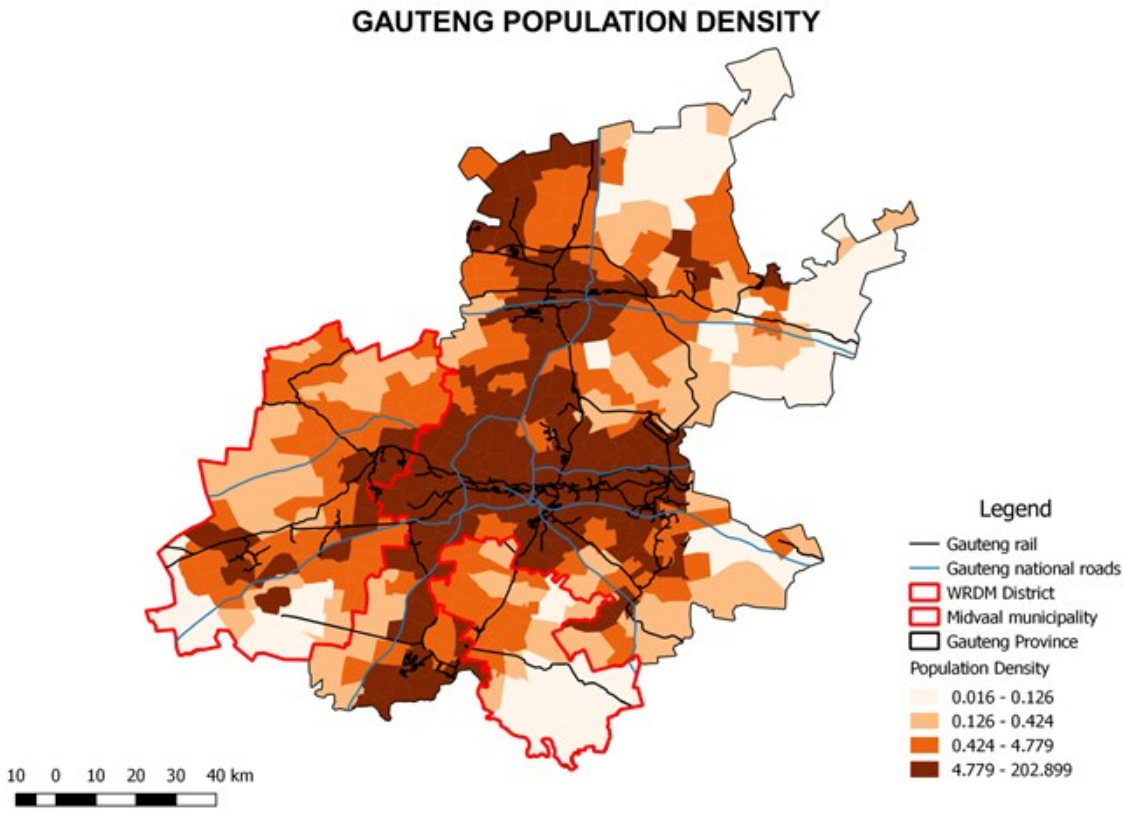


Figure 3: Gauteng population density (Source: CSIR, 2016)

Figure 3 is an indication of the population density distribution in Gauteng. The map reflects the relationship between population density and the study areas. Both municipalities are located on the peripheries of the most populated municipalities in the province such as the City of Johannesburg and sections of Ekurhuleni Metropolitan Municipality. The location of the study areas gives them an opportunity for being developmental regions as listed on the Gauteng TMR vision (GPD, 2014). Evidence of this can be noted from the Gauteng office of the premier's plan of implementing 'Mega Human Settlements Projects' within the West Rand as well as the Sedibeng District (GPD, 2014).

It is important to view the studies areas in the context of the Gauteng City Region as more development planning projects are directed to these areas from a provincial level. The Gauteng office of the premier has adopted the ten (10) pillar projects which prioritize both the West Rand and Sedibeng (GPD, 2014). These projects are aimed at streamlining development such as the Mega Human Settlements and Agri-Parks which

seek to activate economic activities in these regions. The rationale for the projects is also influenced by spatial planning and redistribution of developments within the province (GOP, 2014). The Gauteng office of the premier has viewed the relationship between the two regions with the most populated centers of the Gauteng City Region as an opportunity for spatial transformation. However, reviews of the progress of Gauteng on the TMR also indicated that both Sedibeng (where Midvaal falls) and the WRDM are lagging behind (Gauteng Industrial Forum Presentation, 2015).

1.1.9 DEVELOPMENT PROJECTS IN GAUTENG

The Gauteng province has adopted a developmental agenda that is aimed at transforming the Gauteng economy across its 5 identified developmental regions. The TMR approach Premier David Makhura has set a 10 pillar program to assist municipalities and private sector aligns their development plans towards the transformation, modernization and reindustrialization (Makhura, 2015).

The TMR vision for Gauteng is envisioned in an imbalanced Gauteng province as far as the 5 development regions go. Most of the metropolitan areas area developed and continue to attract various investment opportunities. However, the smaller regions such as the West Rand and Sedibeng fall behind in terms of development and growth. The poor performance of these regions can also be noted from the report of the auditor general (AG, 2014/15). However, within some of these regions there are some local municipalities that are performing well, these include examples such as the Midvaal local municipality under Sedibeng and Mogale City local municipality under the West Rand district municipality (AG, 2016). These two local municipalities were part of the few municipalities to get clean audits in Gauteng (AG, 2016). With these results in mind, it is therefore important to consider the efficacy of the TMR vision and the realization of its 10 pillar programme within the context of struggling local municipalities in Gauteng.

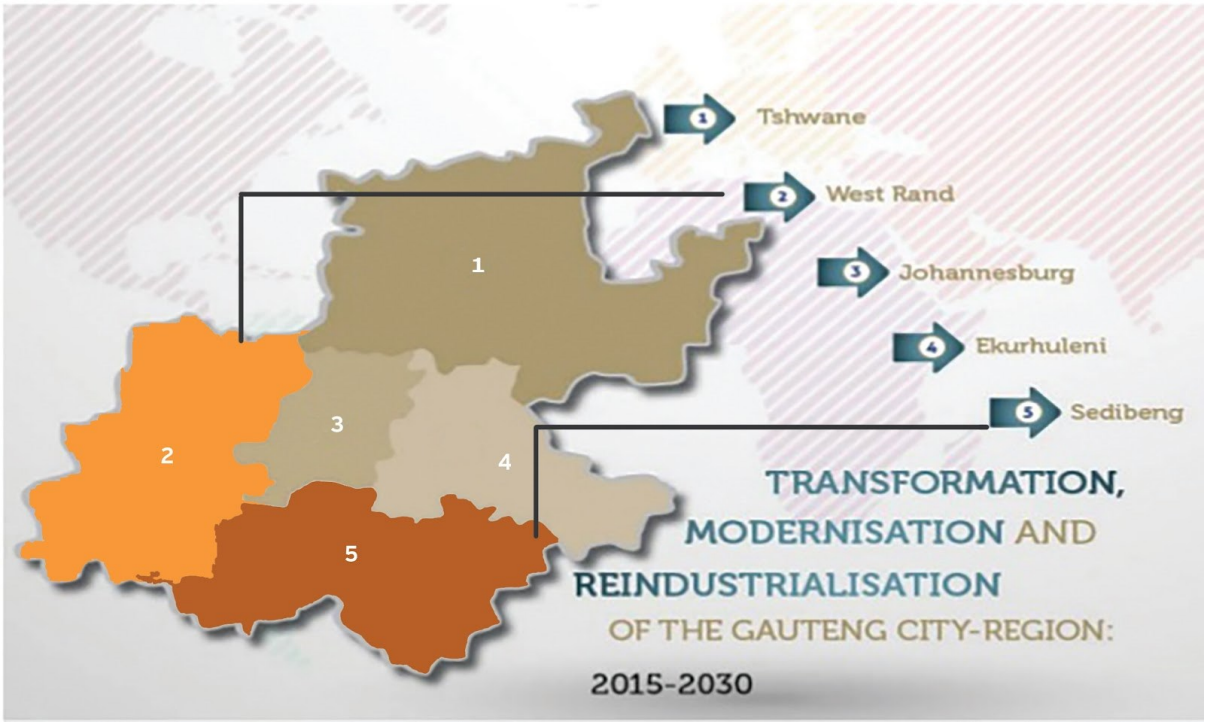


Image 1: Gauteng TMR regions (Seedat, 2015)

The image above represents the Gauteng TMR regions as identified on the Gauteng 2030 vision for the development of the province. The study areas for this study form part of the identified regions crucial to the TMR vision of Gauteng. This therefore places these regions as ideal cases for understanding the subject of decision making for development projects.

REGION	INDUSTRIES
Tshwane	Administrative capital, automotive sector, research, development, innovation and knowledge based economy
West Rand	Tourism, agriculture, agro-processing, Lanseria airport city & renewable energy
Johannesburg	Hub of finance, services, ICT and pharmaceutical industries
Ekurhuleni	Manufacturing, logistics and transport hub, aerotropolis of the GCR

Sedibeng	Vaal river tourism, logistics, agro-processing and urban agriculture

Table 1: TMR key industries per region (GDP, 2015)

Table 1 above gives a clearer description of the key industries planned for the transformation, modernization and reindustrialization of Gauteng. The table further indicates that the industries for Sedibeng (where Midvaal is located) as well as the West Rand have some similarities on industries. Agro-processing, tourism as well as agriculture are the main economic activities envisioned by the Gauteng government in both these regions. The similarities between the two regions give a fair case for the study as they are compared by the same industries and development projections. The TMR vision also means that development planning projects within the two regions will be taking place at almost the same scale.

1.1.10 CONCLUSION

The Gauteng Provincial government's developmental agenda driven by the TMR vision is a clear indication that the province will be promoting various development projects across its five main regions. Local municipalities in these regions will play a vital role in translating their projects through their IDPs into the 10 pillars presented by the TMR vision. It is therefore crucial that local municipalities such as the West Rand District as well as Sedibeng have the relevant development projects in place. Without sufficient planning support tools such as GIS and other decision making tools, planning for development may continue being a key challenge and barrier to the success of the TMR vision. In addition, poor planning and decision making on development projects will lead to increased fruitless and wasteful expenditure. Tools such as GIS provide municipalities with strategic aids for decision making on various elements of decision making such as location of projects, scale of projects, needs analysis, resources monitoring as well as development projections for forward planning (Goodchild et al, 1993).

1.2 OUTLINE OF THE STUDY

This research report is composed of six chapters which include the introductory chapter. The introductory chapter lays the foundation by introducing the study of GIS as a decision making tool in local government. This introductory chapter introduces the research topic, the problem statement, the research questions, the study's aim as well as the study areas. Lastly, the chapter gives a brief discussion on the impact of development planning projects in Gauteng in terms of the TMR vision of the province. The chapter concludes by making the connection on the study and the TMR vision of the province along with highlighting the development regions as identified by the Gauteng Planning Division.

Chapter two of the study gives a broader background of municipal planning and legislative framework from which planning happens. This chapter brings study of GIS as a decision making tool within the context of local government planning imperatives such as the SPLUMA Spatial efficiency principle which requires local government to make good developmental decisions timeously. In addition, chapter 2 gives a definition of GIS to be adopted in for the rest of the study by taking note that various definitions are existent. Lastly, for the purpose of the study, chapter 2 gives a working description of 'Development Projects' by covering what is meant by Development projects within the context of this study.

Chapter 3 of this report covers the literature review on GIS as a decision making tool by reviewing different aspects of GIS research. The chapter begins by giving a review of GIS within local government. This section reviews different aspects of GIS's role in local government from various contexts. The chapter also covers the various debates on perceptions of GIS and its role on decision making both in the private sector as well as government sector. The literature ties the application of GIS, how it is perceived as well as how it is used. It also reviews few cases where GIS was used for various strategic decisions in South Africa and the lessons learnt then. Lastly, the chapter gives the conceptual framework of the study as influenced by the literature review.

Chapter 4 presents the methodology used in this study highlighting the nature of the study, research tools as well as the methods of data collection. The chapter gives a thorough description of the tools used and the kind of data it collects in relation to the objections of the study. Lastly, the chapter gives an indication of the relevance of the methods used in relation to the similar studies carried in 5 United States local government agencies by Budic, 2007.

Chapter 5 presents the findings of the study and the discussions thereof, this chapter reflects on the results carried within the case studies as well as results from the review of critical documents. A discussion of the results of the study is also given in chapter 5. Lastly, chapter 6 offers a summary as well as recommendations for further studies given the results of this study. The research report is concluded with the entire reference list of citations.

CHAPTER 2

GIS IN THE CONTEXT OF GOVERNMENT PLANNING LEGISLATIVE FRAMEWORK

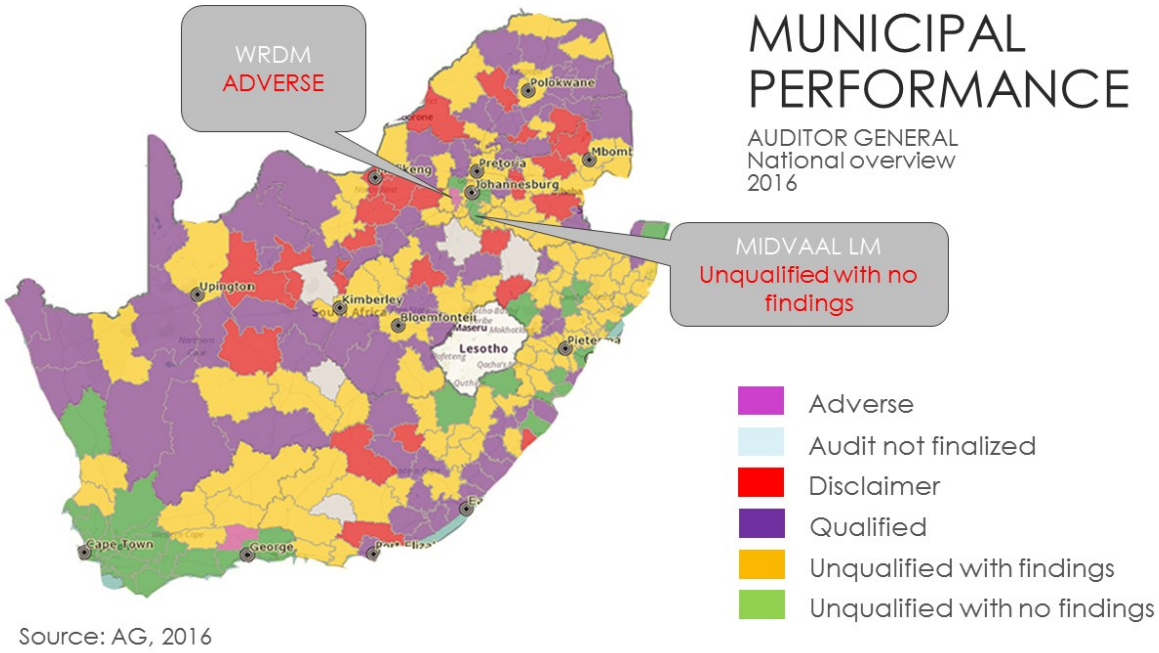
2.1. BACKGROUND

The Spatial Planning and Land Use Management Act (SPLUMA) had implications on the spatial planning and the implementation of spatial development projects for local municipalities in South Africa. Chapter 2 of SPLUMA sets out the main development principles of SPLUMA by which all municipalities should comply. Section 7 (e) of SPLUMA speaks to the principle of good administration in planning matters within local government, this principle is addressing elements around decision making and governance. Chapter 4 of the SPLUMA indicates the role local authorities must play in planning, measuring and managing spatial growth and sustainability through the implementation of spatial development frameworks which cover wall-to-wall boundaries of their jurisdiction.

The requirements of SPLUMA indicate that local government planning is a crucial vehicle for national spatial transformation as well as the redress of previous unjust development trends. As a result, it is crucial to begin the discussion on development planning by contextualizing it within the confines of the SPLUMA legislation. As discussed within the development principles of SPLUMA, good administration is considered a crucial element of development planning. This study therefore took into consideration that decision making falls within the principle of good governance. In addition, it can be concluded that good decision making within local government planning is a requirement by law. However the merits of this claim can be debated further on the interpretation of SPLUMA as legislation.

Most local authorities in South Africa fail in delivering primary services and most importantly development projects as a result of flawed decision making. Reports of fruitless and bad planning decisions relating to development projects often feature in the reports of the Auditor General as the main reason for unqualified audits. The reports of

the Auditor General reflect an image of a public service that is struggling in the entire country with over 90% municipalities receiving unqualified audits. The figure below is a representation of the national performance of local government according to the Auditor General's findings.



Source: AG, 2016

In Gauteng, there has been a general improvement on the performance in local government audit reports (AGSA, 2015). Results of the Auditor General's audit report indicated that between 2014 and 2015 most local authorities had failed to strategically plan, implement and measure the their development projects including infrastructure, housing as well as corporate investment projects. Two of the worst performing category B municipalities fall within the West Rand District of Gauteng.

Local municipalities in South Africa are governed through two coexisting structures. These include the executive team headed by the municipal managers as well as the political leadership headed by the mayors (COGTA, 2014). The executive management of the municipality is considered the party responsible for all technical planning with the ability to present or suggested projects and budgets to the mayoral committee. This however does not always take precedence. On paper, all development decisions must have been considered by executive teams and recommended to council for

consideration. It is there where planning support systems are required and used to aid decision making processes.

Geographic information systems (GIS) have been a crucial tool in decision making across the globe (Goodchild, 1996). Over the past years, GIS technology has grown beyond just a map producing tool into a comprehensive system useful across various industries (Goodchild, 1996). As a comprehensive technology, GIS has influenced decision making processes in many fields of government in the developed world (Wright et al, 1997).

Many professional fields are continuously using GIS related technology to better understand the environments which they are planning for. Research such as the quality of life surveys conducted by the GCRO is an indication of good outcomes of the use of GIS as a decision making tool (GCRO, 2015). Government and private sector institutions can align their projects and plans according to the outcomes of GIS analysis research such as the quality of life survey. The results of such tools may lead to better decision making. Many local authorities around the world have adopted GIS technology into their organizational structures to aid decision making processes (Goodchild, 1997). Goodchild (1997) argued that the adoption of GIS led to various personalized GIS tools and increase research on the use of GIS in Europe and the United States of America.

This study therefore finds an existing gap within the South African local government system in relation to decision making tools and mechanisms. Musakwa and Van Niekerk argued that GIS can be used as a multi-criteria decision making tool because of its ability to integrate other systems and variations of data (Van Niekerk and Musakwa, 2011). It is therefore important to view GIS as a multiplicity of tools working together to reveal the best possible scenarios for planning. One of the arguments in the earlier literature on GIS has been associated with the varying definitions of GIS which could be arguably influential in building perception on the capabilities of GIS.

2.2. DEFINING GIS

What then is GIS? There are many definitions of GIS, often influenced by the different areas of application which affected how scholars and researchers defined GIS. ESRI gives a more comprehensive definition of GIS. They defined GIS as a tool for visualization, questioning, analysing and interpretation of geographic data to understand relationships, patterns and trends (ESRI, 2016). This is a definition that covers the comprehensive nature of GIS. This definition provides a workable understanding of GIS as a tool for the context of this study.

Other definitions include Singh, 2004. He defines GIS as 'a system that facilitates storage and intelligent use of geographic data' (Singh, 2004). Singh continues to point out that GIS can be used to manipulate geographic data, input and analysed to land use planning, resources management, social impacts for better decisions (Singh, 2004). The definition adopted by this study comprises of aspects mentioned in both these definitions.

2.3 DEFINING DEVELOPMENT PLANNING PROJECTS

The term development planning can be used and understood differently if taken from a broad perspective. For the purpose of this study, development planning projects were defined as municipal development projects under the Development Planning Directorate. They can also be categorized as housing, local economic development and urban planning. The table below indicates the variances of projects under the above mentioned classification.

CLASSIFICATION	DESCRIPTION
Housing	• Housing development projects (Township establishments) • Informal settlements upgrading/relocation • Social housing projects

Local economic development	• LED hubs • SMMEs development projects • Agriculture projects (AgriParks) • Township economy projects • Small farmers projects
Urban Planning	• Development zones/districts • TOD/Urban revitalization projects • Infill developments • Land use planning and controls

Table 2: Development planning project classification

This table was informed by the classification of projects within municipal IDPs as well as the municipal annual reports. Both the IDPs and the annual report identified these projects within the classes stipulated above. This indicates that these projects are what are generally considered development planning projects within local government. These projects differ on scale, budget, location as well as their nature but all form part of strategic development interventions for their municipalities. They are also in line with the Gauteng TMR vision falling well under the 10 pillar programme by each class.

CHAPTER 3

GEOGRAPHIC INFORMATION SYSTEMS IN PLANNING

3.1 INTRODUCTION

This literature review focuses on the development of GIS as a planning tool in history by highlighting key areas which have contributed in the shaping of existing literature on GIS. Furthermore, the literature review engages with various concepts and theories on GIS and governance across various fields of study. Since its inception in the 1970s Geographic Information Systems as a technology has continued to affect change and impact on various applicable areas in governance (Cgang, 2003).

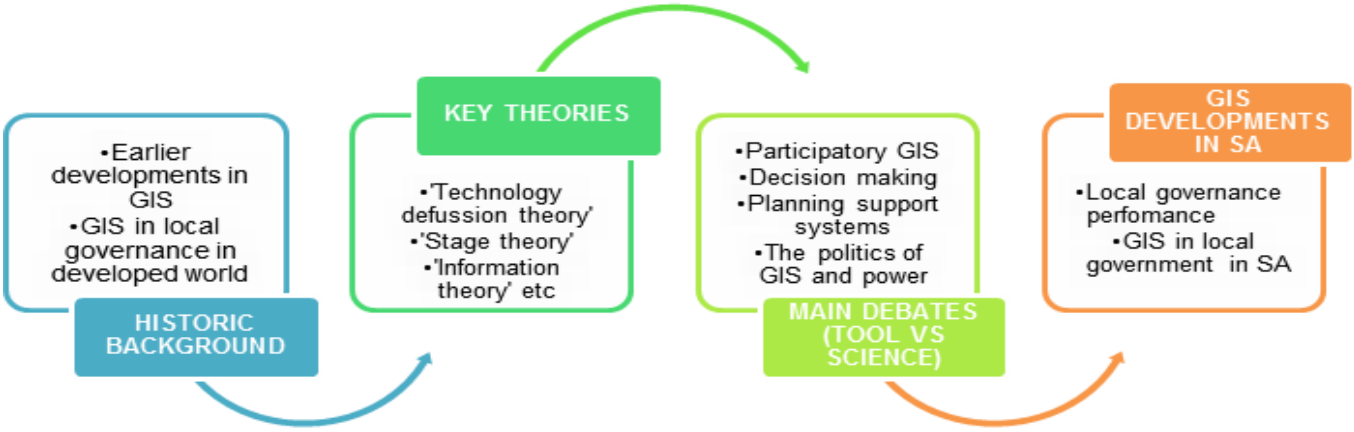


Figure 4: Approach to literature review

The diagram above illustrates the approach taken in this literature review by highlighting the key areas of focus the study used. GIS technology has been largely used in areas such as environmental management, military as well as natural resources management (Cgang, 2003). GIS has evolved into a dynamic and comprehensive tool cutting through various areas of application (Campbell, 1992).The success of the spatial applications of the Canadian GIS (CGIS) has been noted to have played an active role on the imagination of what a GIS could achieve (Goodchild et al, 2005). The technology grew from being a mapping tool for specific departments or state institutions such as the army

to be incorporated within various areas of governance; this is more prevalent within developed countries such as the United States and European countries (Goodchild et al, 2005).

The use of GIS technology in the developed world is at an advanced level compared to the developing world. Longley, 2015 makes an observation of the existing gap on the use GIS between the global north and the global south (Longley, 2015). The adoption of GIS technology in both America and Europe is assumed to be related to the technological advancement in both continents. This is also a notion shared by Budic 1994 and Bossler et al 2012. Both Budic and Bossler argue that technological advancement has an influence on the implementation of technological tools such as GIS, often affected by the cost factor (Budic, 1994 & Bossler et al, 2012). This notion suggests that poorer countries and more directly, local governments will either be advantaged or disadvantaged on technological advancements as a result of their financial capabilities.

Tough there is a substantial volume of publications on GIS and its use in various areas of study, there are generally limited publications on GIS as a decision making tool for urban planning (Bossler et al, 2002 & Budic, 1994). This literature review covers various stages of the development of GIS as a tool for planning and decision making. The study observed GIS developments in the international context and their influence on the use of GIS in South Africa. The literature review highlights the key debates and critiques of GIS as a technology as well as the contribution it has placed in the operation of certain industries.

In addition, the literature review also makes note of the key developing theories and concepts in the use of GIS as a tool beyond mapping and the perceived growth in the global competitive city space. Geospatial technologies influenced by GIS continue to shape the way people experience cities through the increase of connectivity via the internet and the internet of things. This is evidence that GIS is growing as a tool and as a science as new forms of GIS and applications develop.

3.1.2 GIS IN LOCAL GOVERNMENT

The development of GIS as both a science and a planning tool has since taken keen interest of scholars around the world with a lot of publications between the United States and Europe since the 1980s (Worrall, 1994). Various GIS research became prevalent in the late 80's which is proportional to the development and use of the earlier GIS systems as recorded by Thompson, 1990. According to Thompson, 1990 earlier GIS systems such as the Canadian GIS (CGIS) paved the way for the use of GIS at local government as it began transforming the use and view of GIS beyond just mapping but also as a spatial decision making tool (Thompson, 1990 and Goodchild, 1994). GIS use in local government has been documented in cities such as North Carolina, America in the early 1990s. Research on the use of GIS in North Carolina covered largely its impact on local governance in from a systematic and organizational perspective (Budic and Godschalk, 1994).

Budic 1994 documented the introduction and reception of GIS into local government as a planning tool and the limitations and highlights thereof. Budic quotes Campbell (1992) and Antenicci (1991) on the riskiness of innovation technology such as GIS in the local government space. She points out the fear of depending on technology for planning purposes as was eminent from city decision makers as well as planners themselves (Budic, 1994). It is debated that the fear and reservations on the use of technology such as GIS was mostly a fear of the changes in organizational structures to accommodate the use of technology.

Introduction of tools such as GIS could easily be seen as power changing tools (Antenicci, 1991). This is a familiar instance in the introduction of technology in areas primarily dependent on human decisions. It is therefore evident that the emergence of GIS in the American local government planning systems was met with much scepticism (Campbell, 1992). The observations of American and European literature indicate that there are two different development epochs between international government systems compared to the South African government system.

This research gap can be attributed to the development state of the America and Europe compared to South Africa and the emergence of technology as discussed above. The early 1990s presented a crucial era in the evolution of GIS as a tool in local government planning in America and Europe as cities were facing an increased technology innovation growing rate (Worrall, 1994). Worrall 1994 further argued that local government had to improve and allow for innovation as the phenomena of Information Systems (IS) was being realized and the need for integrated systems between GIS and IS.

Worrall points out the impact of increased use of personal computers on the accessibility of computers and costs (Worrall, 1994). Not only were computers more accessible but the use of computerized systems in local government were also becoming apparent and couldn't be avoided. The acceptance of computer systems in local government spaces is described by Budic as rather systematic rather than natural (Budic, 1993).

Budic, 1993's argument suggests that the view of GIS as a tool in local government was possible through the '*Innovation Diffusion theory*'. This is a theory presented by Roger, 1983 which suggests local authorities need to be defused into the acceptance of innovation technologies as aids for planning decisions in local government. Roger argued that local authorities were heterogeneous businesses that needed to be open to innovation in order to deal with the complex urban development pressure (Roger, 1983).

The use of technology to enhance local government activities therefore needed to be a decisive and strategic action. Local authorities needed to see the value of technology integration into their general functions. The innovation diffusion theory is one that is arguable implementable across different industries and not only local government (Roger, 1983). Roger argues that in a bid for organizational transformation, institutions and companies need to align themselves with technological advances to remain competent and relevant (Roger, 1983).

The pressure for technological inclination was not merely on a GIS level but also the growth of internet and telecommunications as well as their impact on the manner business was conducted. Wise and Heining, 1991 argued that local authorities were more concerned with using GIS for the management of spatial data than spatial analysis. This meant GIS was not fully realized as a strategic decision making tool until the late 90s. The argument also meant that GIS technology was not used at a strategic level for decision making but at an operational level and in most cases geographic mapping (Budic, 1994). The strategic use of GIS could only improve with the realization of what GIS could do and the types of data that it can represent. Planners had to play a critical role in channelling the GIS knowledge and skills into strategic local government processes within their organizations (Budic, 1994).

The technological revolution and the commercialization of computer technologies allowed for the realization of the *Innovation diffusion theory* to allow for the familiarity of GIS at both macro and micro level of local authorities (Budic, 1994). Parallel to the introduction and resistance for innovative technologies in planning were the ideologies of value adding technologies in traditional planning systems. GIS as a key tool in local government planning was clearly a game changer and presented American local government agencies as well as those of European with a bigger challenge to adapt while studying the value addition of GIS (Klinskey, 2002).

GIS technology was being implemented in a complex environment driven by political ideologies and varying interests from citizens. Therefore GIS implementation needed to cover all stakeholder interests and been ‘seen’ as a mediating tool rather than an unjust one (Klinskey, 2002). This is a notion that is shared by McGrath, 2008. He argues that planning support tools such as GIS need to provide a comprehensive view of the situation being planned for (McGrath, 2008). This argument is relevant with GIS as it is a comprehensive tool that can combine different aspects of planning problems (Smith, 1992). Smith 1992 presents an argument of the ability GIS has in empowering stakeholders through its information dissemination abilities (Smith, 1992 & Wright, 2001). The output of GIS is the empowering advantage through maps and analysis results of data.

As a result the introduction of *'new ways'* of doing local government business was always met with great scrutiny (Budic, 1993). The awareness of the full potential of GIS as a tool for spatial analysis was very limited but being widely researched (Wise and Heining, 1991). Drawing from earlier international literature it is notable that the use of GIS as a tool has grown into different industries and trades across both government and the private sector.

The earlier introduction of GIS technology and academic research on its impact has allowed for the growth of related technologies in planning (Wright, 2001). The move away from seeing GIS as a mapping tool has led to its adoption in local government as planners realized the complexity of the environments being planned for (O'looney, 1998). The adoption of GIS in the western community drove the development and improvement of GIS based spatial analysis tools (Worrall, 1994). Worrall indicated that some local authorities in the United States began to develop their own custom GIS systems that would aid their planning functions at local level and later at a city wide scale as planners employed spatial analysis tools and strategic management (Worrall, 1994). This assertion is shared by Budic in her studies of the impact of GIS in American local authorities.

Studies of GIS as a decision making tool in governance are proof that the technology has a significant role to play in promoting good governance. The studies and arguments presented by Budic, 1994 and Worall, 1994 are evidence that adoption of GIS as a decision making tool can be beneficial. The study of GIS as a decision making tool in local government in South Africa is therefore conducted within this existing body of literature. The literature review above highlighted the significance of GIS as a tool for planning decisions. It debated impact of understanding GIS from a comprehensive perspective which can influence the perceptions of users and local government agencies on its use. This study is therefore based on the conceptions of GIS built by the arguments of GIS arguments presented here.

3.1.3 THE POLITICS OF GIS, A PARTICIPATORY APPROACH TO GIS USE

The practice of urban planning is undevout of politics in that it can represent ideas and disagree with others. Therefore the very practice of planning is a political action, as a result, any tool that enables the practice of planning such as GIS is perceived to be political in some sense. Much of the rejection and critic of GIS in governance has been related to the perceptions of its ability to shift power (Antenecci et al, 1991). The argument of power is presented from the perspective of access to information of some while some are excluded. (Antenecci et al, 1991) argues that access to information empowers those with it whilst it disempowers those that have no access (Antenecci et al, 1991). This notion can be related to stock market traders who study the markets data and react before the masses know what the markets will experience.

Similarly so within a planning context, developers and politicians thrive on the bases of the information they are presented with. This gives them an upper hand on social and economic elements of their society. As a result, they hold more power than general citizens who are not informed. It is undeniable that GIS can shift and impact the roles of power within a planning context and particularly within local government planning. However, in the past years various developments within GIS studies and practice, various forms of participatory GIS have also emerged (Azad, 1990). The developments in open data, big data as well as open source GIS software such as QGIS and PPGIS has allowed social movements empowerments through the use and awareness of GIS as a strategic tool for communication of ideas (Budic, 1993a). These developments are supported by works such as (Easo, 1988). The study of ‘GIS as an unti-politics machine’ is to be noted as challenging previous assertions of GIS as a political technology (Lupton and Mather, 1997).

GIS applications in some American States counties have been affected by the socio-political state of their contexts (Budic 1993 and Winning 1994). The success of GIS use has been influenced by how society perceived its impact on decisions and planning functions of local authority (Campbell, 1992). Planning functions needed to be representing the interests of all stakeholders. Planning functions could no longer be

driven from a top down approach but needed to be more inclusive. Campbell (1992) introduces the argument on the impact of social movements by highlighting the construct of the British society in terms of governance. He argues that the society is organized around social systems with consist of people and organizations with their individual values and motivations (Campbell, 1992). These differences represent different priorities for local government institutions. Another key challenge to note is the fact that these different interested parties do not assume that local government officials are working towards their goals. Therefore local authorities had the duty to convince citizens that their plans where in their best interest. The result of such competing interests led to constant competition for the representation of interests by the different groups.

Inclusive decision making in local authority planning activities is believed to have led to a local government that is negotiated to better address the interests of each group (Ceccato, 2000). It is in this context that Campbell situates the role of GIS technology in local government planning. He further highlights the symbiotic relationship between technology and the organizational context in which it is embedded (Campbell, 1992). Campbell argues that the definition of GIS is perhaps one of the key elements in enabling adaptation of it in local governance. This argument is driven by the perception that a good understanding of a technology may lead to its correct use. People will respond better to technology if they fully understand its abilities and how it would improve their lives.

It is from this foundation that he builds a further argument that GIS is only effective if the organization fully understands its role and can implement it corporately (Campbell, 1992). Local authorities are public institutions which form a direct contact between state and citizens due to service delivery and basic administration functions. Therefore the implementation of technology such as GIS should be implemented to assist local authorities in exercising their core functions. Therefore social perceptions on such tools as GIS will affect their efficacy in local government (Pavlovaskaya, 2006).

It can be noted as well from literature that most metropolitan municipalities are more advanced on their use of GIS technology. This is a similar case within the South African context as most metropolitan municipalities have adopted a corporate GIS platform. Corporate GIS allow an organization to foster towards strong intergovernmental relations while improving organizational goals and objectives (Johnson & Walker, 1997). Organizations will only pursue corporate GIS if they understand its contribution to the functions of the organization. This is crucial as these organizations need to understand the monitory value of GIS before they could budget for it and understand it as an investment. However, in the British local government system GIS has helped with the unifying of various data within organizations improving decision making from a multi-disciplinary perspective. This is what Gault and Peutherer (1989) deem as 'Rational Decision Making Procedures' which has helped improve tendering and budgeting within local government (Gault and Peutherer, 1989).

3.1.4 THEORIES AND CONCEPTS OF GIS ADOPTION IN LOCAL GOVERNMENT

NOLAN's STAGE THEORY

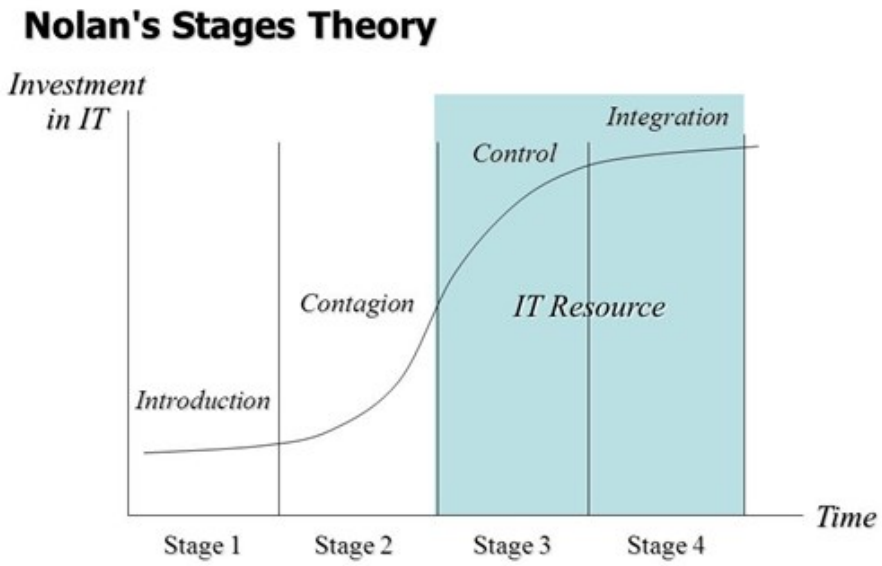


Figure 5: Nolan's stage theory (Source: Ching, 2005)

The stage theory as introduced by Richard Nolan, focused on the evolution of computing and information systems within organizations in the age of the technological revolution. The theory assumes a position of decoding the nature in which organizations gradually increase their dependence and use of technology. Nolan studied three organizations which helped him frame his debate on the stage theory (Nolan, 1973).

There have been a large number of publications on the stage theory and its realization within organizations and the ITC. Much like any other theory, there are also some critiques on the assumptions and efficacy of this theory in a practical environment (O'Flaherty et al, 2005). There are however some crucial elements of the stage theory that have proven to be consistent with findings on the development of technology within organizations in the developed world. This also relates to the implementation of GIS in America as recorded by Dueker, 1990.

GIS use in local government is perceived as an incremental process which is made successful by the organization's critical stance on computer systems and innovation in

their daily functions (Dueker, 1990). Goodchild et al, 1990 argues that organizations in America have undergone various stages of implementation of computer systems including GIS. These stages are arguably identical to the stages as discussed by Nolan in his stage theory as indicated on figure 5 above. Both Goodchild and Deuker agree that GIS is a comprehensive tool within local government planning which takes time to be fully implemented (Goodchild et al, 1990 and Deuker, 1990).

One of the constant arguments in their writings focus on organizational change which gives way for 'new ways' of doing business for local authorities as argued by Budic, 1993 earlier. In their discussions, it is evident that organizational change is difficult but necessary for improvement. Therefore Nolan's stage theory offers an incremental, staged process by which computer systems may be accepted in these complex environments (Dueker, 1990). Nolan's stage theory focuses on four critical stages of computing in organizations. The table below describes the stages as conceived by Nolan.

NOLAN'S FOUR STAGES		
Stage 1	Initiation	• *This stage represents the initiation stages of computer adoption/this could represent GIS implementation as well. Usually involves the acquisition of hardware.* • *The beginning stages involve low profile tasks and few departments* • *Usually early problems are identified during this stage.*
Stage 2	Contagion	• *At this stage organizations make efforts to increase the use of computer/GIS* • *Organization's management gives support as the impact of the computer systems/GIS is realized* • *There is usually an increase in costs as more investment is required.* • *Clearer ideals of functionality are drawn.*

Stage 3	Control	• *At this stage, organizations have a better understanding and control of the computer systems/GIS.* • *New policies and management of the systems are created* • *Expenditure is more under control* • Control and responsibility is made clear within the organization, therefore centralization is eminent.
Stage 4	Integration	• *Control is refined at this stage* • *Organizational adaption and resources are structured around the technology* • *Developments of the computer systems/GIS to fit organizational expectations and needs take place.*

Table 3: Nolan's stage theory (Deuker, 1990)

The consideration of Nolan's stage theory in the context of GIS is taken on the assertion of GIS as a crucial technology in governance (Goodchild, 1997). As a technology GIS offers key opportunities for organizations and companies alike. Therefore it is important to view how local authorities around the world have dealt with the introduction and adoption of GIS technology within their institutions. Evidence from the works of Budic, 1993 and Klinskey, 1994 provide crucial evidence that the introduction of GIS technology in American local authorities and some European local authorities involved an incremental approach (Johansen, 1994).

Nolan's stage theory also provides insights why some local authorities in the United States where beginning to develop their own customized GIS systems (Budic, 1994). It is evident from observing the description provided by Deuker (1990) that most of these local authorities were already on stage four. They now understood the role GIS played within their organizations leading to customization of the technology to suit their operational needs. This also proves the argument presented by Goodchild that successful GIS is dependent on organizational change to accommodate GIS within decision making structures (Goodchild, 1997).

Goodchild further argues that organizational changes should be aligned with decision making structures. His standpoint on this assertion is based on the notion that a well-defined decision making structure can lead to a successful GIS implementation within an organization (Goodchild, 1997). In his discussion, Goodchild discusses the impact of stage four of Nolan's theory by indicating how better understanding of the computer system or GIS within the organization leads to the clear controls needed for its success. These controls includes the centralization of the GIS within a specific department in the organization.

Deuker (1990) supports this notion by pointing out that most local government institutions in America had dedicated GIS to the natural resources departments within their organizations (Deuker, 1990). Goodchild argues that this may not be an easy task as all stakeholders require access to the GIS system. It is therefore clear that the earlier notion of GIS as a comprehensive tool is true. Nolan's stage theory represented the systematic and incremental manner in which GIS technology was introduced into highly complex local government spaces in the developed world. Though the theory has its own critiques, it is important to note the complexity of the environments to which GIS is applied due to systematic as well as structural contexts. Therefore an incremental approach as a means to defuse the use of technology such as GIS is essential.

3.1.5 GIS AS A PLANNING SUPPORT SYSTEMS (PSS)

Planning support systems (PSS) are an area of interest in recent literature on planning and management of planning projects (Brown and Brudley, 1993). At the core of these planning support systems is the ideal for providing planning tools that will guide and improve planning decisions within local government planning departments. There are many varying definitions on what planning support systems are and their impact on planning. Goodspeed (2016) defines these systems as infrastructure for analysis, design and evaluation for planning specific contexts. There are many discussions on the definitions of these planning systems, it can be understood that some of the definitions are influenced by the nature in which planners and scholars experience these systems

in their context. Geertman and Stillwell (2003) argue that planning support systems are geo-information instruments used to support specific parts of professional planning tasks. Geertman and Stillwell's (2003) attracts the discussion on the spatial nature of planning projects and the need to spatial tools to create better solutions and decisions for planners. It is clear that spatial tools provide spatial alternatives for planners to compare.

The role of planning support systems can be summed up into key interventions necessary for decision making with the planning profession. However, PSS go an extra mile by providing systems education for all parties involved within the planning process. This notion is supportive of the collaborative planning theory of planning as discussed by Healey (1997). Healey (1997) argues that learning is one of the critical components of collaborative planning in its attempt to build consensus. It is also clear that though these planning support systems are driven by innovation and solutions finding, they are still embedded within existing planning theory allowing them to drive planning agenda within a theoretic rationale.

3.1.6 GIS & SPATIAL DATA INFRASTRUCTURE (SDIs) FOR LOCAL GOVERNMENT PLANNING

Barlett et al (1994) argue that more European countries are using GIS since the 1990s which has increased the access to timely, reliable and appropriate spatial data. As a result, the EU has funded various initiatives on SDI (Spatial Data Infrastructure). Local government as a key branch of national government is the best place for the diffusion of GIS technology and other information technologies in governance. This allows for the development of the technology to take a ground up approach. The evidence of this can be seen on the nature of GIS in local government in Europe where GIS formed part of the information management strategies of local government.

This allowed the GIS to be developed within the confines of the organizations allowing for better organizational alignment of GIS as a tool. Barlet et al (1994) argue that GIS is one of the fastest growing branches of information technology. In addition, Daratech Inc. estimated the total cost of GIS to a sum of 2 billion dollars in 2004. This amount is

presumed to have more than doubled in 2016 given the access and development of GIS and its demand. The other critical observation from Barlett et al (1994) is the declaration that in Europe central governments as well as local government agencies remains some of the biggest users of GIS.

It is important to understand the impact of GIS technology and its ability to influence certain decisions especially as planning support systems for planners. There are various planning support systems used to inform strategies and budgets for cities, this is the crux of the study at hand as it attempts to understand the role GIS can play on informing relevant decisions for development planning projects.

3.1.7 GIS AS A STRATEGIC PLANNING TOOL

There are many lessons to be gathered from literature on GIS incorporation into strategic management structures in the international community (Wiggins, 1993). It is evident from the literature that GIS has presented an opportunity for measuring the efficacy of government plans to begin with (Goodchild, 1990). Therefore the notion that GIS could reduce the grasp of the government in the wake of a smart innovation is yet to be proven correct. Drawing from the ideologies of the diffusion theory (Wiggins, 1993), Wiggins refuted that the macro level diffusion in local government happens when local municipalities acquire GIS or any other innovation technological tools.

To understand this notion one needs view the South African local government planning systems as if it were during the 1990s America to deal with the 20 year development gap in the use of GIS. There needs to be an understanding that GIS adds value to the traditional models and techniques of planning than taking away power from governance. In the context of the American local authority planning systems of the 1990s, there was very limited awareness of the potential of spatial analysis in improving strategic decision making (Wise and Heining, 1991). However once GIS was adopted as a planning tool, it was used at a strategic policy level and drove perspectives and decisions (Roger, 1983).

The literature review will attempt to draw from the current debates on whether GIS is a science or a technology and how these views affect the use and incorporation of GIS in local government institutions. In addition to these key factors the literature review will aim to cover some of the emerging and prominent concepts in GIS operation in comparison to the politics of GIS and its ability to shape power in the planning environment.

In conclusion, the literature will make a case for GIS as a comprehensive tool for decision making in various areas of planning because of its ability to combine different aspects and consideration during decision making processes. Kliskey (1995) introduces the debate of bottom up GIS by touching on the availability of various GIS platforms allowing people access to the planning process against the misconception of GIS being a separate process in the planning space. She argues that GIS is getting cheaper and more affordable to implement compared to its earlier days. As a result, she asserts that planners should use GIS more cognitively. One of the strongest views she presents in what she deems the 'alternative view to GIS' which challenges the traditional approach to technology from a top down approach.

Kliskey (1995) notes that the integration of GIS into planning process in the United States has almost become standard practice in local government (Budic, 1998). Weiner and Harris, 1998 argued that GIS based decisions marginalized local knowledge in that it was only empowering those that were planning. However, it is clear from Kliskey (1995) disproves this notion by introducing the concept bottom up GIS which is an alternative to the top down technician driven GIS.

The ideals of a bottom up GIS are such that communities are allowed to interact in decision making processes and information and knowledge could be shared through GIS. The concept of bottom up GIS suggests that communities can be involved through participatory planning approaches which are promoted by emerging GIS systems such as BUGIS (Shiffer, 1994). BUGIS allows residents to use GIS in communicating how they perceive their communities and neighborhoods to planners and city officials (Kodmany, 1998). In other words, systems such as BUGIS can assist communities in

articulating their needs better for planning purposes by allowing them to paint a spatial picture of their perceived needs. Graham & Marvin (2012) introduce yet another imperative component and key theoretic turn in the academic debate on GIS and technology. Their discussion focuses on the impact of technology in planning by addressing the emergence of cyber space in the city. This notion if highly driven by the acknowledgement that society today is much more information driven through internet and the internet of things. Graham and Marvin introduce the terms 'information society' as well as 'network society' to elaborate the nature of connectivity of citizens as well as the culture of data or information sharing within cities.

More data is now available in cities as well as the number of data consumers from both business and private individuals. This has shaped how people interact with space and their surroundings. Mulgan (1991) perpetuates this notion by arguing that information technology and telecommunications are becoming the sinew of our society in a real sense (Mulgan, 1991). The discussion above can therefore be summed up to be introducing the concept of 'cyber spaces' within the city. There is a growing interest in literature on the impact of these cyber spaces on the way cities grow and the distribution of land use activities.

It is undeniable that cyber spaces transformed the manner in which most American and European city spaces where used and experienced. The introduction of telecommunication technology and the growth of the internet transformed how businesses conceptualized the provision of services to their clients as well as the manner in which their clients interacted with them. As an after impact, these changes began to change city spaces and gave a spatial translation (Castells, 1996).

Drummond and French (2008) argue that the increased use of GIS in many cities is also influenced by the increased affordability of the technology. In addition to the impact of affordability, accurate and high resolution data has made the case for GIS more pragmatic for major metropolitan centres as they depend of quality data for decisions. Drummond and French (2008) further argue that most Metros in the United States have access to GIS and that GIS allows these metros to have access to key geographic data

such as demographics, cadastral as well as environmental data. This is again a notion that is presented by Harris, (1989). Harris (1989) argues that there is an increased use of GIS within US metros. However he notes with great intent the mismatch between planning and GIS by highlighting the existing gaps between what planners do, and the functions of the GIS. His argument is that planners still saw GIS as a plan making tool than a management tool which could be used for decision making (Harris, 1989). Harris calls for planners to have a shift of mind in their view of GIS. In observing the discussion brought by Harris, it is evident that the debate was driven by his realization of the potential of GIS in affecting decisions and adding value to the planning process of metros in the planning processes. This debate is crucial in literature as it opens up the discussion on the comprehensive role of GIS as a tool for decision making than the traditional view of GIS as a tool for making maps. It is upon this discussion that this study finds its significance.

The use of GIS in local authorities for merely highlighting land uses, street addresses as well as other non-strategic functions is in actual fact an underutilization of GIS. Klosterman, 2001 makes a case for GIS as a planning support system as it can incorporate economic, demographic and land use data for better forecasting of city growth and development. The use of GIS is also viewed by Klosterman (1992) as a means to democratize information.

Klosterman (1992) sums up the input of GIS on planning in these three key aspects, according to him planners can gain great impact in (a) analysis, the analyzing of geospatial data can allow planners the ability to make informed decisions through the engagement with fundamental data and data stories. (b) Design, this aspect of the GIS is also seen as a crucial element that can gain from the results of spatial analysis. Planners and Urban Designers can better engage with their environments with improved spatial representations along with urban simulation techniques.

These opportunities could allow planners and decision makers' access to crucial insights before major development decisions could be implemented in other cases even the arrival to conclusions could be impacted (Guhathakurta, 1999). In addition to these

are the opportunities to create traffic impact models, storm water models, social impact models etc. In conclusion, GIS can allow planners and decision makers alike the opportunity to evaluate various alternatives for development proposals perhaps in real time in other cases.

GIS is a robust planning support system and can advance the understanding of alternatives as well as the calculation of consequences. Developments in GIS as a tool and technology have led to the ability of GIS to produce 3D models and visuals allowing planners and developers the ability to visualize development scenarios (Drummond and French, 2008). These 3D models of GIS scenarios can also create better opportunities for negotiations between neighbourhoods and city officials.

3.1.8 GIS AS A TOOL IN SOUTH AFRICA

Studies of GIS as a planning and decision making tool is very limited in the context of South Africa. Fewer scholars have researched on the use of GIS and earth observation technology in the context of South Africa (Van Nie Kerk, 2010 and Musakwa 2011). Similar challenges as those documented by Budic (2007) in the introduction of GIS at local government level are experienced in South Africa at the present moment. Many local authorities have some access to a form of GIS whilst a large number of local municipalities especially those further outside of cities continue to operate without any access to GIS and other key resources (SACN, 2011).

Literature and research on GIS has been on an incline since the early 2000s with many scholars particularly in Geography documenting its contribution in various areas of study. Studies such as the impact of mining on the environment in the Highveld, Mpumalanga in 1998 began indicating the benefits of GIS technology in planning (Pristorius, 1998). This kind of literature made it rather easier for science and technology scholars to begin engaging with what GIS could do especially in the area of resources management (Chan, 1997).

Contrary to the rural and smaller towns in South Africa, major cities and municipalities in places such as Johannesburg and other major cities seem to have an upper hand on GIS and information systems technologies (Mokoena, 2016). These disparities present a picture of a divided South African local government system. It can be argued that this is a reflection of the infrastructure development gaps in South Africa (SACN, 2011). Even though the use of GIS is noticeable around urban municipalities and major cities, there is still a large gap between GIS functions and what planners do (Odendaal, 2013). This gap is also translated in the operation of local municipalities and their decisions on spatial development and planning. GIS use appears to be an operational level rather than a strategic management level (GPD, 2015).

Odendaal (2013) has looked at the efficacy of information technology in the South African government context. Her observations suggest that governance will be affected by the growth of technology and the concept of e-governance. She argues that in the coming few years as cities in South Africa strive towards global competitiveness and connectivity there will be more dependence on technology such as GIS (Odendaal, 2013). Odendaal further argues that government needs to adopt innovative ways of governance and planning support tools that will aid planning and governance in the digital era (Odendaal, 2013).

Odendaal's argument is supported by various studies indicating that the South African population is increasingly becoming digitally (Worldwide worx, 2014). Business Research on the infiltration of smart phones in the South African also proves that there is an increase in digital dependence for the general population (Worldwide worx, 2014). The results of these studies indicate that more and more South Africans are digitally active. Therefore government needs to align itself strategically to maintain communication and service delivery.

Odendaal continues to ask the question whether the relationship between state and nation is being weakened by the technological innovation (Odendaal, 2013). The question by Odendaal is consistent with the findings of the studies by Zorica Budic and other scholars of the late 1990s American local government and GIS. Similar responses

in literature were noted as various researchers queried the political nature and power shifts presented by GIS in the local government system (Goodchild, 1990). Central to this question is the idea that (1) citizens want to engage with their government during planning decisions. (2) GIS presents an opportunity of power play as those with information always have an upper hand (O'Flaherty et al, 2005).

One of the key issues presented by Odendaal is the view of technological innovation in local governance being a double edged sword. On the one hand it presents opportunity for smart governance and citizen engagement whilst on the other hand it reduces the meaning of traditional government or governance (Odendaal, 2013). The question however becomes, should the role of technology such as GIS be completely avoided in local governance out of the fear of compromising government control? This argument is evident almost 2 decades later than Budic and other scholars asked the same question in the American context (Budic, 1993a, Campbell, 1992 and Godschalk, 1993).

This is the proof of the development gap in this study and its context. As a result, the literature review on the subject has to juxtapose late 1990s America and early 2000s South Africa. It is an indication that research in this subject must increase to contextualize the same study within the South African. Though there will be similarities in the studies there will be differences as well as South Africa is different economically, socio-politically as well as spatially.

There is limited focus on GIS as a decision making tool especially at local government level. As discussed above, the results of the Gauteng Planning Division survey on Gauteng Municipalities indicated that local authorities have access to GIS but limit the use of GIS in their strategic decision making process but rather use it at an operational (GPD, 2014). However, a few research projects completed in South Africa present theories and techniques of using GIS for strategic planning decisions (Van Niekerk, 2013). Adrian Van Niekerk studied the benefits of using GIS and other Spatial Planning Support Systems to determine growth potential in the Western Cape.

3.1.9 MEASURING POTENTIAL GROWTH IN THE WESTERN CAPE

Van Niekerk's research demonstrated the potential GIS presents in providing insights into which strategic decisions can be derived. Van Niekerk further demonstrated that the growth potential theory alone was ill structured and needed the aid of other tools to determine growth potential arrears (Van Niekerk, 2015). In his study, Van Niekerk further argued that the ability to measure these growth potential areas through GIS and other tools can assist local authorities decide on the correct areas to direct investment projects and interventions as well as infrastructure (Van Niekerk,2015).

These GIS tools can assist local municipalities spend their budgets on fruitful projects as well as get a return on their investment as compared to the currently used models (Van Niekerk,2015). This notion was also mentioned by Handerson and Wang (2007) with the argument that well located corporate investment and infrastructure projects will have a positive socio-economic impact if they reach the areas with high growth potential. They argue that strategic decisions to promote particular types of developments in specific areas require accurate and timely information. This is where tools such as GIS and their analysis functions can assist local government in decision making to ensure that the spatial location of their corporate investment projects as well as infrastructure projects are in areas where they will enable growth (Van Niekerk,2015).

GIS could therefore provide the guide through spatial analysis for policy directives that will allocate investment projects in areas of real potential. Through GIS analysis, investment strategies and decisions will accelerate development if placed well (Van Niekerk, 2015). GIS has more potential in gathering the relevant data for decision making through its comprehensive nature. When considering the comprehensive nature of GIS, it is critical to note how GIS consolidates various tools and as well as its ability to work along other processes and methods of analysis. Musakwa gives more insights on the use of GIS and earth observation technology in mapping spatial change and land use changes where there was no primary data (Musakwa, 2013).

In his research on Stellenbosch, Musakwa demonstrated the use of GIS tools to collect data which informs public policy on land use changes therefore adding value to the strategic decision making process (Musakwa, 2013). The studies and findings of Musakwa and Van Niekerk are located well in the context of the GIS state in South Africa and need to be supported by studies such as this one in enquiring the perspectives, use and development of GIS at a local government level.

Though they point out strategies and solutions for using GIS as a strategic tool, they assume that there is a common understanding and use of GIS in the local government context. Another short coming could be the fact that the location of the GIS within a municipality has not been engaged with. Similar studies by Kinkskey indicate that this has had influence on the successful use of GIS in the Britain local government system (Kinkskey, 2005).

Therefore this study fills the gap between the proposed strategic applications and use of GIS and the actual applied areas of GIS use in local government, specifically as a decision making tool for development planning projects. The improvement in local government decisions could play a crucial role in the improvement of municipal performance and the use of resources through better decision making. Technology and development in Africa remains one of the highest growing areas of study in literature looking at emerging economies and the concept of developmental states. It is estimated that most of African cities will urbanize in the coming decades with one of the youngest population in the globe (UNHABITAT, 2013). Parallel to these studies and estimates is the level of technological advancement in Africa.

More and more people are getting access to smart technology and technology is starting to make its mark in governance and everyday lives. South Africa is one of the leaders in technological, economic as well as developmental progress in the continent. The study of technology and specifically geospatial technology is crucial in building up an epistemological base for GIS and its benefits for local government planning. A limited number of publications are focusing on technology such as GIS especially in the context of an African city (Odendaal, 2014). This literature review looks at the existing body of

knowledge on GIS and geo-informatics in local governments around the world by comparing literature on GIS from the South African context and some of the American scholars of GIS.

3.1.10 GIS AND DECISION MAKING IN THE PRIVATE SECTOR

In the South African context, business and local government are operating at different positions in relation to GIS technology and the internet of things . As indicated above, various publications continue to point out the growth of technology in various areas of business. GIS specifically has made its mark in various other spheres and branches of government such as the municipal demarcations board, the IEC, departments managing natural resources and other institutions continue to demonstrate how GIS has changed the way of doing business. In the recent local government elections, the IEC continuously represented voting results through GIS technology that allowed citizens to see the results and the performance of their wards in relation to voting. The voting results indicated that people engage better with visual representation of information as many continued to be glued to their screens.

Geolocations attributes of data could lead to better engagement of stakeholders than the previously thought stance of GIS as a top down tool. The notion of GIS as an extension of '*Comprehensive planning approaches*' has been proven inconsistent in this literature review. The results of most of the applications of GIS technologies in Europe and the United States indicate the public engagement in the sharing of information enabled by spatial representation from GIS. It was demonstrated by Budic and O'looney that GIS enables participatory approaches to decision making through its ability to simplify information for even the untrained eye (O'looney, 2006)

The digital society is an engaged society, this is a notion also shared by Odendaal, 2013. Through connectivity and the internet of things more people are connected and share valuable information through various channels of technology. The smart technology and the concept of smart governance is becoming for feasible in South

Africa. Though late, people can engage with local government over planning decisions and plans through geolocation services linked to smart devices over the internet. This is an opportunity for GIS to be located within the geo-informatics and information departments within municipalities.

O'looney approaches the argument by challenging the traditional conception of GIS as a mapping tool only. In his book titled 'Beyond Maps' O'looney makes a case for the advanced capabilities of GIS beyond just mapping. He began his stance by pointing the advantages and key role maps play in the GIS process so not to discredit maps as key functions of a GIS. However, the argument presented meant to point towards the 'hidden' benefits of GIS which are not commonly known and understood by planners and local government officials.

According to him , maps promote the power of display which improves rationality in decision making (O'looney, 2000). In acknowledging the already known functions of a GIS, O'looney highlights the potential of GIS in innovation driven and experimentation for capabilities in governance. He argues that those who can produce information can easily set the agenda for debates and discussion leading to active governance and policy formulation. It is therefore clearer how GIS could also contribute in policy formulation by setting the agenda through its ability to create new information as a result of analysis. Increased access to information can lead to increased factual conclusions on matters.

Key and remarkable elements of this study by O'Looeny are the results yielded when GIS was observed in certain local government instances through inception and progress over three years. The study found that there was a noticeable amount of improvement within a space of three years in local government processes and decision making. In the case of Albertina, it was found that productivity had improved drastically (Hugh Calkins).
Calkins argued that this was mostly driven by the ability for local authorities to address queries faster. This is similar to the results of studies carried by Budic (2007) in the United States. In measuring GIS inputs, Budic (2007) found that where GIS was used

as an operational tool and decision making tool it bore good results. Her study covered 22 planning departments in Southern parts of the United States using four indicators for operational effectiveness and five indicators for decision making.

The results of the study indicated that GIS improved operational efficiency where it was implemented specifically for policy executives as well as decision making. She noted the improvements to access to information and data as well as the communication of information. As a result, the study concluded that a shared GIS, resembling corporate GIS will reduce the time needed to make decisions because of the availability of data to various decision makers.

She further added the key role played by analytics in the decision making process which could be driven by GIS analysis. Lastly, Budic made mention of the potential of GIS resolving conflict for development disputes. O'looney (1998) argues that displays make decision making smarter and that is makes key changes to the manner in which problems are seen and addressed. The key theme that sums it up is the ability of GIS to answer those 'What-if' questions during the planning and decision making process.
Ceccato presents yet another case from the Swedish context of the role of GIS in local planning context. Though the argument begins with a critique of GIS according the local government and general perceptions, it builds on to support the studies of Budic (2007) and O'looney (2000) in presenting GIS as a key value addition tool for planning. Ceccato argues that many critiques of GIS debate that it is driven by the Rational Planning theory of the 1960s which was deemed 'Social engineering'.

In many ways it was viewed as a top down approach to planning and decision making. However, Budic's presentation of GIS in local government as well as that of O'looney (2000) discredits this notion by clearly outlining the opportunities presented by GIS for community and stakeholder engagement in the planning process through shared data and visualization. Other critiques such as Clarke (1988) that GIS does not deal or address ethical issues in relation to technology and information sensitivity. He further addresses it as a tool for 'exploitation' of information. The key aspects of this debate by Ceccato are that GIS will always have critics because of its ability to make information

vulnerable. The fact that local government information can now be accessed and understood by all becomes a challenge to some political houses in that the power is now spread. On the brighter side, local government bodies are able to conduct much more sophisticated investigation prior to decision making through what Ceccato (2000) deems as 'Analytical and Synthesis-Oriented tasks.

These analysis techniques addressed here can allow local government institutions to carry out various spatial planning tasks as well as management of key interventions and plans. On the surface of GIS is the noticeable application on land use management, zoning, environmental planning, transportation management as well as economic development. Most of these areas of application involve map overlaying as well as we statistics mapping. These processes are not flawed at all but could be depend if the application of GIS is more strategically inclined and engraved in the organization of power within the institution.

This [AK69] means if the GIS is sitting at a much more strategic position for decision making, the output and application area will also be greater. Some of the identified challenges in the application of GIS in British local government are mentioned by Campbell to be driven by (a) lack of competence in governance (b) sizes of the municipalities (c) economic capacity of the municipalities, this is also shared by Kiib, 1996. Brandt argues that planners should find new ways of applying analysis by combining qualitative and quantitative analysis approaches in decision making.

Planners should be able to both measure and represent spatial elements of their plans for better choices on projects (Brandt, 1998). According to Brandt, this would allow for the expectations of social groups to be adequately represented as key input in the decision making process through GIS. He further asserts that maps build the bases for arguments as they create access to information and transparency (Brandt, 1998).

3.1.11 GEO-SPATIAL ANALYTICS FOR DECISION MAKING

Technology in South Africa is increasingly becoming accessible to a larger portion of the population, this includes previously disadvantaged communities. Cheaper smart phones and decreasing mobile data rates allow people to connect and engage on socio-political issues as well as general social media. Cheaper smart phones continue to infiltrate the different markets and population groups leaving vast data footprints that businesses and other private institutions use to gather information about their clients (Biz Report, 2015). The concept of 'analytics' in business is increasingly becoming a key term especially for financial institutions who need to understand their clients behavior and habits to better align their businesses to the social changes.

These analytics allow businesses and banks to plan and take informed decisions on the future of their strategies (World Wide Worx, 2015). In most cases, analytics data is georeferenced and spatial in nature which indicates the role of GIS in allowing these businesses to understand the geographies of their clients. This is a good indication of how GIS can influence companies' strategies and inform their investment plans (FNB, 2015). It can be concluded from these observations that GIS could be used as a strategic instrument for informing policy as well as future plans.

Mapping spatial data from analytics has changed how some business practice and align themselves. The emergence of GIS solutions such as 'Hudlr' which is a South African developed GIS information application used to inform businesses of their clients behavior indicates the realization and acceptance of GIS's spatial information in decision making (Hudlr, 2014).

3.2 CONCEPTUAL FRAMEWORK

The literature review conducted created a framework of the use of GIS that begins with the conceptions of what GIS is capable of doing (Budic, 1991, Budic, 1993 and Godschalk, 1993). The use of GIS within local government is influenced by the way

decision makers understand it. The literature review above began with the understanding of GIS use in the developed world, its development and the impact of technological advancement. The literature divides the role of GIS into two perspectives, that of operation effectives as well as that of decision making effectiveness, The argument here is the GIS theories and concepts are built on these two basis as a framework for understanding its influence on local government functions (Wiggins and French, 1991).

According to Budic (2007) GIS implementation within local government is driven by the seven factors which create a framework GIS in local government. These factors are defined as follows:

- Political support systems for GIS implementation
- Staff support for GIS (diffusion of technology)
- Length GIS is used
- System sharing
- Comprehensiveness of GIS
- Number of applications of GIS used
- Tasks of GIS used (synthesis)

(Budic, 1993; Brown and Brudley, 1993)

Brown and Brudely (1993) found that GIS as a tool for local government planning produced the following results (a) increased productivity of government functions (b) decision making, which included the time it takes for government agencies to take decisions and the quality of decisions taken and lastly (c) customer service, which included improved service delivery as a result of good decision making (Brown and Brudley (1993). These findings have influenced this study to construct the conceptual representation of GIS in local government within the South African context. The diagram below indicates the needs for GIS on the left, the operations context and legislative regulations as well as the desired goals on the far right.

Conceptual framework for the implementation of GIS in local government

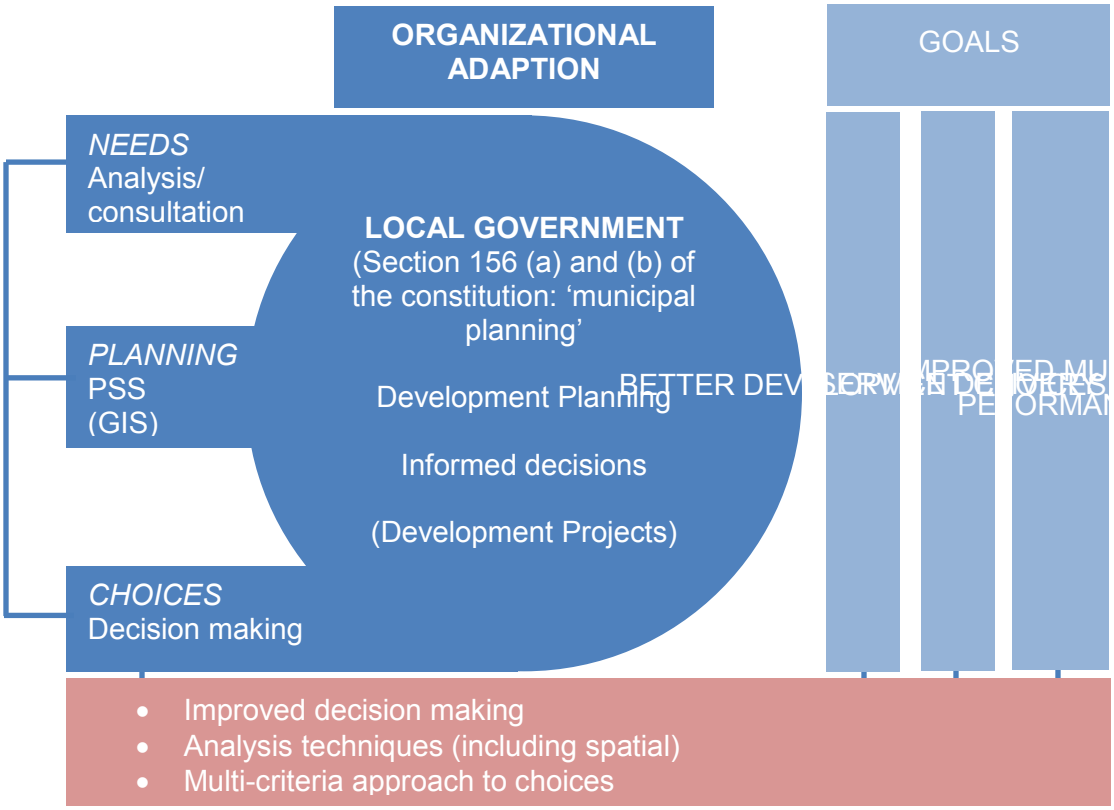


Figure 6: Conceptual framework

The literature engaged in this study reveals that GIS adoption within a planning environment is much more complex due to various external factors. The adoption of GIS within American local government institutions revealed the perceptions and challenges experienced by advocators of GIS and the use of technology in planning (Budic, 1990). The use of GIS within local government therefore needs to address various theoretic aspects of governance. One of the key aspects was covered by Klinskey (2005) as the politics of GIS. The argument presented by Klinskey (2005) made mention of the highly political decision making environments local government institutions are (Klinkey, 2005). To achieve a GIS accepting local government planning environment, GIS would need to be perceived as a neutral tool that does not show bias.

The planning environment is constantly changing and becoming more technological. The increase of technologically active citizens requires local government to adopt a technological approach to planning and decision making in order to be aligned with service delivery needs. This is a view also shared by Brandt, 1998 who argued that

planners need to have tools that assist them with spatial measures as well as well as planning for futures (Brandt, 1998).

3.2.2 CONCLUSION

The literature review covered in this study has highlighted the role of GIS as a strategic planning tool by highlighting various cases where GIS was used and the different results it produced. In addition, the literature review provided a framework on the implementation and measuring of GIS effectiveness within local government by introducing the arguments on the factors affecting GIS implementation (Budic, 2007). Evidence from literature indicates that GIS can improve local government functions which include decision making for development planning decision, provided the correct framework is applied (Brown and Brudney, 1993).

CHAPTER 4

4.1 RESEARCH METHODOLOGY

4.1.1 INTRODUCTION

This section of the study covers the research design by stipulating the methodology employed in achieving the objectives of the study. The chosen research tools were used to connect the research to the study's objectives in the context of local government in South Africa. A similar study was conducted by Budic (2007) in 5 United States counties local government agencies over ten years ago. It is therefore imperative to note that the approach and methods used in this study are informed by those of the study carried by Budic (2007). However, the context is largely different from governance, political, social and geographic perspective. As a result, this study applied some changes to the research methods in considerations of the South African government and planning context.

Budic (2007) studied various elements of GIS which looked at the implementation of GIS as well as progressive impact it had on local government planning functions. The methods used had to be supported and backed up by evidence in literature. Studies of the in the United States counties revealed the complexities of working with GIS in a local government context (Budic, 1993a). These studies presented a framework for understanding the approaches to GIS's effectiveness in local government. Budic (1993) discusses the term of 'intelligent planning' as an ideal for planners in order to execute well informed decisions for the development of their cities. According to Budic (1993), intelligence planning is informed by data and well calculated actions as a result of analysis and synthesis of data (Budic, 1993).

This study adopts the approach used by Budic (2007) and that of Wiggins (1993) in viewing GIS as a two part technology within local government. According to Wiggins, GIS is used at two levels which can be measured using different means (Wiggins, 1993). Budic (2007) defines these two approached to assessing GIS as (a) Operational effectiveness, which she argues deals with the improvement of planning as a result of

available related data (Budic, 2007). The second aspect presented by Budic (2007) is the (b) decision making effectiveness of GIS. These two areas of GIS assessment require different tools of research. However, the two assessment criterion for GIS is interconnected (Wiggings and French, 1991). This means one cannot study the effectiveness of GIS on decision making without studying its operational effectiveness. Godschalk (1993) argues that the operational status of GIS within an organization will determine the functions it assumes (Godschalk, 1993). The assertion by Godschalk is also supported by Budic (1993a), who also argues that the perceptions of GIS within local government agencies influenced its use within the organization which affects operational effectiveness (Budic, 1993a).

It is clear from the arguments presented by Godschalk (1993) and Budic (1993) that studying the effectiveness of GIS as a decision making tool has to be approached from the two angles discussed above, operational as well as decision making effectiveness. This is the approach taken by this study as a method of studying GIS as a decision making tool in local government within the South African context.

4.1.2 NATURE OF THE STUDY

The nature of the study is an enquiry, descriptive and comparison of GIS as a tool for decision making in development planning projects. It is qualitative in nature, therefore requiring qualitative methods of gathering data and analysis. Qualitative studies are crucial for studying a phenomenon within a particular complex context. Qualitative research approaches allows for in depth study of the research issue (Danker, 1986). They can allow researchers to use various information sources to make conclusions of the nature, relationships communities or institutions using a variety of lenses (Yin, 2003).

Qualitative research approach allows the study answer critical questions which address the objectives of this study. In addition to answering of specific questions, the qualitative research approach allows the study to gather research proof on aspects of GIS functions within the identified municipalities. The complexity of local government in South Africa requires a study approach that considers context as municipalities are

autonomous. In order to make use of the contextual uniqueness of the study, a case study approach was adopted as the key method of study that allows the connection of context and phenomena (Yin, 2003). The context in this regard is local government and the phenomenon is GIS.

4.1.3 RESEARCH INSTRUMENTS

Godschalk (1993) argues that in order for one to understand the relationship government agencies and users have with GIS, one would have to observe GIS in use (Godschalk, 1993). According to Budic (1993) this method allows for assessing the efficacy of GIS on tasks and its influence on planners decisions. In framing the study within a local government context, case studies allowed for better focus of the study for both Midvaal local municipality as well as West Rand district municipality. To support the study and comparison of the use of GIS within the two municipalities, additional data was necessary. The study therefore used document review as a method of gathering facts about the two government authorities as well as field observation in line with the assertions by Godschalk (1993) and Budic (1993).

In the study conducted by Budic (1993) in the United States, additional tools such as questionnaires were used to gather data about the perceptions of GIS users within local government. This was done for 39 municipalities in Florida, North Carolina as well as South Carolina (Budic, 2007). Budic (2007) reported that the response on the questionnaire were rather slow and in some cases no responses were received back from municipal officials (Budic, 2007). Similar challenges were recorded by Brown and Brudely (1993). However, Budic (2007) argues that the ideal respondents for this study are GIS technicians within local government because of their comprehensive understanding and knowledge of GIS (Budic, 2007).

The arguments by Budic (2007); Brown and Brudney (1993) about the methods of studying GIS functions and effectiveness within local government influenced the decision taken by this study on the ideal research tools to be adopted along with the objectives of this study. It is the results of the studies carried by Budic (2007) that

confirm the benefits of using the qualitative research approach as an ideal for this study. As a result, the following research tools were used to gather data about GIS as a decision making tool for development planning in local government.

4.1.3.1 Case Studies

The study consisted of two case studies namely (a) Midvaal local municipality (b) West Rand District Municipality which represents two categories of local government within the South African context. Each of these municipalities were studied from an institutional perspective to determine their use of GIS and the role GIS plays in decision making for development planning projects. The case study approach assists the study in answering the questions such as 'who' and 'why' pertaining to the use of GIS. This was achieved through the exploration of functions of the GIS technology within the separate organizations as well as the organizational attitude towards GIS.

The case study approach allowed the study to study these government institutions in a holistic manner as far as the location and functions of GIS are concerned. According to Brown and Brudney (1993) assessment of GIS effectiveness within local government has to be looked at from a tangible and intangible results perspective (Brown and Brudney, 1994). Where tangible results led to increased productivity and intangible results represented organizational enhancement. In order to achieve this, the case study approach allowed for focusing the study on GIS within specific aspects of municipal planning.

Case studies as research methods

Case studies are commonly used research methods across various fields of study (Zainal, 2007 and Yin, 1984). As a research tool, the case study approach is considered to be a critical tool for answering questions such as who? And why? (Zainal, 2007). It is an approach that allows one to gather and analyse data in a contextual setting whilst providing an opportunity to analyse both quantitative and qualitative data.

According to Yin (1984), case studies allow researchers to use the three main categories of case studies to thoroughly investigate a phenomenon. He mentions these categories as (a) exploratory (b) descriptive and (c) explanatory (Yin, 1984).

Though case studies are widely used as a research method, there are some advantages and disadvantages to using case studies. Yin (1984) presents these advantages and disadvantages as follows:

Advantages of using case studies as research methods

- *Data examination is conducted within the context of its use (Yin, 1984). This advantage is critical for the study at hand as GIS is used in a wide spectrum of contexts and therefore needs to be viewed within the development planning context of local government.*
- *Case studies help reveal the real life complexities of situations*
- *Case studies can incorporate both qualitative and quantitative studies (Yin, 1984).*

Disadvantages of case studies

- *One of the commonly discussed disadvantages of case studies is that they have very little basis for scientific generalization since they use very small study subjects (Yin, 1984; 24)*
- *Other arguments are based on the lack of rigour within case studies (Yin, 1984).*

In conclusion, the case study approach provided a better framework of studying the use of GIS between the identified study areas as well as the means for the comparison of results on the use of GIS in both institutions.

4.1.3.2 Documents reviews

Strategic planning documents such as annual reports, IDPs as well as the Auditor General reports contain critical information about the arrangement and performance of municipalities. In addition, these documents also contain information about the decision making bodies within municipalities. The IDPs of municipalities indicate the manner in which decisions are approved within the organization.

The form of decision making bodies within municipalities is crucial for this study as describes the decision taking environment to which GIS is meant to contribute. Annual reports of municipalities also report of the key and strategic tools the municipality uses, this information is crucial to the study as it reveals the relationship the organization has with GIS and other decision making tools.

Budic (2007) argued that decision making effectiveness of GIS is influenced by what Antenecci et al (1991) identified as 'factors affecting GIS implementation' in local government. These factors are as follows:

- *Political support for GIS incorporation* (The structure of decision making bodies and political systems , which are contained within the IDP and annual reports can indicate if GIS use has political support or not)
- *Stuff support for GIS incorporation*
- *Systems sharing*
- *Comprehensiveness of data (including GIS databases)*
- *What GIS is used for (number of applications)*
- *Length GIS has been existent*
- *Tasks of GIS (synthesis)*

Municipal documents and reports cover information to these factors directly or indirectly. Direct information could be presented in detailed reports of GIS use within the

municipality whilst indirect proof of GIS use within the organization could be found in thematic maps and graphic representation of GIS synthesis processes.

Using document reviews as research method

Document review as a research method is commonly used by researchers to gather background information about programs of organizations and the organizations themselves. Lusthaus et al (2009) argue that document review can assist researchers with answering questions like what and how. This can assist researcher to gain understanding of the history and philosophy of programs and operations (Lusthaus et al, 2009).

Advantages of using document review

- Document review is a relatively inexpensive method of conducting research
- Documents can offer good backgrounds about organizations and programs (Lusthaus, 1999)
- Documents may also reveal information not previously noted by researchers.

Disadvantages of using document review

- Information may be disorganized or out of data (The case of IDPs in many municipalities in South Africa, which contain a lot of reputation of information and vagueness)
- It is time consuming to collect, review and analyze documents
- Information contained could be biased

Document review as a method of study was a relevant tool for this study given the limited resources of the study. In addition, municipal documents contain good

background information on the organizational elements of municipalities as well as their projects.

4.1.3.3 Field observations

In order to determine the location of GIS within the two municipalities, observations were carried out through site visits. Both municipalities were visited and assessed on site according to my observations of use and location of the GIS. These observations were recorded and reported as reflections.

4.1.3.4 Key informants through structured interviews

Lastly, key informants were used to furnish this study with critical information on the political and organizational willingness to adopt technology such as GIS in local government institutions such as municipalities. As a result, Directors for Development Planning were interviewed to understand their view of the role of GIS in the own departments for the two local municipalities. The findings of these interviews were analysed, summarized and categorized to ascertain whether the views of Development Planning Directors on GIS and its potential as a decision making tool is has any bearing on the actual use of the technology during decision making processes

4.1.4 POPULATION OF THE STUDY

This study is aimed at planning departments and directorates within local government in two categories on local government. The first category is a category B municipality which is classified as a local municipality in terms of the municipal structures framework. The second is a category C municipality which is classified as a district municipality. Both these categories of municipalities form a functional arm of the local governance system of South Africa from which planning functions are vested. Section 144 of the Constitution clearly stipulates that all planning functions are vested in local government. As a result the planning functions of local government are often located within the development planning directorates of municipalities

The selected municipalities are not the same in size and classification; however various decisions concerning development planning projects are taken in these municipalities. The decision making mechanisms applied in both municipalities are almost similar. It is crucial to note that levels of planning and planning decisions are slightly different between these municipalities. Category B municipalities are more directly linked to projects on the ground as local municipalities whilst category C municipalities play a more facilitative role at a district level which tends to focus on regional interests and development facilitation.

These different responsibilities are often interpreted into projects where category B municipalities facilitate local development projects while category C carries out regional projects. In many cases these category C municipalities play a supporting role to local municipalities as far as planning projects are concerned. The commonality between the two municipalities is mostly based on the organizational structures as well as the way decision making processes are carried out. The study focused on these commonalities for the purposes of the comparison as well as investigation of decision making tools and planning support systems within the two categories. The focus also spread towards the nature of projects being studied, which were development planning projects in the case of this study. This part of the study was essential in ensuring that the study compares apples with apples in both municipalities.

4.1.5 METHODS OF DATA COLLECTION

The collection of data in this study was carried out in accordance to the various methods and sources as identified above. In order to derive to answers to the questions of the study, the data collection methods employed had to relate to each tool's uniqueness. Data collection was not conducted in a defined chronology as a result of appointments and travelling limitations.

4.1.5.1 DOCUMENTS REVIEWS

Key documents were collected and organized according to the data they contained relating to the study. These documents included the IDPs of the two municipalities (MLM and WRDM). The reviews of the IDPs was organized through a table reporting format which assisted in capturing the variables of the organization organogram as well as decision making bodies.

MUNICIPALITY	IDP TERM	DEVELOPMENT PLANNING WITHIN THE ORGANIZATION	GIS ROLE & LOCATION WITHIN ORGANIZATION	DEVELOPMENT PROJECTS MAPPING
Midvaal local municipality (Category B)	*MLM IDP 2016/17* *(this is the latest and current IDP for the municipality)*	*What is the municipal attitude towards development?* *What are the key development activities and their KPAs?*	*Where is GIS located within the organization?*	*Are there any maps on the IDP (except the SDF that indicate GIS analysis and synthesis?)*
West Rand District municipality (Category C)	*WRDM IDP 2016/17*	*What is the municipal attitude towards development?* *What are the key development activities and their KPAs?*		

Table: IDP assessment criteria

Reviewing the IDPs of both category B and C municipalities provided a basis for understanding organizational elements within the two classes of local government. Through the IDP reviews, it could be established if there are significant changes on project types as well as decision structures.

4.1.5.2 FIELD OBSERVATION

In accordance with the assertions shared by Godschalk (1993), Budic (1993a) and Simpson (1993), observing GIS in use is a key and informative way of evaluating its effect on organization performance. As a result, field observations were conducted for both sites with an assessment sheet. The key areas of assessment covered the following aspects which were informed by similar studies carried by Budic (1993) and Brown and Brudney (1993).

- *What is the GIS being used for?*
- *Is the GIS used for planning activities?*
- *What other departments and staff use the GIS?*
- *What forms of outputs are mostly achieved?*
- *How visible is the GIS office?*
- *Does the location of the GIS correlate with the IDPs description of GIS location?*

Each municipality was visited separately and the GIS office observed within a 90 minutes period in order to answer these assessment questions. The results of these observations are discussed in detail in chapter 5 of this report.

4.1.5.3 KEY INFORMANTS

Further data was collected through a structured interview questionnaire which was informed by the elements of Budic (2007) study in 4 American counties. The interview structure took into consideration the tangible and intangible results of GIS as noted by Azad (1990), Brown and Budney, 1993). As a result, the questions of the interviews covered both questions on tangible effects of GIS as well as intangible results. These interviews were aimed at GIS practitioners within the two municipalities as people who

worked on a daily basis with the GIS within their organization (Godschalk, 1993). Results of the interviews were also recorded on paper.

Limitations

However, only one interview was carried out due to the response from the two municipalities. Attempts to secure an interview with either the GIS practitioner or other users of GIS within the West Rand district municipality were highly unsuccessful. During visits on site, it was found that the GIS practitioner was unavailable.

An interview was therefore conducted with the GIS professional within the Midvaal local municipality. The results of the interview were sorted and used to inform the case study and comparison assessment of the two municipalities. Results of these assessments are also contained in Chapter 5 of this report.

4.1.6 LIST OF DATA SOURCES USED FOR THE STUDY

1. Auditor General Audit reports (2013-2016)
2. Municipal IDPs (Current)
3. Statistics South Africa (STATSSA)
4. Municipal Annual Reports (2014-2016)
5. Key informants (interviews)
6. Site/field observations at the Midvaal local municipality as well as the West Rand district municipality

4.2 ETHICAL CONSIDERATIONS

Qualitative studies have implications on ethical issues which relate to the researcher and the respondent(s). As a result, this study took into consideration the elements surrounding the study which border on ethical issues. Though the study mainly used secondary sources for data, key informants were used to inform certain aspects of the

study. As a result, a formal consent was required to address the issues of anonymity of the respondents.

Respondents were explained in detail the nature and purpose of the study. In addition, their written consent was acquired before any enquiry could be conducted on them. The respect and dignity of the respondents was taken into consideration along with their responsibility within their organization.

CHAPTER 5

5.1 INTRODUCTION

This section of the report covers the findings of the study through combining collected and analysed data from the various tools used in this study. The approach adopted in this study was based on the framework of the similar study by Budic (2007). As a result, the basis of data analysis and presentation is highly influenced by the elements of Budic (2007) study. However as indicated earlier, some elements of the study were amended due to the context and limitations of the study i.e. the length and extent of the interviews and observations. The results of the study were organized into two cases. Each municipality was assessed as a separate case and then later compared the results with the basic performance of the two municipalities in terms of the Auditor General findings.

According to Budic (1993) and Godschalk (1993), the operational effectiveness of GIS can be related to the basic performance of the municipality in performing planning tasks such as development decisions. As a result, the ability of the municipality to use GIS to make decisions can increase productivity. These groups addressed the aspects of GIS's operational effectiveness as well as those of decision making effectiveness. The results were then used to build each case of the municipality using a table format to compare the findings. The similar criteria were applied taking into consideration the political context in which the GIS function is located. This was done in line with the argument by Pinto (1993) that political support and influence plays a crucial role in the successful implementation of GIS as a tool in local government (Pinto, 1993).

5.1.1 FINDINGS & DATA PRESENTATIONS

The lack of proper decision making mechanisms is addressed in various reports and studies conducted at various local municipalities (Khanyane, 2006). This is a debate that is constant and proves to be the challenge for local government performance. However, there is little success on the creation of tangible solutions to address these challenges. Van Der Walt (2006) also adds that local government fails on performance management and decision making leading to the failure to make adequate decisions for municipal plans and projects (Van der Walt, 2006).

The challenges of South African local government appear to be similar across the board (Mogale, 2003: 227). To summarize the findings of this study upon observing the CoGTA report (2009) as well as SALGA (2010), it is clear that these challenges are at institutional level. Municipalities seem not to have the proper capacity and tools to make the right decisions as well as the implementation and monitoring (Koma, 2010) of various plans. Koma (2010) argues that capacity can be a broader concept, however in this case it should be understood as the availability of and access to concrete or tangible resources such as GIS and other key tools (Koma, 2010). The resources addressed by Koma are broader and also cover human resources, financial resources as well as technological resources.

This study found that South African municipalities do not have the same access to resources which is believed to be a key factor in their success on project planning and implementation (CoGTA, 2010). The unavailability of key resources and skills for management teams is said to be a major challenge for municipalities in Category B and C. CoGTA reports that most councillors lack the relevant skills required to plan and make decisions for development and financial growth (CoGTA, 2010). These findings are similar to the report compiled by Khanyane (2006). Not only do local municipalities suffer leadership vacuum but also critical skills for better decision making (Khanyane, 2006). Khoma notes that legal advice and decision support systems are some of the lacking resources in local governance (Khoma, 2010).

In assessing the report of CoGTA, it is evident that decision making within local government is a general challenge. However, the report on the state of local government also revealed that municipalities may continue failing as a result of limited resources. Information technology and more specifically GIS therefore does not become an urgent intervention in struggling municipalities. In cases of municipalities having access to GIS, it can also be assumed that trained GIS professionals and planners who can be able to make use of GIS within decision making remains a challenge.

5.1.2 THE CASE OF MIDVAAL LOCAL MUNICIPALITY

GIS within the municipality

In adopting the study framework of Budic in the United States, the case studies on the two municipalities focused on the observations of key areas. These areas comprised of the location of GIS within the municipalities in relation to its use for planning purposes. The results of the Midvaal local municipality indicated that the GIS is located within the Development Planning and Housing directorate of the municipality. The institution regards GIS as a strategic tool for planning. As a result, the organogram of the Development Planning Directorate places GIS at the same level as Strategic Planning. The diagram below indicates the finding of the GIS location analysis through IDP review results. These results were also confirmed through the field observation as well as the interview with the municipal GIS practitioner.

Budic (2007) argued that the success and functionality of GIS is highly influenced by the location of the GIS within the institution (Budic, 2007). According to Budic, the more visible the GIS was, the more easier it was defused into the organizational operations and welcomed as a tool (Budic, 2007).

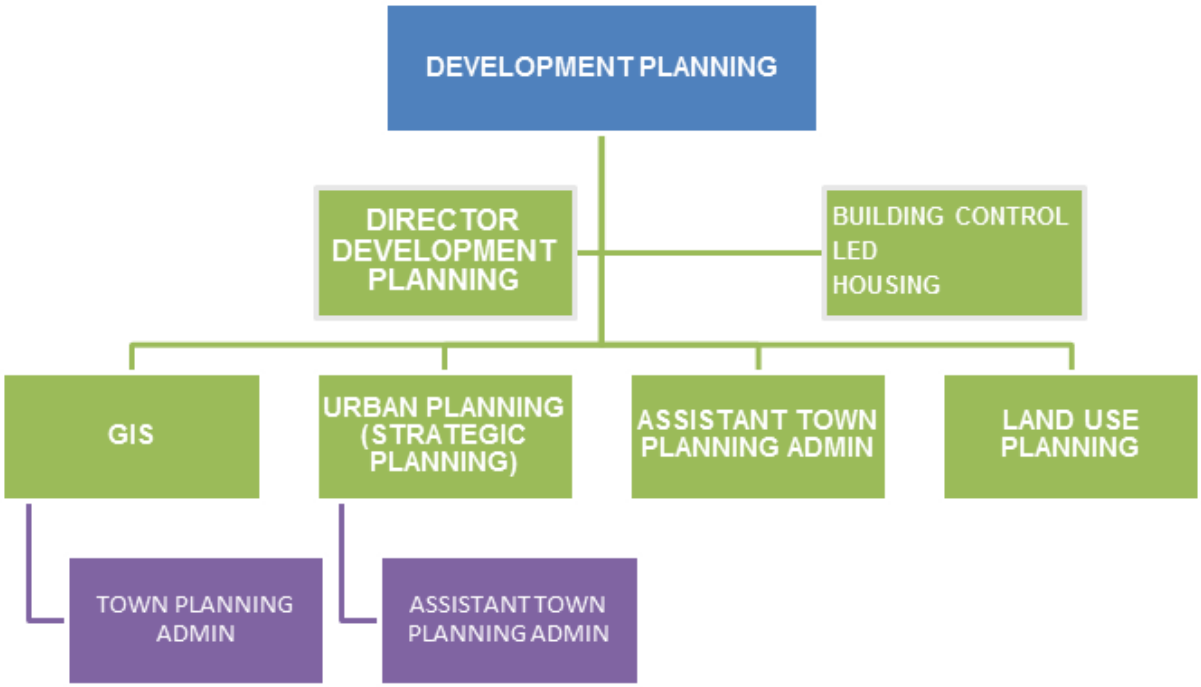


Figure 7: Midvaal LM organogram for Development Planning Unit (Source: MLM IDP,2016/17)

Figure 7 above indicates that the Midvaal local municipality has located GIS in a rather strategic location within the organization. However, GIS within the municipality is still at an isolated functional state with only one office that performs administrative functions as well as database and analysis functions for urban planners. The municipality uses the Esri product ArcGIS Desktop for all its GIS functions with the incorporation of a custom developed system to integrate GIS tasks and urban planning processes to improve efficiency. The location of the GIS within the Developmental planning directorate makes it a strategic location for interaction with other internal municipal departments. Assessment of the municipal annual report indicated the nature of political influence on decision making. The decision making structures of the municipality are in line with the Municipal Systems Act's requirements for the composition of a council. The chain of events leading to decision making are represented on the diagram below.

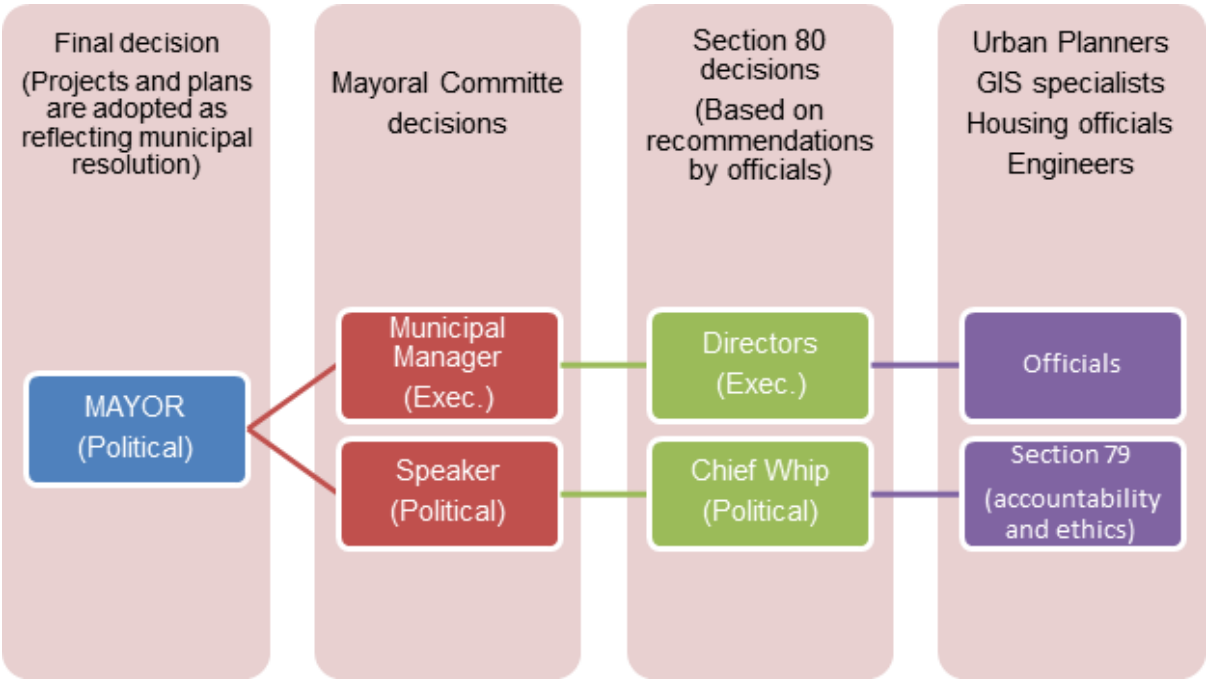


Figure 8: Decision making structure of the MLM (Source: MLM IDP, 2016/17)

As part of the framework for studying GIS effectiveness, Budic (2007) made use of the seven factors of GIS implementation within local government to study the use effectiveness of GIS within American local government agencies. Similarly, these seven factors were noted directly and indirectly within the Midvaal local municipality's GIS functions and location. The decision making process indicates the political factor of decision making which is presented by Budic (2007).

Municipal decisions for development planning projects are highly political and this is the case at the Midvaal local municipality. Through the section 80 processes, development planning decisions are debated before they are sent to the mayoral committee for approval. This is a stage where the GIS is often used to determine aspects such as location of proposed projects. Interview with the GIS practitioner revealed that GIS is often used to communicate certain elements of projects and as a result affect the decisions taken.

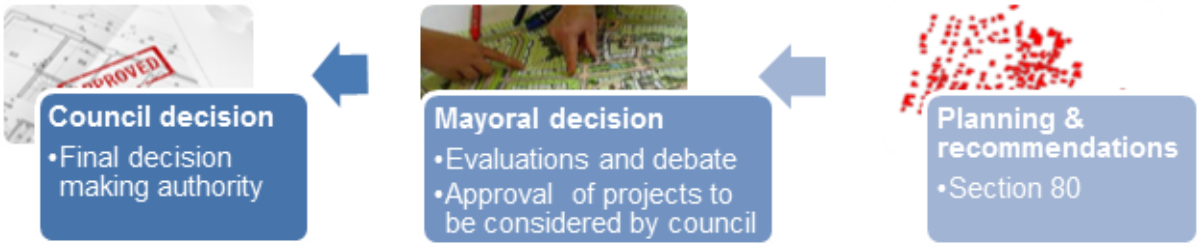


Figure 9: Development Planning Projects Decision process in MLM (Source: MLM IDP, 2016/17)

Figure 9 above indicates the deliberation process for development planning projects and the decision making process flow. The general perception of GIS within the municipality is that of a communicative tool, assessment of choices and synthesis. GIS has been used for site identification for development of human settlements projects. Wigging and French (1991) argue that GIS can allow for different display of professional analysis effecting better decision making.

It was noted that the Midvaal local municipality's GIS did have additional data layers representing other professional information such as dolomite and environmental data. This information was however limited but often used to determine suitability of sites for development projects. The municipal GIS was often used for public queries on site locations and zoning information. Internally, the GIS was used by Town Planners in order to motivate for development proposals for the Section 80 decision making meetings.

The GIS database still lacks integration with other municipal departments such as finance. As a result of capacity, most of the database management and maintenance is carried out by consultants. The dependence on consultants for some GIS tasks is still one of the key challenges for the Midvaal local municipality.

The general perception of GIS within the municipality was noted through the municipal plans for incorporating technology to assist in overall municipal performance. The municipality has adopted an institutional transformation approach that prioritizes systems and technology to achieve effectiveness and competitiveness.

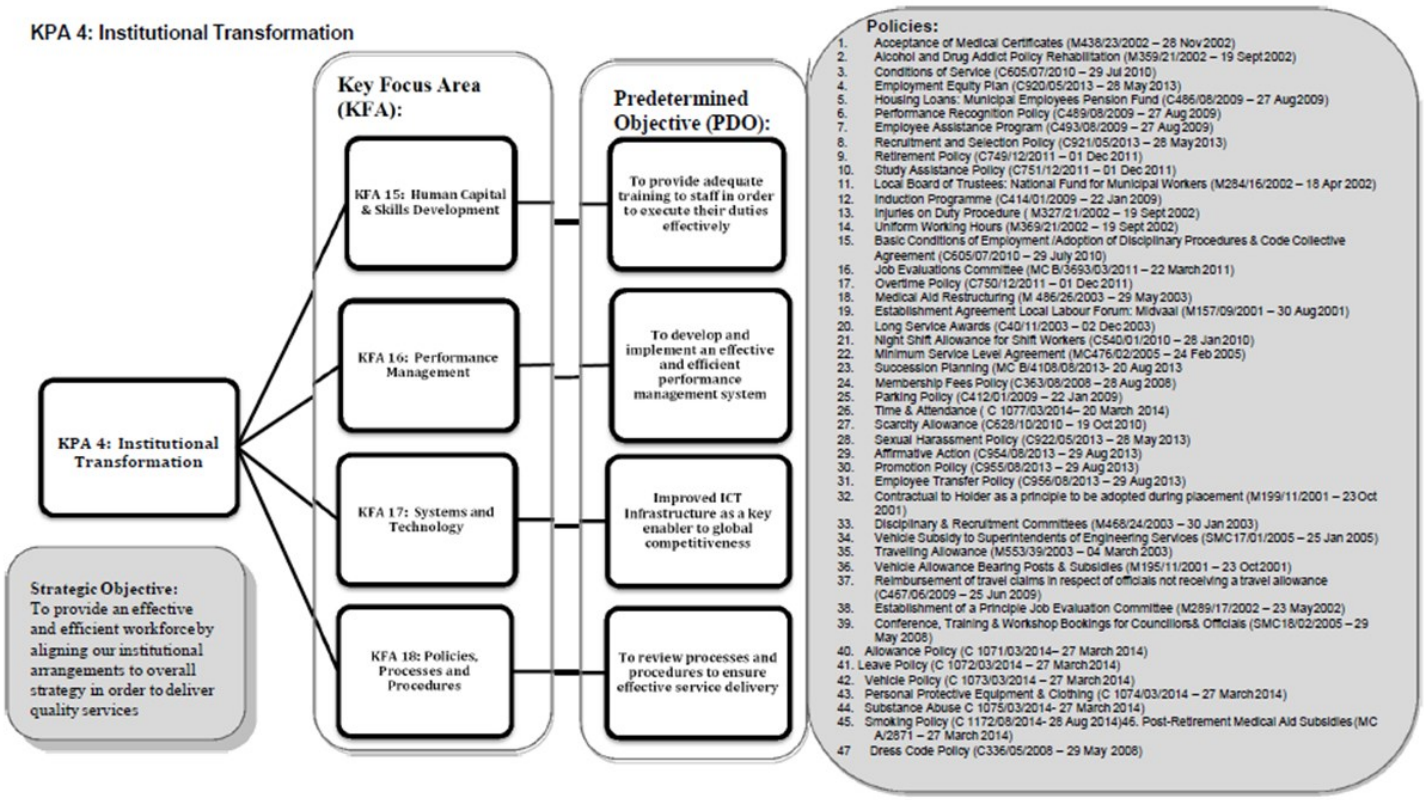


Figure 10: MLM ICT PLAN (IDP: 2016/17)

Figure 10 above indicates the position of the Midvaal local municipality on the incorporation of GIS technology and other technologies for organizational transformation and effectiveness of planning for service delivery. This is a good step towards a full GIS implementation. As noted by Godschalk (1993), it takes time to realize the benefits of GIS at an institutional level as many systems require alignment with the GIS (Godschalk, 1993). However, there were some challenges that were identified with the GIS within the municipality. It was noted that GIS perceptions from outside the Directorate were limited to GIS as a mapping tool, with only planners seeing it as a strategic tool.

In addition, politicians did not have a comprehensive understanding of the capabilities of GIS. This was reported to be a challenge for the improvement of the GIS as not enough budgets is allocated for the development of the GIS.

5.1.3 THE CASE OF THE WEST RAND DISTRICT MUNICIPALITY

The assessment of GIS use and functions within the West Rand District Municipality revealed that the GIS is located within the IT department of the district municipality. Very limited information was available on the database composition of the GIS. However, assessment of the municipal IDP and annual report indicated that the municipality sees GIS as a strategic decision making tool for improving service delivery. However, there was no identified link to operational functionality that proves these claims. Field observation revealed that the GIS was located within a hidden, closed up environment which was restricted for majority of municipal and public use.

The GIS in the West Rand district municipality therefore serves as an internal tool with very little use by other departments. The annual report revealed that majority of the data contained within the GIS is prepared by consultants. The district municipality conducts tasks that relate to regional plans while all local development projects are carried by its local municipalities. No information was available to indicate cases where the GIS was used for development planning decisions. An attempt to secure an interview with the GIS practitioners was unsuccessful, leading to inconclusive results about the use of the GIS and the operational qualities.

FIFTEEN YEAR SCENARIO PLANNING : UNDERPINNING PROGRAMME/ PROJECTS TO ACHIEVE IMPACT, OUTCOME AND TARGETS OUTLINED ABOVE			
Write 1: WRDM 2: District Wide	Define Programme / Projects for First Five Year	Define Programme/ Projects for Second Five Year Term	Define Programme / Projects for Third Five Year Term
2	P1.1 Fully functional District Planning Tribunal	p2.1 Fully functional District Planning Tribunal	p2.1 Fully functional District Planning Tribunal
2	P1.2 Alignment of human settlement plans with Provincial and National	P.2.2 Stakeholder Satisfaction Index Survey	P3.2 Stakeholder Satisfaction Index Survey
2	P1.3 Identification of social housing restructuring zones and adoption by	p2.3 Information/ awareness sessions on Human Settlements and related programmes	P3.3 Information/ awareness sessions on Human Settlements and related programmes
2	P1.4 Resubmission of application for Human Settlement Accreditation	p2.4 Revitalisation of distressed mining towns: Development of Framework Plan and fund application	P3.4 Monitoring Revitalisation of distressed mining towns: Development of Framework Plan and fund application
2	P1.5 Information/ awareness sessions on Human Settlements and related	p2.5 Monitoring functioning Rental Housing Tribunal Information Offices at local municipalities	P3.5
2	P1.6 Revision of SDF to make provision for Randfontein and Westonaria merger (inclusive of Precinct Plans and Game	p2.6 Monitoring and co-ordination of social housing/ rental programmes	P3.6 Coordination and monitoring progress on social housing programme
2	P1.7 Monitoring and co-co-ordination of progress on title deed backlogs reduction	p2.7 Monitoring and co-ordination of human settlement projects within the region	
KEY REQUIREMENTS TO DELIVER PROJECTS (Define Requirements wrt Decisions, Things that Needs to be done to make Deliver above mentioned Projects)			
	Political will	Political will	Political will
	Availability of funds	Availability of funds	Availability of funds
	Grant funding	Grant funding	Grant funding
	Personnel	Personnel	Personnel
	GIS	GIS	GIS
	Accreditation to deliver housing	Accreditation to deliver housing	Accreditation to deliver housing

F Figure 11: GIS in the WRDM (WRDM IDP: 2016/17)

The diagram above indicates the perception of the West Rand district municipality regarding GIS as a strategic tool. GIS is listed on the institutional improvement plan as a tool for improving service delivery. Supporting information on the current use is very limited. However, the Auditor General report does not list the West Rand district municipality on the list of good performing municipalities.

It was found that the West Rand district municipality manages various projects for the region but does not play an active role of identification of land, and in other cases budgets for the projects. Rather it plays a facilitative role on the implementation of these projects. The projects uncovered include housing development projects as well as agricultural and economic projects such as the agri-parks.

5.2 DISCUSSION OF RESULTS

MUNCIPALITY	GIS OPERATIONAL EFFECTIVENESS	GIS DECISION MAKING EFFECTIVENESS	CHALLENGES
Midvaal LM	The municipality has an operational GIS that is used for addressing public queries and internal planning approval functions. (Hopkins, 1987) GIS is an immediate good and this is the case for Midvaal. The GIS is accessible and used to inform.	There is very little evidence of the use of the GIS for decision making especially for development planning projects. This is because of two reasons (the complexity of decision making requires full **case studies**, **decision analysis** as well as **decision modelling**) *Budic, 2007* There was not enough time to cover these elements in detail	Majority of database functions still handled by consultants, this limits the efficacy of GIS and ability to integrate data faster due to supply chain processes involved in securing consultants and budget approvals.
WRDM	There is an operational GIS that is limited to few departments and exclusive to the public. It is therefore not in an good operational level	There is no evidence of GIS used as a decision making tool	GIS in the WRDM is not visible which may affect the actual functions of GIS on decision making and institutional functions

Table 4: GIS state within municipalities

GIS within local government is still at an elementary stage within the two municipalities. However, Midvaal local municipality indicated an advance use of the technology to improve operational effectiveness of planning functions and public interaction. The GIS unit is located in an easily accessible location with the ability to address public queries as well as development queries. In addition, the municipality has made attempts to integrate databases for improving decision making using varying displays of data.

The internal GIS is not limited to the development planning department as other municipal departments have access to it. However there are still opportunities for the implementation of the GIS across the organization to improve internal communication of projects as well as general inputs to the section 80 decision making processes. Capacity remains a challenge as the municipality depends on consultants for most of its database management and functions. This limits the ability for the municipality to build a functional database link with key department such as finance for better updating of information.

The results of the West Rand district municipality are inconclusive as access to field data and key informant was very limited. The results of the assessments of the Midvaal local municipality and the West Rand District municipality indicated that both institutions have an operational GIS. However, the use of the GIS varied between the two institutions. Midvaal local municipality used their GIS very actively for operational functions such as attending land queries, land use management as well as plan production. There was very little use of GIS to effect decisions because of the decision making mechanism as stipulated in this study. In addition, it was found that urban planners were more active users of the GIS to inform their own decisions on approval of development applications, however this was not seen throughout the organization. The use of GIS is not balanced in line with the arguments of Godschalk (1993) on balancing operational effectiveness as well as decision making effectiveness (Godschalk, 1993) .

CHAPTER 6

6.1 INTRODUCTION

This chapter concludes on the findings of the study by reflecting on the key findings from the study areas, the executive summary as well as the recommendations for further studies.

6.1.1 SUMMARY OF FINDINGS

Outcomes from the Auditor General (AG) present a consistent image of local government in South Africa. Most of South Africa's local municipalities face challenges relating to services delivery, management as well as financial management (AGR, 2015). It can be concluded that municipal challenges are a result of cumulative failures that consist of three main issues. These issues are also noted by CoGTA in its report on the state of local governance in South Africa. They are listed as (1) Capacity (2) Infrastructure backlogs (3) Institutional challenges.

Capacity is argued to be in different phases which include human capacity, institutional capacity as well as financial capacity (Mnguni, 2016). These are similar elements that were argued by Budic (2007) in her findings. Budic (2007) argued that the ability of local authorities to take good decisions or to have to right tools to make good decisions was highly influenced by capacity, in the form of access to technology such as GIS as well as organizational challenges such as political will (Budic, 2007).

This argument is proven true in the context of the municipalities assessed by this study. In the Midvaal local municipality, though GIS is prioritized within the development planning it is not given the political support needed to be fully implemented across the organization. This affects the perceptions of the organization on GIS. GIS within the WRDM is rather abstract.

It is not clear how decisions for projects reflected in the municipal IDPs are taken. The IDPs contain various plans, policies as well as interventions to address key challenges

within the municipalities. These strategies are listed clearly indicating a systematic approach to planning through strategic interventions. This can be noted in the IDP for Midvaal Local Municipality which outlines the KPIs and KFAs of the municipality by enlisting 8 KPAs by which the municipality aims to prioritize and align its projects with other spheres of government. However, the IDP document does not state what tools or systems are put in place to guide decisions taken for development projects. Both the IDPs of the municipalities do not contain any information on the use of GIS for decision making at any level of the organizations.

The West Rand district municipality's IDP lists most of the development planning projects which are aligned to the TMR vision of the Gauteng province. However, there is not spatial presentation of their projects within the IDP. GIS could play a crucial role in the communication of municipal goals and vision in a strategic document such as the IDP. According to Wigging and French (1991), GIS can act as a communication tool for different stakeholders if adopted and used for presenting organizational goals (Wigging and French, 1991). This appears to be the missing element in both municipalities based on the assessment of their IDPs.

6.1.2 CONCLUSION AND RECOMMENDATIONS

Due to the limitations of this study, various elements were not covered which affected the results of the study. However, it was discovered that GIS use within local government plays a particular role in influencing development planning decisions within local government. GIS implementation occurs at different levels across municipalities in South Africa but still largely unsatisfactory. Observations of the Midvaal local municipality indicated that GIS can have a positive impact on planning decisions, especially development planning decisions. However, the lack of political support influences the diffusion of GIS into an organizational tool for decision making.

Both municipalities identify GIS as a crucial need within their IDPs but there is not enough support to implement a corporate GIS. GIS should be considered as a strategic planning tool and most importantly a decision making tool within local government.

Budic (2007) found that institutions that used GIS in her study got better results and in some cases even beyond expected results.

TABLE 3: GIS—Meeting the expectations (n=22)

RESPONSE	Agencies	
	Number	Percentage
Expectations Met	10	45.5
Expectations Exceeded	3	13.6
Too Early to Tell	9	40.9

Table 5: Budic findings on GIS (Budic, 2007)

As a result, the adoption of GIS has been on the increase since 1984. Figure 12 below is an indication of the trends of GIS use in local government agencies.

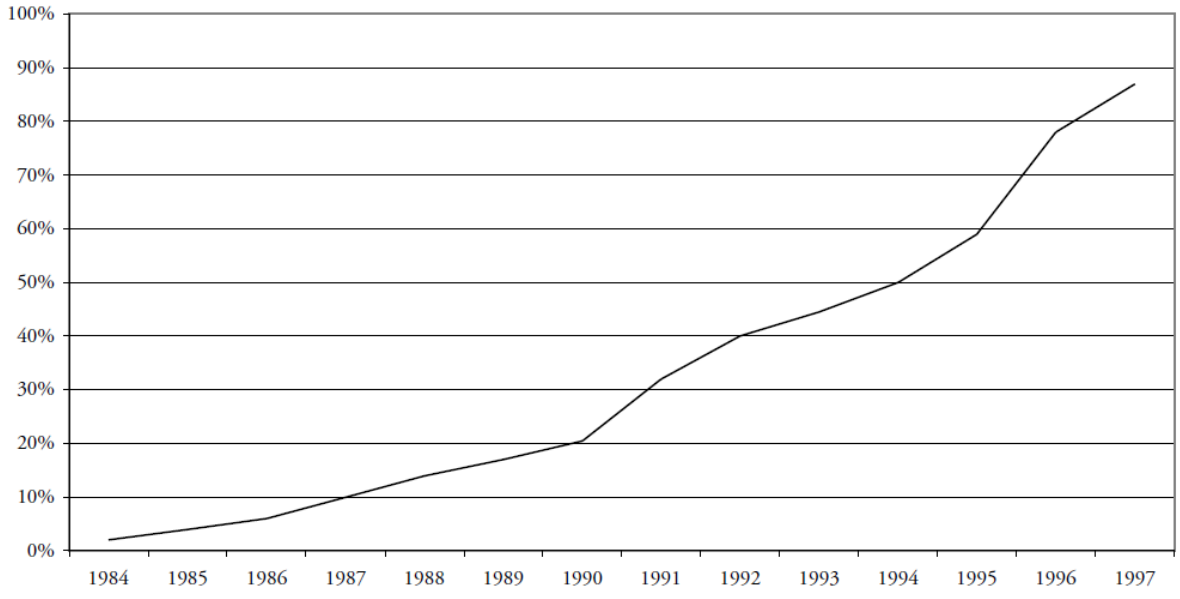


Figure 12: GIS adoption in the US

In the United States, GIS use has increased drastically because of the visible benefits local organizations noted. The results of the use of GIS are discussed by Budic (2007) and Godschalk (1993) in their different studies. It is clear that GIS use within local government in South Africa needs to be thoroughly studied and results published in order to encourage local authorities to see GIS as a strategic tool and not just a mapping tool. Cases on decision making models and the results of developments influenced and/or informed by GIS spatial tools should be studied in detail to establish the real impact of GIS on the final decision. As found in the literature review of this study, GIS is used by the business sector to improve business decisions through spatial analytics. Evidence is needed to prove GIS can assist municipalities in making informed decisions thereby improving operational effectiveness.

It is recommended that a comprehensive study be conducted to determine the effectiveness of GIS within an organizational perspective. GIS technology within local government can play a role in improving both operational effectiveness as well as decision making if it is perceived and considered from both the political leadership as well as the executive leadership. The implementation of GIS requires an organizational support and consideration rather than limited to a single department as found in this study. This prompts further research on the tools and systems that are used for decision making in relation to the effectiveness of GIS.

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